Appendix A
Eagle Conservation Plan

GOLDEN EAGLE CONSERVATION PLAN FOR THE OCOTILLO WIND ENERGY FACILITY

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1.0 INTRODUCTION

1.1 Project Background

Pattern Energy, through Ocotillo Express LLC (OE LLC), owns and operates a wind energy facility known as the Ocotillo Express Wind Energy Facility (OWEF) near Ocotillo, California, in Imperial County (Figure 1). The OWEF was constructed in 2012 and 2013, with the Project becoming fully operational in the fall of 2013. The OWEF is located primarily on Bureau of Land Management (BLM) land and a small portion of private land. The OWEF is located on approximately 12,565 acres in the Project area and consists of 112 Siemens SWT – 2.3-108 wind turbines (approximately 315 megawatts [MW]) and associated infrastructure. The diameter of the circle swept by the blades is 354 feet (108 meters). Turbines are 440 feet (134 meters) in height. The OWEF connects to the new SDG&E Sunrise Powerlink 500-kilovolt (kV) transmission line. SDG&E constructed and operates a switchyard independently from OE LLC and as such, the post construction monitoring and mitigation measures identified for the OWEF do not apply to the SDG&E facilities. SDG&E switchyard and facilities meet APLIC standards for electrical equipment design. The collection lines connecting one turbine to the next and to the project substation are buried underground, generally adjacent to the interior turbine access roads.

The BLM issued a Record of Decision (ROD) approving the Project on May 11, 2012 and issued the right-of-way (ROW) grant on May 11, 2012. An Avian and Bat Protection Plan (ABPP) and an Eagle Conservation Plan (ECP) were developed for the OWEF in cooperation with the BLM and U.S. Fish and Wildlife Service (USFWS). The ABPP and ECP were finalized in early 2012 and approved as part of the overall BLM approval of the Project. The 2012 ECP included information on the risk of impacts to golden eagles (*Aquila chrysaetos*), as well as avoidance, minimization, and mitigation measures specific to golden eagles.

Since the 2012 ECP was finalized, the USFWS released the 2nd Version of the ECP Guidance (USFWS 2013). OE LLC has developed this ECP to reflect the recommendations contained in the latest 2013 ECP Guidance, as well as the new site-specific information that has been collected since construction and operation of the OWEF. The overarching purpose of the ECP is to re-evaluate risk to eagles at the OWEF given the 2013 ECP Guidance and all the site-specific information available as well as to revisit the avoidance, minimization, and mitigation measures implemented at the Project given the level of risk to eagles at the Project. The OWEF ECP evaluates the need for a programmatic eagle take permit and documents compliance with the regulatory requirements for a programmatic eagle take permit and the National Environmental Protection Act (NEPA) process that is associated with the granting of an incidental (i.e., non-purposeful) take permit for eagles, assuming it is determined that such a permit is warranted for the OWEF. The ECP provides detailed information on the OWEF and the mitigation measures OE LLC committed to and implemented during project siting, construction, and operations to avoid and minimize take of eagles.

This ECP was developed to support an application for an eagle take permit at the OWEF, should OE LLC decide to pursue a take permit for the Project. The 2012 OWEF ECP was developed in close coordination with Region 8 USFWS Migratory Bird Program staff and OE LLC intends to continue to coordinate with USFWS regarding the ECP, as well as decisions regarding potential eagle risk and the possibility of applying for an eagle take permit.

The 2013 USFWS ECP Guidance provides a process for conserving bald and golden eagles during siting, construction, and operation of wind energy facilities through a staged approach that is similar to the tiered approach in the 2012 USFWS Land-based Wind Energy Guidelines (WEG). The ECP Guidance emphasizes the importance of implementing avoidance and minimization measures throughout all phases of wind energy development and operations. Although the OWEF was constructed prior to the release of the 2013 ECP Guidance, OE LLC developed the 2012 ECP in close coordination with the USFWS and based the ECP on the guidance available at the time. As such, OE LLC did consider avoidance and minimization measures for golden eagles during project siting, construction, and operations. However, given the 2013 ECP Guidance and the site-specific information collected to date, OE LLC is re-evaluating the risk to eagles posed by the OWEF and the appropriate avoidance, minimization, and mitigation measures, given the current understanding of the level of risk posed by the Project.

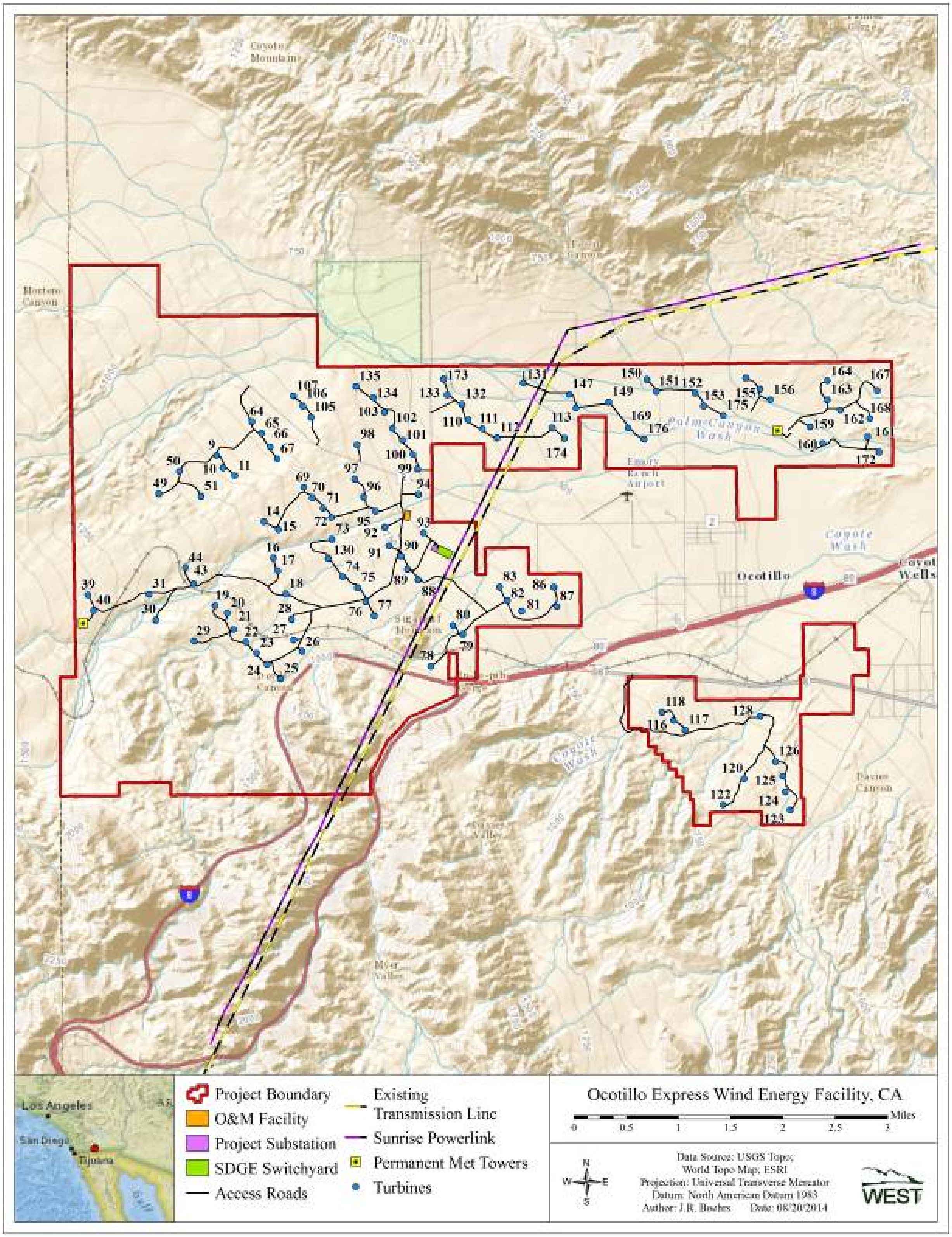


Figure 1. General location of the Ocotillo Wind Energy Facility.

1.2 Environmental Setting

The project site is located within four U.S. Geological Survey 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 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 (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.

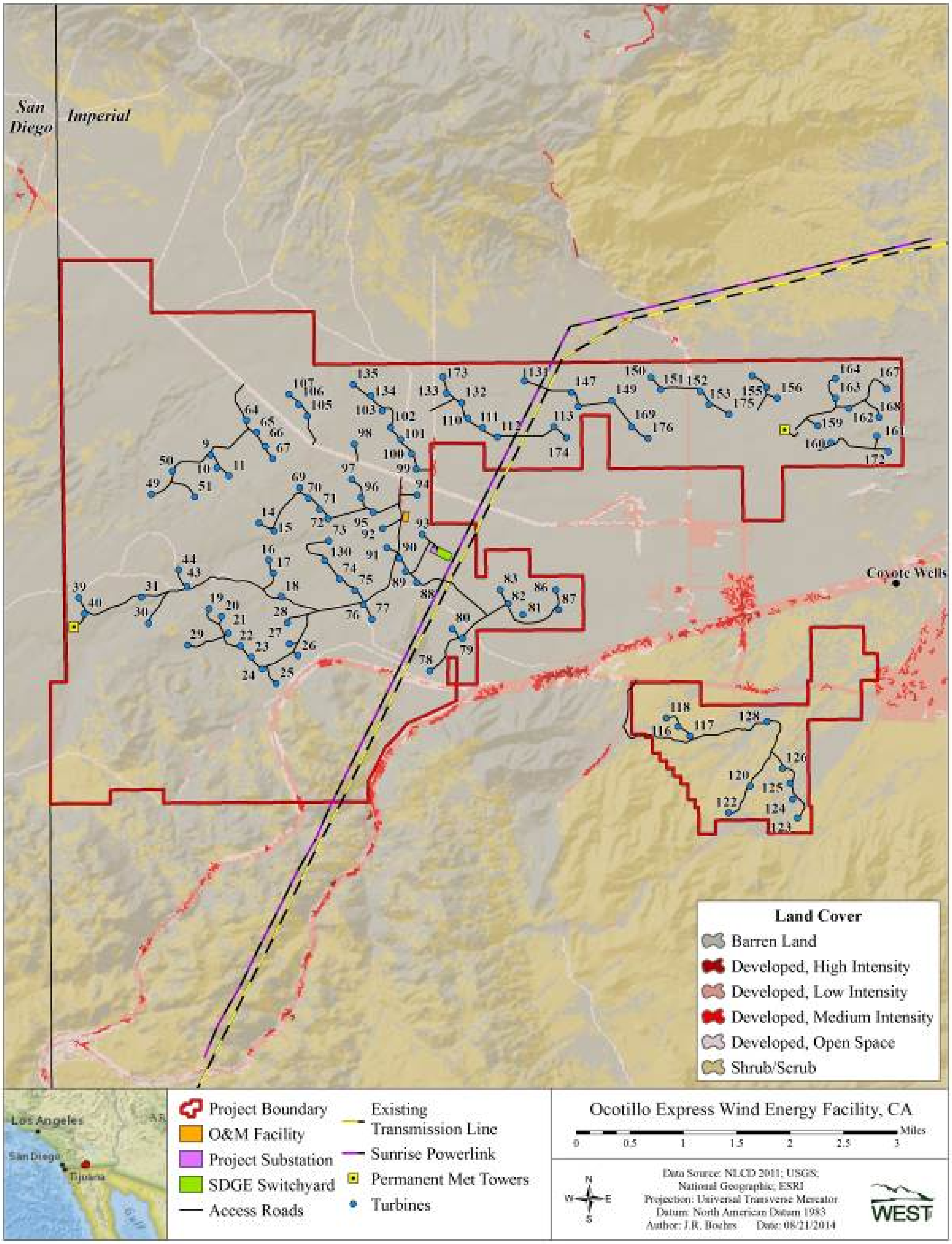
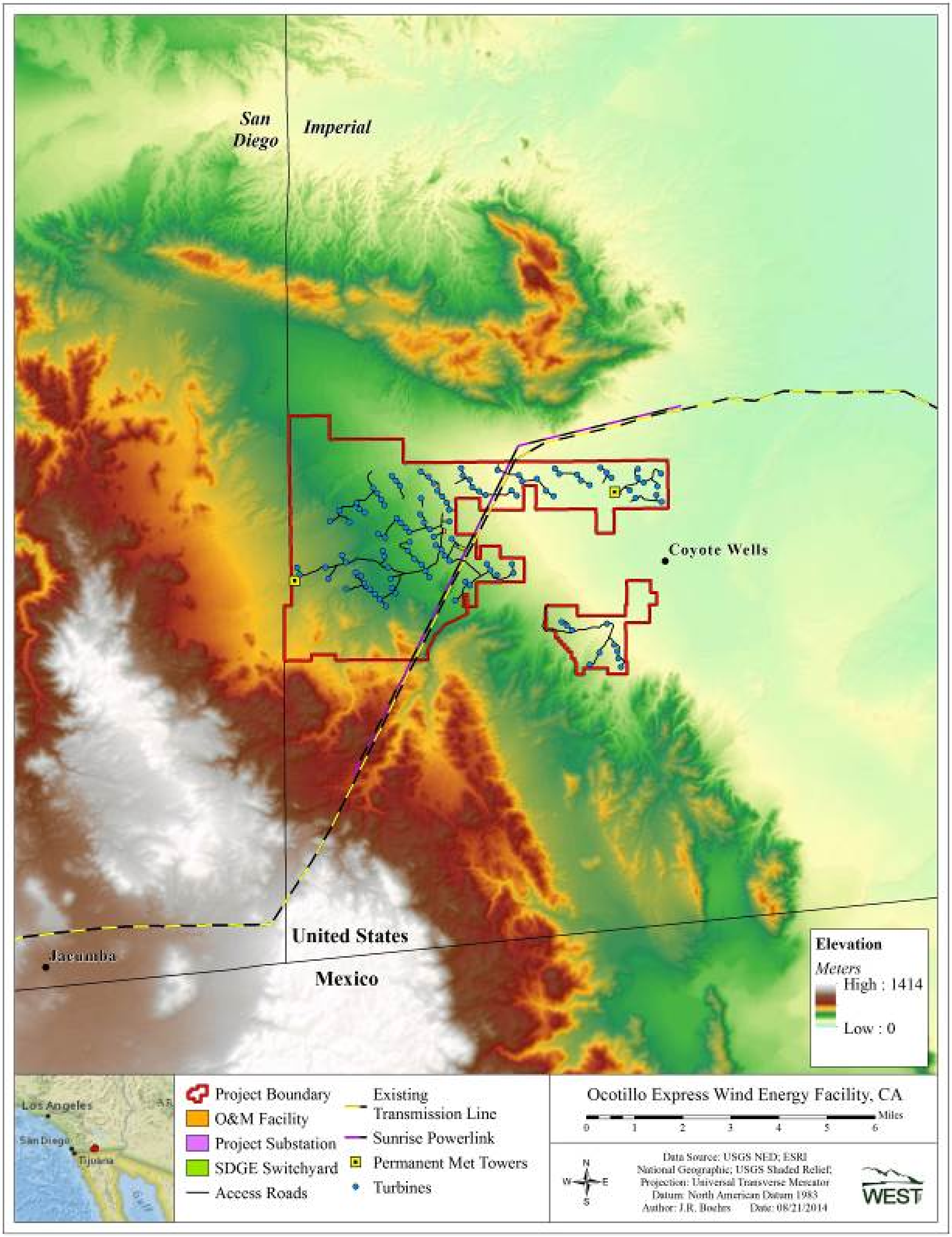


Figure 2. Landuse/Landcover information for the Ocotillo Wind Energy Facility (NLCD 2001).

Elevations on site range from approximately 300 feet above mean sea level (AMSL) in the northeast portion of the site to approximately 1,490 feet AMSL in the southwest portion of the site (Figure 3). The site generally slopes downward from the west to the east, with the Coyote Mountains to the north of the site, and the Jacumba Mountains to the west and south of the site.



Data Source: USGS NED; ESRI
National Geographic; USGS Shaded Relief;
Projection: Universal Transverse Mercator
Datum: North American Datum 1983
Author: J.R. Boehrs Date: 08/21/2014

Figure 3. Digital elevation map of the Ocotillo Wind Energy Facility.

1.3 Regulatory Framework

1.3.1 Migratory Bird Treaty Act

The federal regulatory framework for protecting eagles includes the Migratory Bird Treaty Act (MBTA) (6 U.S.C. §§ 703-711) of 1918 and the Bald and Golden Eagle Protection Act (BGEPA) (16 U.S.C. §§ 668-668d) of 1940. The MBTA is the foundation of migratory bird conservation and protection in the United States. The MBTA implements four treaties that provide for international protection of migratory birds, and is a strict liability statute, meaning that proof of intent, knowledge, or negligence is not an element of an MBTA violation. The MBTA prohibits the take of migratory birds and does not include provisions for allowing unauthorized take. The statute's language is clear that actions resulting in the "taking" or possession (permanent or temporary) of a protected species, in the absence of a USFWS permit or regulatory authorization, are violations of the MBTA. The MBTA states, "Unless and except as permitted by regulations… it shall be unlawful at any time, by any means, or in any manner to pursue, hunt, take, capture, kill… possess, offer for sale, sell …purchase … ship, export, import …transport or cause to be transported… any migratory bird, any part, nest, or eggs of any such bird ….[The Act] prohibits the taking, killing, possession, transportation, import and export of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior" (16 U.S.C. 703). The word "take" is defined by regulation as "to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect" (50 CFR 10.12). The USFWS maintains a list of all species protected by the MBTA at 50 CFR 10.13. This list includes over one thousand species of migratory birds, including eagles and other raptors, waterfowl, shorebirds, seabirds, wading birds, and passerines.

1.3.2 Bald and Golden Eagle Protection Act

Under authority of the Bald and Golden Eagle Protection Act (BGEPA), 16 U.S.C. 668–668d, bald eagles and golden eagles are afforded additional legal protection. BGEPA prohibits the take, sale, purchase, barter, offer of sale, purchase, or barter, transport, export or import, at any time or in any manner, of any bald or golden eagle, alive or dead, or any part, nest, or egg thereof. BGEPA goes on to define take as to include "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb," and includes criminal and civil penalties for violating the statute. The USFWS further defined the term "disturb" to mean to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available: 1) injury to an eagle; 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior; or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.

On September 11, 2009 (*Federal Register,* 50 Code of Federal Regulations [CFR] 22.26 and 22.27), the USFWS set in place rules establishing two new permit types: 1) individual permits that can be authorized in limited instances of disturbance and in certain situations where other forms of take may occur, such as human or eagle health and safety; and 2) programmatic permits that may authorize incidental take that occurs over a longer period of time or across a larger area.

The 2012 OWEF ECP was developed to meet BLM and USFWS requirements for addressing BGEPA and the MBTA as it relates to eagles. As described in the USFWS Draft ECP Guidance dated January 2011, the USFWS recommended that project proponents prepare an ECP to avoid, minimize, and mitigate project-related impacts to eagles to ensure no-net-loss to the golden eagle population. Pursuant to BLM Instructional Memorandum (IM) 2010-156, the BLM requested "concurrence" from the USFWS that the ECP meets specific requirements. OE LLC developed the 2012 OWEF ECP in coordination with the BLM and USFWS and USFWS provided a letter to the BLM allowing the BLM to issue the ROD and ROW grant for the Project.

Since the 2012 OWEF ECP was finalized, the USFWS finalized the Eagle Conservation Plan Guidance - Module 1 - Land-based Wind Energy Version 2 in 2013 (USFWS 2013). If eagles are identified as a potential risk at a project site, developers are strongly encouraged to follow the ECP Guidance, which describes specific actions that are recommended to achieve compliance with the regulatory requirements in BGEPA for an eagle take permit. The ECP Guidance provides a national framework for assessing and mitigating risk specific to eagles through development of ECPs and issuance of programmatic eagle take permits for eagles at wind facilities, and strives to meet the goal of no-net-loss to eagle populations.

The ECP Guidance document was written to guide development of wind energy projects from their earliest conceptual planning phase and recognized that it may not be possible for projects already in the development or operational phase to implement all stages of the recommended approach. As such, the ECP Guidance recommends that project developers or operators with operating or soon-to-be operating facilities that are interested in obtaining a programmatic eagle take permit contact the USFWS to determine if the project might be able to meet the permit requirements in 50 CFR 22.26. The OWEF is an operational facility that was constructed in the fall of 2012, prior to finalization of the 2013 ECP Guidance, and therefore falls into this category of project. OE LLC has been communicating with the USFWS regarding the results of ongoing post-construction monitoring efforts and intends to continue communicating with USFWS.

The OWEF ECP is intended to support an application for a programmatic eagle take permit if it is determined that the OWEF should apply for a permit, while also reducing or eliminating the need for costly experimental ACPs at the project, given our current understanding of the level of risk to eagles based on the 2013 ECP Guidance and the collection of all site-specific data that is available.

1.3.3 National Environmental Protection Act

NEPA [42 U.S.C. 4321 et seq.] establishes national environmental policy and goals for the protection, maintenance, and enhancement of the environment and provides a process for implementing these goals within the federal agencies. NEPA ensures that the environmental impacts of federal actions and appropriate mitigations for those impacts are fully considered through a systematic interdisciplinary approach. All federal agencies are required to prepare detailed statements assessing the environmental impact of, and alternatives to, major federal actions that significantly affect the environment. Issuance of an eagle take permit by the USFWS constitutes a federal action and thus requires an assessment of the potential environmental impacts associated with the action and alternatives under NEPA. Because the OWEF is located on federal (BLM) lands, an Environmental Impact Statement (EIS) was completed by the BLM in accordance with NEPA requirements prior to project construction. Potential impacts to eagles were considered in the EIS, as well as in the ABPP and ECP. In addition, because the USFWS must complete a NEPA analysis before it can issue an eagle permit, an additional NEPA analysis would need to be completed in conjunction with the issuance of any eagle take permit that may be granted to OWEF.

1.4 Pattern Energy Policy and Commitment to Environmental Protection

Pattern Energy is an independent, fully integrated energy company that develops, constructs, owns, and operates wind power projects across North America and parts of Latin America. Pattern Energy commenced operations in June of 2009 as one of the most experienced and best capitalized renewable energy companies in the United States. OE LLC, through Pattern, is dedicated to delivering the highest values for their partners and the communities where they work, while exhibiting a strong commitment to promoting environmental stewardship and corporate responsibility. OE LLC is committed to building environmentally responsible renewable energy projects, and continues to work closely with environmental agencies to develop appropriate mitigation measures to reduce impacts to wildlife.

2.0 SITE SPECIFIC SURVEYS AND ASSESSMENTS (STAGE 2)

Baseline data were collected on golden eagles in the vicinity of the OWEF beginning in the fall of 2009. Golden eagle nest surveys, raptor migration surveys, and avian point counts were conducted (Helix 2010a, 2010b, 2011). Golden eagle nest surveys were conducted in the spring of 2010 by Wildlife Research Institute (WRI), a local firm that has extensive historical information on golden eagles nesting in the vicinity of the OWEF. Migration surveys were conducted by Helix Environmental Planning, Inc. (HELIX) in the fall of 2009, spring and fall of 2010, and spring of 2011. Avian use point counts were conducted weekly over a one-year period from September of 2009 to August of 2010. The following sections provide more details on the site-specific baseline golden eagle information collected for the OWEF. Additional data collection on eagles has been conducted since November of 2012 and is currently ongoing (see Section 5.0 – post-construction monitoring for additional details).

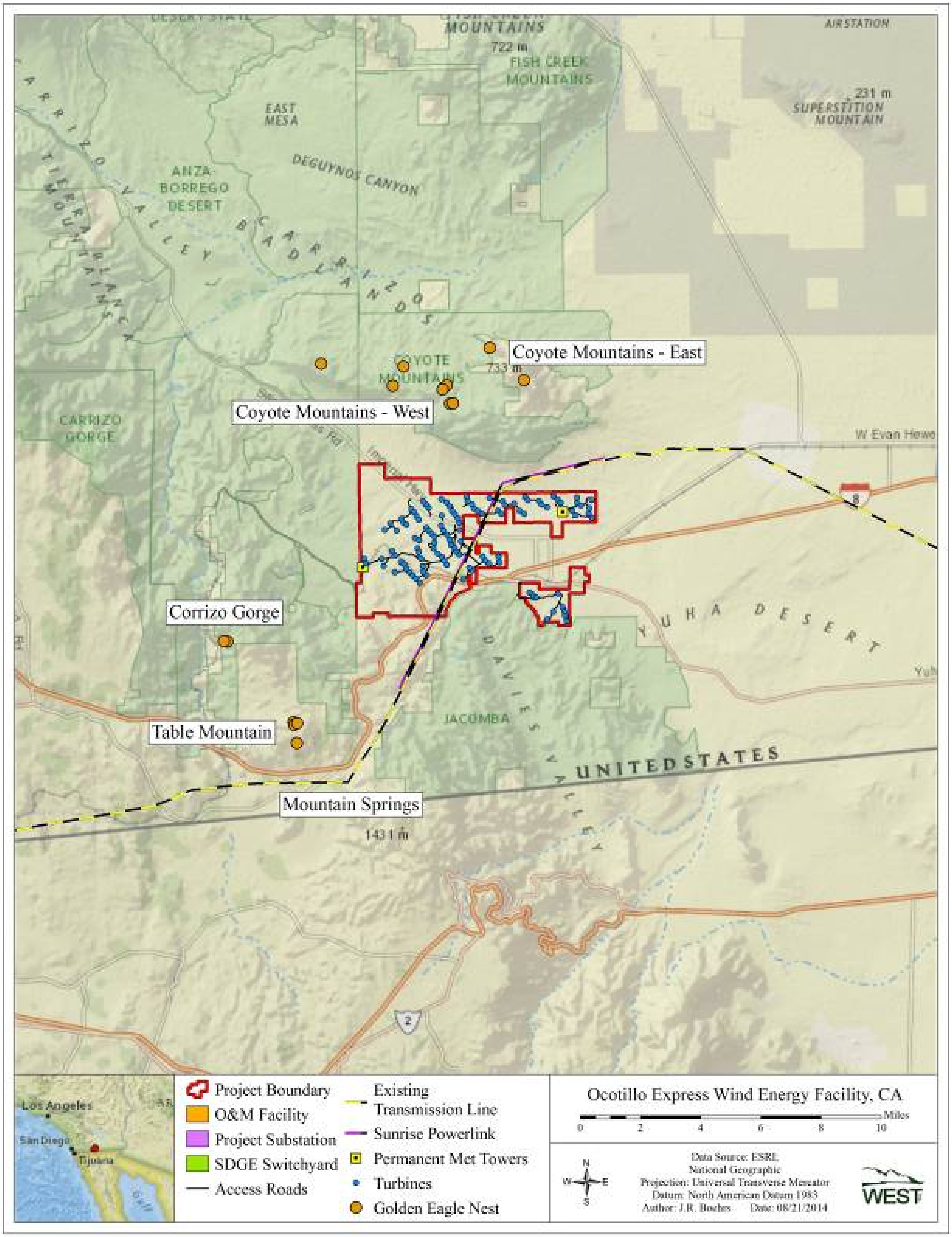
2.1 Golden Eagle Nest Surveys

2.1.1 Methods

HELIX contracted with WRI to conduct surveys of golden eagle (*Aquila chrysaetos*) nest sites in eagle territories that occur within 10 miles of the project site, in accordance with the guidance provided in the USFWS Inventory and Monitoring Protocols (Pagel et al. 2010). WRI conducted helicopter surveys in four known territories (referred to as Coyote Mountains West, Coyote Mountains East, Table Mountain, and Carrizo Gorge) in the spring of 2010. A hand-held GPS was used to record the helicopter flight path and the location of each nest site. Nest-specific information was documented by two eagle biologists in the helicopter, and each nest site was photographed. In addition to helicopter surveys, WRI conducted ground surveys of an additional suspected golden eagle territory (referred to as Mountain Springs) in the spring of 2010. Helicopter surveys were not allowed by USFWS in the Mountain Springs area because of potential disturbance to Peninsular bighorn sheep (*Ovis canadensis nelsoni*).

2.1.2 Results

Twenty-one golden eagle nests were observed in the five territories during nest surveys in 2010 (Figure 4). Two of the five territories were designated as active by WRI in 2010. One nest in the Coyote Mountains West territory was considered active. Two additional nests in the Table Mountain territory were considered as inactive/possibly active due to subtle signs of activity that were difficult to confirm. On September 15, 2010, a breeding pair of adult eagles was observed on the Table Mountain territory, providing further support for the active designation of this territory in 2010. The remaining three territories were designated inactive in 2010.



Data Source: ESRI,
National Geographic
Projection: Universal Transverse Mercator
Datum: North American Datum 1983
Author: J.R. Boehrs Date: 08/21/2014

Figure 4. Location of golden eagle nests and territories within 10 miles of the Ocotillo Wind Energy Facility.

2.1.3 Discussion

According to information contained in the Avian and Bat Protection Plan (ABPP) for the Tule Wind Project, WRI conducted golden eagle nest surveys within four of the territories (excluding Mountain Springs) in 2011 (Tule Wind LLC 2011). Two of the territories (Coyote Mountains West and Table Mountain) were identified as active in 2011. Coyote Mountains West was determined to be occupied during the first round of golden eagle nest surveys. However, Coyote Mountains West was not confirmed to be productive in 2011 (Tule Wind LLC 2011).

Historical nesting information for some of the territories is available to provide further information on golden eagle activity within 10 miles of the OWEF (Helix 2010a, b). The historical nesting information has been compiled from previous work conducted by WRI and others including review of the BLM's historic documents and potentially relevant correspondence from resource agencies. Based on this historical information, the Coyote Mountain East territory has been inactive for several years. Table Mountain was successful in producing at least one chick in 2004 and Carrizo Gorge was successful in 2007. Coyote Mountain West is a newly identified territory. Mountain Springs had no sign of activity, although closer monitoring may be warranted in future years. Drought conditions and the timing of the 2010 golden eagle nest surveys limit the utility of the one year of baseline golden eagle nest surveys for anticipating impacts to nesting golden eagles from the OWEF. The long-term data help in understanding use of the territories in relation to the OWEF.

Based on the golden eagle nest data from 2010 as well as the 2011 results contained in the Tule Wind Project ABPP, none of the nests identified were within three miles of turbine locations. The closest active nest in either 2010 or 2011 was located 4.1 miles from turbine locations (Coyote Mountains West territory). Table Mountain was determined to be active in both 2010 and 2011. No other active territories were confirmed during the 2010 or 2011 raptor nest surveys conducted within 10 miles of the OWEF.

2.2 Avian Point Counts

2.2.1 Methods

HELIX conducted Avian Point Counts (APC's) approximately weekly over a one-year period (September 1, 2009 – August 31, 2010). The APC's were conducted in accordance with the survey protocols approved by BLM (HELIX 2010a) and generally in accordance with the bird use count methods described in the California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development (California Energy Commission [CEC] 2007). The goal of the APC's was to record bird species, abundance, behavior, and flight characteristics from selected sampling locations over a 30-minute period. A total of 50 weeks of point counts were conducted over the one-year period (APC's were not conducted the week of November 29-December 5, 2009, or the week of January 17-23, 2010). Each APC location was visited once per week (the one exception is that Location 13 was not surveyed the week of February 21-27, 2010).

Twenty-one APC locations were established approximately one mile apart throughout the approximately 15,000 acre site (Figure 5). The CEC Guidelines allow for locations to be 5,200 feet apart for large wind resource areas with good viewsheds, which is the case for the study area. The APC locations were chosen based on viewsheds, elevation, and habitat types. Each location had good visibility in all directions, with no major impediments impairing the range of view. Locations also covered a wide range of elevations, from approximately 340 ft AMSL (Location 4) to approximately 1,250 ft AMSL (Location 18). Finally, APC's were strategically located to sample different microhabitats. Although each of the locations occurred in desert scrub habitat, several of the locations were within and adjacent to dry desert washes (e.g., Locations 6, 10, 13, 14, and 21) while others were located on or adjacent to hilly topography (e.g., Locations 2, 12, 18, and 19).

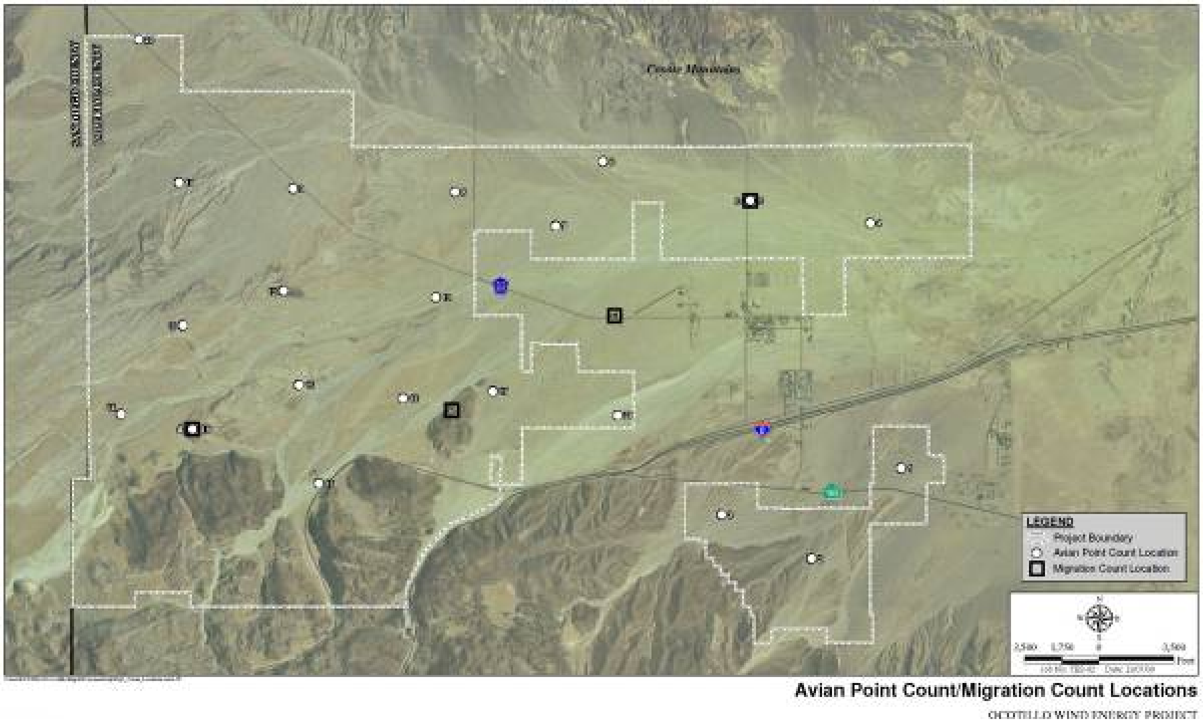


Figure 5. Avian and raptor migration point stations at the Ocotillo Wind Energy Facility.

At each APC location the species, number of individuals, flight height, flight direction, distance from observer, and behavior (e.g., directional flight, perched, flapping flight, soaring, etc.) was recorded over a 30-minute period. Weather conditions (e.g., temperature, wind speed and direction, and cloud cover) were recorded at the start and end of the 30-minute survey period using a hand-held Kestrel anemometer. Species were detected visually with the aid of binoculars and by identifying songs and call notes. All observations were recorded on standardized data sheets. APC's were conducted once per week at each location. Efforts were made to sequence observation times so that locations were surveyed both in the morning and in the afternoon and under varying weather conditions, in accordance with the CEC's Guidelines (CEC 2007).

2.2.2 Golden Eagle Results

Three golden eagles (two adults and one juvenile) were observed flying north over the western portion of the project area during Week One at approximately 1000 feet above ground level (outside the Rotor Swept Area [RSA]; Table 1; Figure 6). No other golden eagles were observed during weekly point counts, but golden eagles were observed during fall 2009 migration counts (see below; HELIX 2010).

Table 1. Summary of golden eagle observations during avian point counts at the Ocotillo Wind Energy Facility, September 1, 2009 – August 31, 2010.

Date	Time of Observation	# of Individuals	Age	Flight Height (ft above ground)	Distance From Observer (ft)	Total Length of Mapped Flight Path (m)	Length of Mapped Flight Path within Survey Plot (m)
2-Sep-09	1110 to 1112	3	2 Adults; 1 Juvenile	1,000	600	4,741.05	761.61

2.2.3 Discussion

The yearlong APC's were conducted in what was considered a typical year for the Colorado Desert. The 2009-2010 time period was considered an average rainfall year for the region and the region did not experience abnormally long hot, cold, wet, or dry periods during the 2009-2010 timeframe. As such, the results of the APC's would be considered typical for this area. The timing of migration, resident and migratory species composition and abundance, and bird behavior may vary during years when conditions are abnormally wet, dry, hot, or cold. Two years of raptor specific migration surveys (summarized below) are also used to assess golden eagle use.

Based on the data collected to date, the OWEF does not support large numbers of resident golden eagles. The site does not appear to be part of a major migration corridor for golden eagles. Golden eagles were seen only once during the point counts study (September 2, 2009) and were observed flying at a height above the RSA.

Some concerns have been expressed regarding the use of avian point count surveys for assessing eagle and/or raptor use. Avian point counts are commonly used to assess raptor use (including eagles) at WRA's (Strickland et al. 2011). Comparisons of use between concurrent raptor specific surveys and avian point counts have shown similar levels of use (when the level of effort has been standardized). One example is from the North Sky River (NSR) project in Kern County, CA. Spring eagle observation surveys at the NSR project estimated eagle use to be 0.055 eagles/30-minute survey and spring avian point count surveys at the NSR project estimated eagle use to be 0.05 eagles/30-minute survey (Erickson et al. 2011). Additional raptor specific migration surveys were conducted at the OWEF and are summarized below. The raptor migration surveys at the OWEF provide further support for the low levels of golden eagle use observed during the APC's.

2.3 Golden Eagle Migration Surveys

2.3.1 Methods

HELIX conducted migration counts in the spring and fall seasons during a two year period (over an eight calendar-week period during the 2009 fall migration period [September 24 – November 10, 2009], over a 10 calendar-week period during the 2010 spring migration period [March 22 – May 28, 2010], over a 12 calendar-week period during the 2010 fall migration period [August 23 – November 12, 2010], and over a 10 calendar-week period during the spring 2011 migration period [March 21 – May 27, 2011]). The methods of each survey were developed in coordination with the BLM and were based on the recommendations provided in the California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development (CEC 2007). The purpose of the migration study was to document diurnal raptor activity within the project area in order to provide a risk assessment for these species. HELIX stationed four surveyors throughout the site to scan the sky and record bird migration data. The four migration count locations (Locations A through D; Figure 5) were spaced approximately two miles apart, generally along a southwest-northeast axis across the site. Migration count points were located to maximize the likelihood of detecting potential north-south and east-west migration through the site.

Migration counts were focused on the time of day when raptors were observed to be most active over the site (late morning to late afternoon). The migration counts were staggered to either begin shortly after sunrise or to conclude before sundown to cover the bimodal activity of diurnal bird migrants. During the fall of 2009 and the spring of 2010, migration counts were conducted approximately 8 hours per day; during the fall of 2010 and the spring of 2011, migration counts were conducted approximately 5.5 hours per day (typically from mid-morning to late afternoon).

2.3.2 Results

A total of 747.9 observation hours were logged during the fall of 2009. Nine golden eagle observations were recorded during the fall of 2009 (Table 2; Figure 6). A total of 930.2 observation hours were logged during the spring of 2010. No golden eagles were observed during spring migration counts; however, a single golden eagle was observed during a burrowing owl survey on the site on June 17, 2010 (Table 3; Figure 7). A total of 581.4 observation hours were logged in the fall of 2010, and 11 golden eagles were observed during the fall migration counts in 2010 (Table 4; Figure 8). A total of 486.1 observation hours were logged during the spring of 2011. Eleven golden eagles were observed during the spring migration counts in 2011, with just over one-third of the observations occurring on March 22, 2011 (four observations; Table 5; Figure 9).

Table 2. Summary of golden eagle observations during Fall 2009 raptor migration surveys at the Ocotillo Wind Energy Facility, September 24 – November 10, 2009.

Date	Time of Observation	# of Individuals	Age	Flight Height (ft above ground)	Distance From Observer (ft)	Total Length of Mapped Flight Path (m)	Length of Mapped Flight Path within Survey Plot (m)
25-Sep-09	1440 to 1442	1	Juvenile	30 – 800	300	16,564.20	1,666.17
25-Sep-09	1545 to 1555	1	Juvenile	400 – 4,000	5,200 – 8,000	4,035.75	NA
2-Oct-09	1315 to 1319	2	1 Adult; 1 Juvenile	800 – 1,200	1,000	7,359.15	NA
22-Oct-09	1145 to 1212	2	Unknown	200 – 500	7,000	9,074.18	1,028.68
30-Oct-09	1325 to 1335	1	Juvenile	200 – 1,000	3,000	11,494.10	NA
10-Nov-09	1230 to 1330	2[†]	1 Adult; 1 Juvenile	0 – 1,500	1,000 – 10,000	9,904.44	NA

[†] These eagles were determined to have been observed by more than one observer. Ranges in the table for flight height and distance include the range reported by all observers. Also, observations are treated as independent for estimating standardized eagle use estimates.

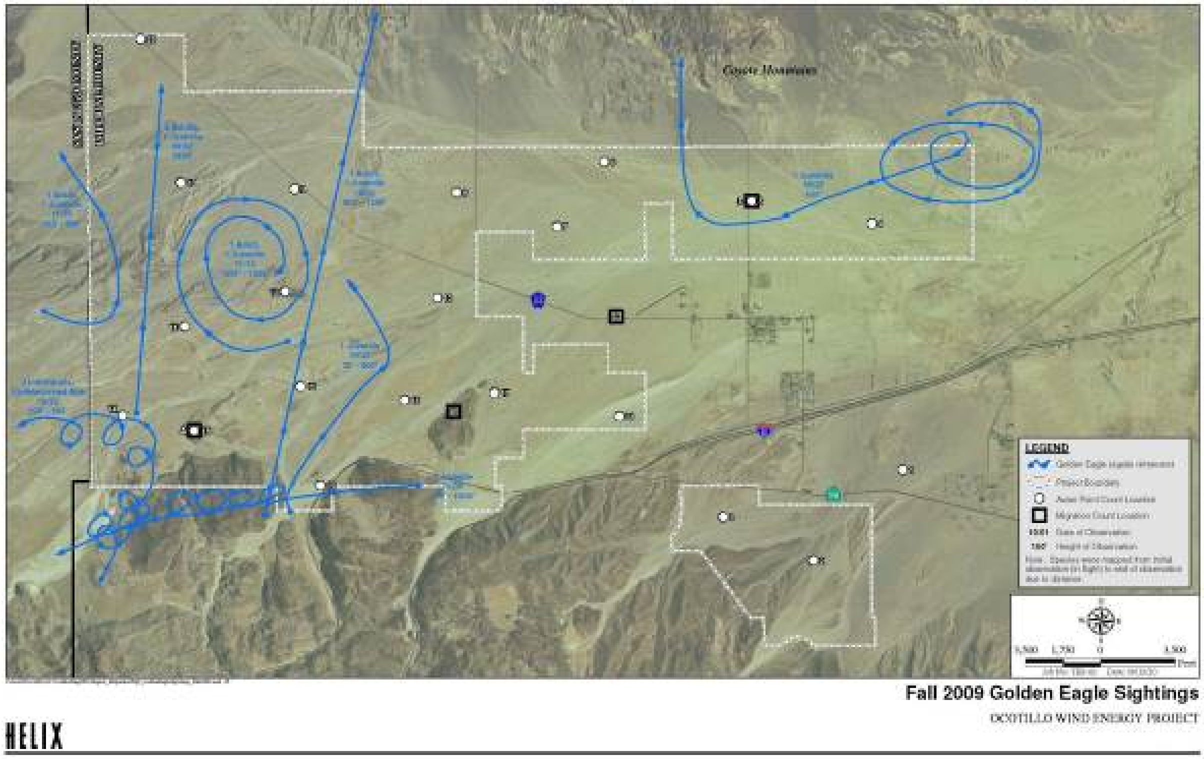


Figure 6. Mapped flight paths and perch locations for golden eagles observed during the fall of 2009 within the Ocotillo Wind Energy Facility.

Table 3. Summary of incidental golden eagle observations during Spring 2010 raptor migration surveys at the Ocotillo Wind Energy Facility, March 22 – May 28, 2010. No golden eagles were observed during Spring 2010 raptor migration surveys.

Date	Time of Observation	# of Individuals	Age	Flight Height (ft above ground)	Distance from Observer (ft)
17-Jun-10	0530 to 0532	1†	Adult	0 – 100	20
17-Jun-10	0630 to 0631	1†	Adult	0 – 20	200

† Determined to be the same individual observed separately by two biologists during burrowing owl surveys (Helix 2010b).

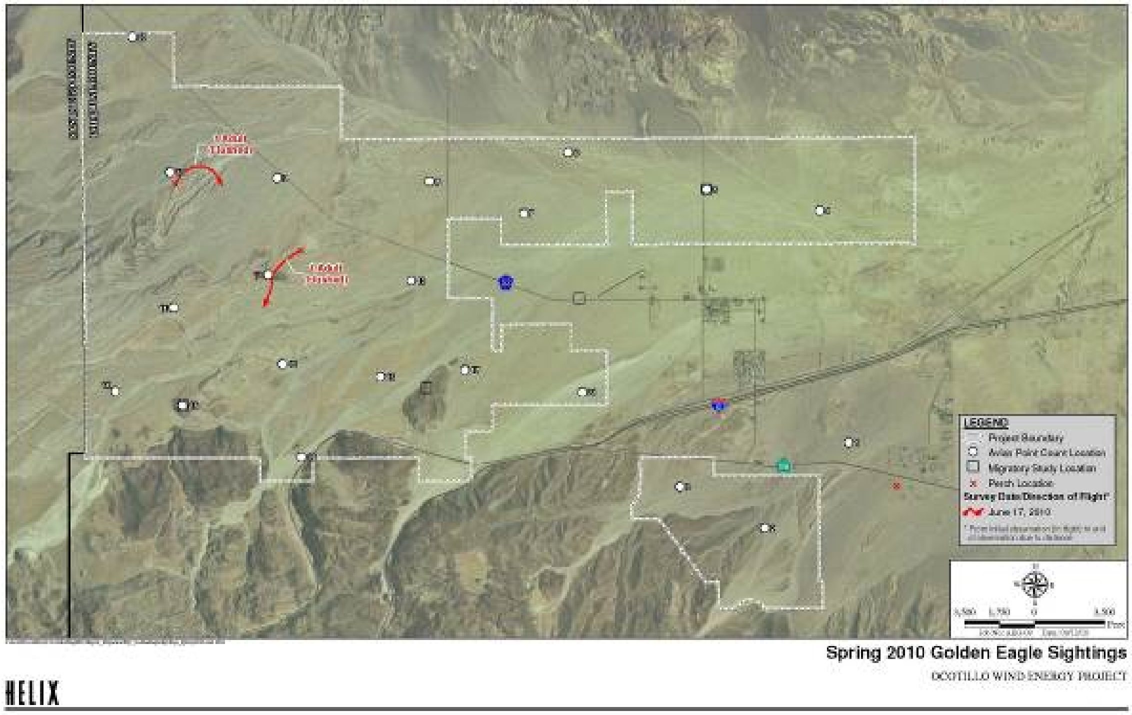


Figure 7. Mapped flight paths and perch locations for golden eagles observed during the spring of 2010 within the Ocotillo Wind Energy Facility.

Table 4. Summary of golden eagle observations during Fall 2010 raptor migration surveys at the Ocotillo Wind Energy Facility, August 23 – November 12, 2010.

Date	Time of Observation	# of Individuals	Age	Flight Height (ft above ground)	Distance From Observer (ft)	Total Length of Mapped Flight Path (m)	Length of Mapped Flight Path within Survey Plot (m)
21-Sep-10	1105-1300*	1†	Undetermined	500	4,000 – 9,000	7,455.66	NA
4-Oct-10	1053-1057	1	Juvenile	400 – 500	6,000	2,267.52	NA
13-Oct-10	1156-1214	1	Adult	35 – 3,000	200	5,164.82	NA
29-Oct-10	1050-1130	1†	Adult	100 – 800	5,000 – 7,500	14,500.70	NA
3-Nov-10	1145-1158	1	Undetermined	1,500 – 2,000	9,000	6,913.04	NA
5-Nov-10	1035-1048	1	Undetermined	200 – 400	3,000 – 9,000	8,415.28	NA
5-Nov-10	1220-1235	1†	Undetermined	100 – 600	200 – 1,000	4,620.72	NA
10-Nov-10	0940-0946	1†	Undetermined	400 – 1,250	400 – 8,000	17,348.70	NA
12-Nov-10	1225-1233	1†	Adult	150 – 500	2,000 – 3,000	3,450.36	NA
12-Nov-10	1235-1256	2†	1 Adult; 1 Juvenile	150 – 1,000	4,000 – 20,000	13,304.30	5403.05

*Includes time eagle was perched off site (80 minutes) as well as the additional time eagle was observed flying off site over the Jacumba Mountains (25 minutes).

†These eagles were determined to have been observed by more than one observer. Ranges in the table for flight height and distance include the range reported by all observers. Also, observations are treated as independent for estimating standardized eagle use estimates.

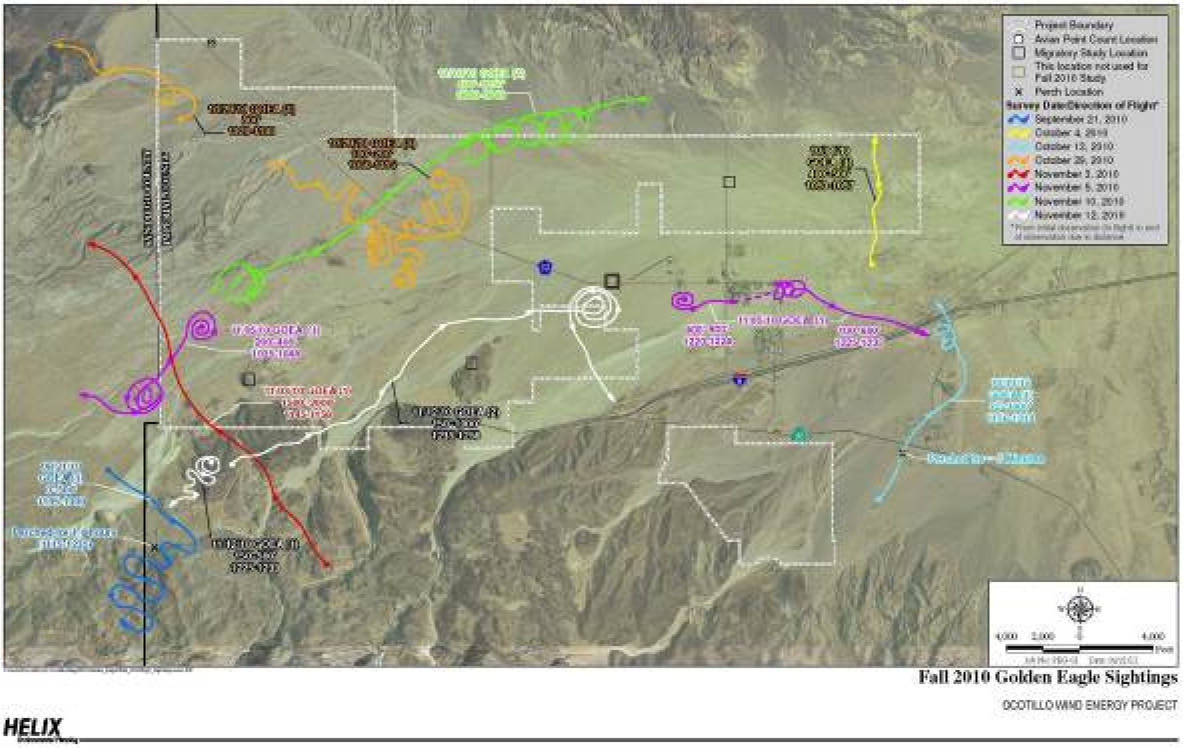


Figure 8. Mapped flight paths and perch locations for golden eagles observed during the fall of 2010 within the Ocotillo Wind Energy Facility.

Table 5. Summary of golden eagle observations during Spring 2011 raptor migration surveys at the Ocotillo Wind Energy Facility, March 21 to May 27, 2011.

Date	Time of Observation	# of Individuals	Age	Flight Height (ft above ground)	Distance From Observer (ft)	Total Length of Mapped Flight Path (m)	Length of Mapped Flight Path within Survey Plot (m)
22-Mar-11	1130-1135	1	Unk	200 – 1,000	1,500	7,005.83	NA
22-Mar-11	1326-1334	1	Juvenile	200 – 1,200	200 – 3,000	11,108.20	1,231.82
22-Mar-11	1410-1426	1†	Juvenile	1,000 - 1,500	3,000 – 6,000	14,803.20	NA
22-Mar-11	1450-1500	1	Juvenile	100 – 1,000	2,000	8,298.89	6227.3
23-Mar-11	0930-0940	1	Juvenile	300 - 1,000	1,700	6,281.99	1,364.99
30-Mar-11	1050-1055	1	Juvenile	300 – 1,200	3,000	3,867.49	179.80
6-Apr-11	1302-1315	1	Juvenile	500 - 1,000	6,000	12,049.50	6542.01
3-May-11	1055-1114	1†	Adult	0 - 500	4,000	5,965.67	NA
4-May-11	1232-1241	2	1 Adult; 1 Unk	100 – 2,000	7,500	15,394.30	NA
16-May-11	1309-1312	1	Juvenile	100 - 200	3,500	7,640.75	NA

†These eagles were determined to have been observed by more than one observer. Ranges in the table for flight height and distance include the range reported by all observers. Also, observations are treated as independent for estimating standardized eagle use estimates.

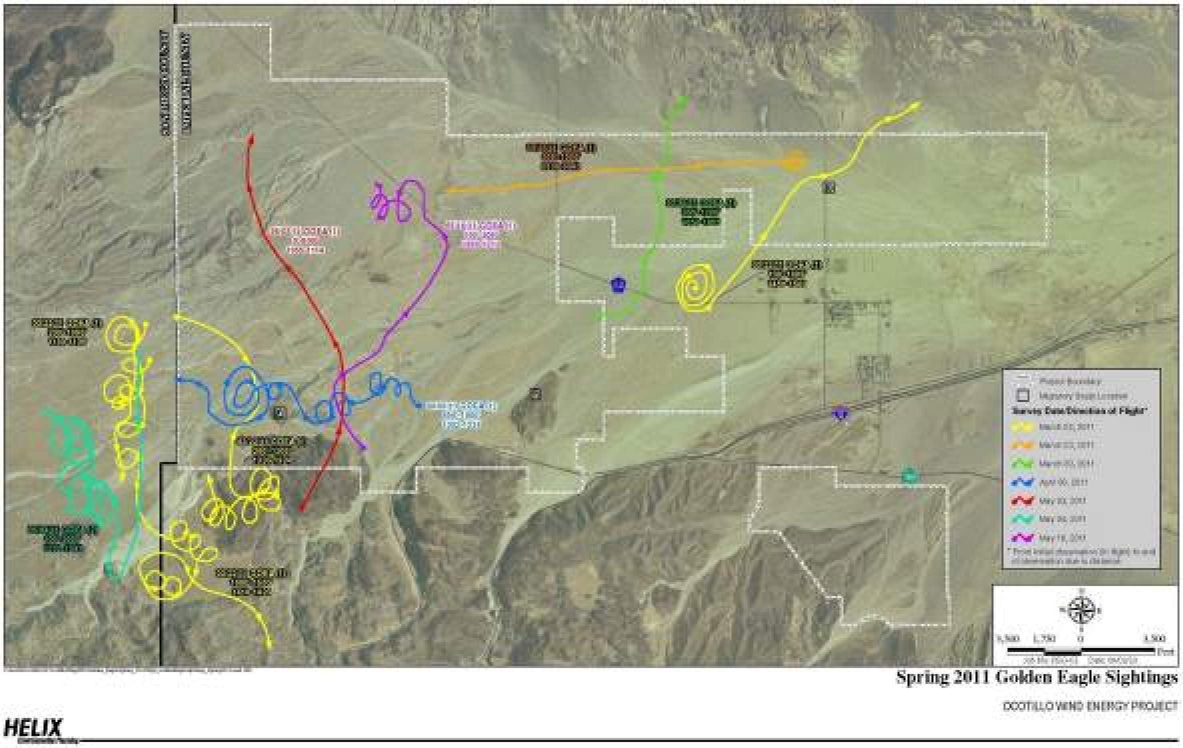


Figure 9. Mapped flight paths and perch locations for golden eagles observed during the spring of 2011 within the Ocotillo Wind Energy Facility.

2.3.3 Discussion

The OWEF is not located in a known raptor migration corridor (Aspen Environmental Group 2008; pers. comm.; Unitt 2007). The majority of the project site supports desert scrub vegetation and dry desert washes. The site does not contain the appropriate topography to funnel migrating birds through the site. With the exception of Sugarloaf Mountain and the rocky terrain in the southwest portion of the site, the project is generally flat and is located east of the Jacumba Mountains and south of the Coyote Mountains. The southwesterly prevailing wind direction would not appear to be conducive to creating updrafts in the project site that are often associated with high raptor migration areas. The site lacks a major ridgeline, water bodies, and large stands of mature trees. The closest major water body is the Salton Sea, which is 30 miles to the northeast of the site, and the irrigated agriculture fields near El Centro are approximately 15 miles to the west of Ocotillo. The results of HELIX's labor-intensive fall 2009, spring and fall 2010, and spring 2011 migration counts (two years of surveys) indicate that the OWEF site is not part of a major migratory pathway for golden eagles. Golden eagles were observed up to the end of the fall season during both the 2009 and 2010 raptor migration surveys. Results from the yearlong APC study (only 3 golden eagle observations on September 2, 2009) provide further support that the OWEF site is not part of a major migratory pathway and that the timing of the raptor migration surveys would not have missed any large influxes of migratory golden eagles (since no golden eagles were recorded during the APC surveys in November or December).

2.4 Pre-construction Golden Eagle Use

A total of 3,270.1 observation hours were logged and only 40 golden eagle observations (six of which were determined to be observations of the same eagle(s) by more than one observer) were recorded, resulting in 0.01 golden eagle observations per hour (Table 6). The golden eagle use estimates suggest relatively low use of the project site during the study period, especially when compared to other projects in California (where similar methods were used to document use), such as the High Winds Wind Resource Area (0.3 eagles/30-min survey during pre-construction surveys; Kerlinger et al. 2005, 2006) and the Diablo Winds Wind Resource Area (0.3 eagles/30-min survey during the post-construction period; WEST 2008).

Table 6. Summary of golden eagle observations, raptor observations*, sampling effort, and mean use at the Ocotillo Wind Energy Facility during raptor migration surveys and avian point counts, September 1, 2009 – November 10, 2010.

Season	Species Group	Observations	Sampling Effort (hours)	Mean Use (Obs/Hour)
Raptor Migration Surveys				
Fall 2009**	golden eagles	9	747.9	0.01
	raptors and vultures	165	747.9	0.22
	raptors	150	747.9	0.20
Spring 2010	golden eagles	0	930.2	0
	raptors and vultures	522	930.2	0.56
	raptors	206	930.2	0.22
Fall 2010	golden eagles	11	581.4	0.02
	raptors and vultures	451	581.4	0.78
	raptors	368	581.4	0.63
Spring 2011	golden eagles	11	486.1	0.02
	raptors and vultures	935	486.1	1.92
	raptors	479	486.1	0.98
All Seasons	golden eagles	31	2,745.6	0.01
	raptors and vultures	2,073	2,745.6	0.76
	raptors	1,203	2,745.6	0.44
Avian Point Counts				
1-Sep-09 through 31-Aug-10	golden eagles	3	524.5	0.01
	raptors and vultures	227	524.5	0.43
	raptors	139	524.5	0.27
All Surveys To Date				
1-Sep-09 through 12-Nov-10	golden eagles	36[†]	3270.1	0.01
	raptors and vultures	2,300	3270.1	0.70
	raptors	1,342	3270.1	0.41

*Raptor data reported by HELIX Environmental Planning, Inc. included turkey vultures (Helix 2010a, 2010b, 2011, unpublished data).

**Large numbers of raptors and turkey vultures were not documented during Fall 2009 raptor migration surveys (Helix 2010)

[†] Includes two incidental observations of the same individual during Spring 2010 burrowing owl surveys.

3.0 ASSESSING GOLDEN EAGLE RISK AND PREDICTING FATALITIES (STAGE 3)

3.1 Assessing Golden Eagle Risk at OWEF

The USFWS ECP Guidance uses a three category system in defining risk to eagles, and their definitions are provided verbatim below.

Category 1 – For sites with high risk to eagles, and potential to avoid and mitigate impacts is low

A project is in this category if it:

(1) has an important eagle-use area or migration concentration site within the project footprint; or

(2) has an annual eagle fatality estimate (average number of eagles predicted to be taken annually) > 5% of the estimated local-area population size; or

(3) causes the cumulative annual take for the local-area population to exceed 5% of the estimated local-area population size.

Category 2 – High or moderate risk to eagles, opportunity to mitigate impacts

A project is in this category if it:

(1) has an important eagle-use area or migration concentration site within the project area but not in the project footprint; or

(2) has an annual eagle fatality estimate between 0.03 eagles per year and 5% of the estimated local-area population size; or

(3) causes cumulative annual take of the local-area population of less than 5% of the estimated local-area population size.

Category 3 – Minimal risk to eagles

A project is in this category if it:

(1) has no important eagle use areas or migration concentration sites within the project area; and

(2) has an eagle fatality rate estimate of less than 0.03 eagles per year; and

(3) causes cumulative annual take of the local-area population of less than 5% of the estimated local-area population size.

Projects in category 3 pose little risk to eagles and may not require or warrant eagle take permits, but that decision should be made in coordination with the USFWS.

We discuss several risk factors and the information used to evaluate the risk characterization of the OWEF, including evaluating eagle use areas, calculation of the fatality estimate, and understanding local-area population size and cumulative annual take. Based on the data presented in the following sections, we conclude that the OWEF may meet the criteria of a Category 3 site or at the very least, an extremely low risk Category 2 site.

3.1.1 Nesting and Breeding

Based on the definitions used by WRI and for the purposes of the OWEF ECP, an active nest is a nest in good condition that has evidence of new material having been added during the season in which the survey was conducted. An active nest may or may not be occupied in the survey year. An occupied nest is an active nest in which an adult, young eagle, or new egg has been observed on the nest in the survey year. Lastly, an active territory is a territory for which an active or occupied nest was present or there have been observations of a breeding pair of adult eagles in the territory during the survey year.

The 2010 golden eagle nest surveys indicated that two of the five territories (Coyote Mountains West and Table Mountain; identified by WRI) were active in 2010, while the remaining three territories were considered to be inactive. Two nests in the Table Mountain territory were observed by WRI to show signs of possible activity in 2010 (i.e., shallow, poorly-formed bowls). One nest in the Coyote Mountains West territory was observed by WRI to have signs of activity, including white wash on the rock wall and a prominent bowl in the nesting materials. However, no occupied nests were identified, meaning that no incubating females, chicks, or eggs were noted within the nest sites at the time WRI conducted the helicopter and ground surveys in 2010. According to the Tule Wind Project ABPP, both Coyote Mountains West and Table Mountain were active again in 2011. Coyote Mountains West had an occupied nest in 2011, although no production was confirmed (Tule Wind LLC 2011). Appendix A shows the history of each of the four territories that have been monitored. It is clear these territories generally have not been consistently active, occupied, or productive for the last decade. These findings have been confirmed during post-construction eagle nest monitoring conducted in 2013, 2014, and 2015 (see section 5.0 below). Caution should be exercised when evaluating the status of eagle territories in the desert as it is well known that desert golden eagle territories are not as productive or active as they are in other habitats (USFWS personal communication).

Turbines have been sited greater than three miles from all of the 21 historic golden eagle nests identified within a 10-mile buffer of the project (Table 7). Nine of the historic nests have at least one turbine within a five-mile buffer. The maximum number of turbines within a five-mile buffer of an eagle nest is 61. The maximum number of turbines that are located within 10 miles of an eagle nest is 112 (Table 7).

The approach in the 2013 ECP Guidance for evaluating the potential disturbance impacts to occupied nests calls for measuring nearest neighbor distances from occupied nests (USFWS 2013). Since no occupied nests were identified and only one nest was considered active, this is not possible. Instead, three approaches were used to approximate territory size in the vicinity of the OWEF. Under the first approach, the average maximum nest distance between territories closest to one another was calculated for all five territories identified in Helix (2010). This assessment assumes that the nests within 10 miles of the OWEF have been correctly assigned to their respective territories. The distance to Mountain Springs was approximated, since the actual nest locations were unknown. Table 8 shows the maximum distances between nests in territories closest to one another. The average of these maximum distances is 4.97 miles, so half that distance (2.49 miles) was the buffer used from nests to determine territory overlap with the project and assess the potential for nest disturbance. While this approach does not fit exactly to the ECP guidance, it would appear to be a reasonable approach for defining a buffer to help evaluate the potential for nest disturbance (Figure 10). The second approach was based on the two active territories and used the maximum distance of active (or potentially active) nests between the two active territories (Coyote Mountains West and Table Mountain). The maximum distance between active/potentially active nests between the two territories is 12.36 miles, so half that distance is 6.18 miles, which was the buffer used from nests to determine territory overlap with the project under the second approach. The second approach provides a more conservative estimate of approximate territory size (Figure 10). A third estimate of territory size, based on the 6.2-mile inter-nest distance suggested in the 2011 Draft ECP Guidance, yields a buffer of 3.1 miles (Figure 10; USFWS 2011).

Table 7. The number of turbines within various buffers of all known nests in each of the five known territories within 10-miles of the Ocotillo Wind Energy Facility.

	Number of Turbines		
Territory-Nest #	**2-mi.**	**5-mi**	**10-mi**
Corrizo Gorge - Nest1	0	0	79
Corrizo Gorge - Nest2	0	0	79
Corrizo Gorge - Nest3	0	0	77
Corrizo Gorge - Nest4	0	0	77
Coyote Mtns. W - Nest1	0	0	98
Coyote Mtns. W - Nest2	0	0	98
Coyote Mtns. W - Nest3	0	28	112
Coyote Mtns. W - Nest4	0	11	111
Coyote Mtns. W - Nest5	0	42	112
Coyote Mtns. W - Nest6	0	44	112
Coyote Mtns. W - Nest7	0	46	112
Coyote Mtns. W - Nest8	0	61	112
Coyote Mtns. W - Nest9	0	61	112
Coyote Mtns. E - Nest1	0	1	112
Coyote Mtns. E - Nest2	0	34	112
Table Mtn. - Nest1	0	0	90
Table Mtn. - Nest2	0	0	90
Table Mtn. - Nest3	0	0	90
Table Mtn. - Nest4	0	0	87
Table Mtn. - Nest5	0	0	87
Mountain Springs – No nest locations known	0	0	Similar to Table Mountain

Table 8. Calculations of maximum distances between nests of territories closest to one another near the Ocotillo Wind Energy Facility.

Territory	Nearest Territory	Maximum Distance
Coyote Springs West	Coyote Springs East	6.77 miles
Carizo Gorge	Table Mountain	4.16 miles
Mountain Springs	Table Mountain	3.02 miles
Table Mountain	Carizo Gorge	4.16 miles
Coyote Springs East	Coyote Springs West	6.77 miles
	Average	**4.97 miles**
	Buffer (1/2 average)	**2.49 miles**

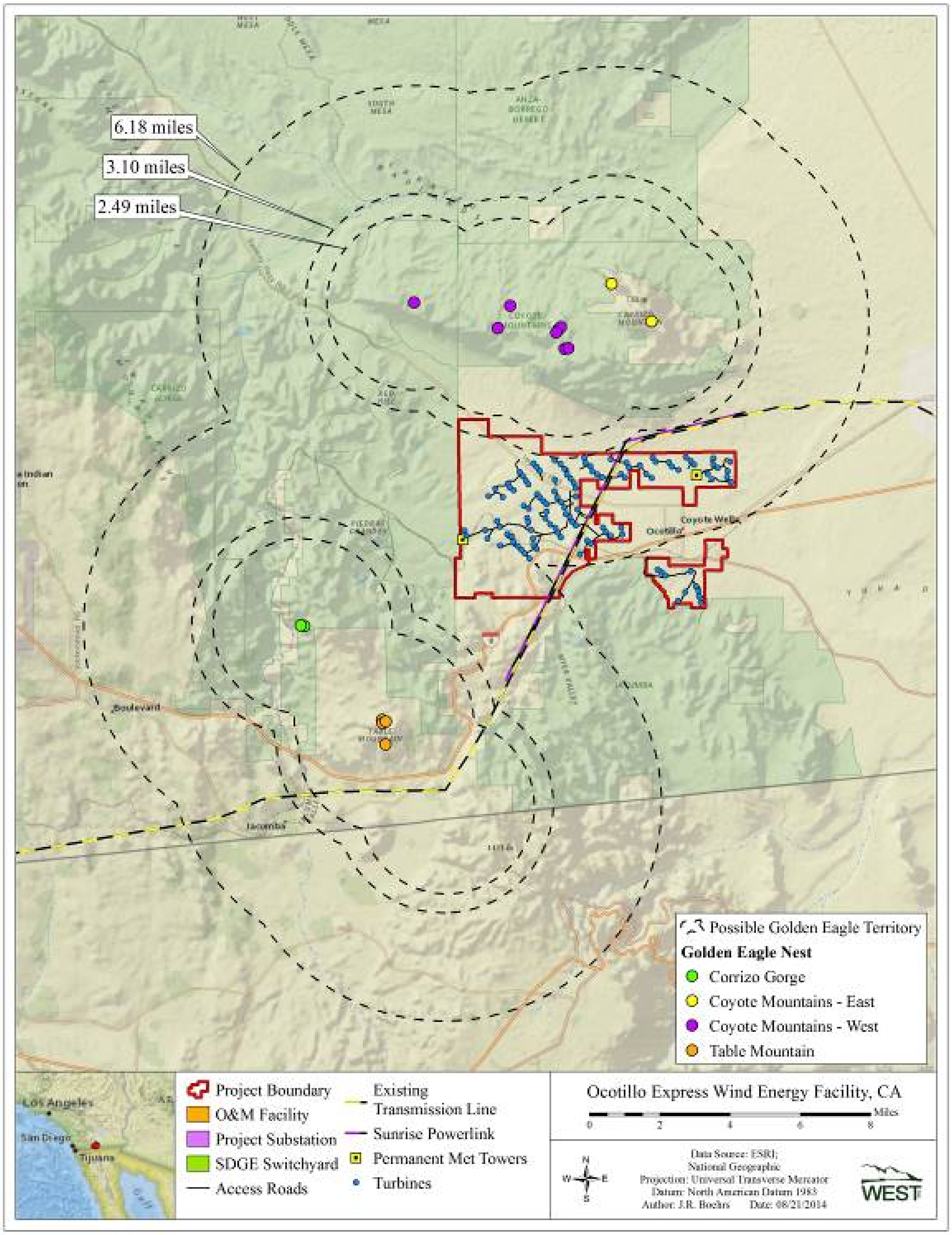


Figure 10. Nest buffers for the eagle territories within 10 miles of the Ocotillo Wind Energy Facility. A buffer distance of 2.49 miles was used based on average maximum distances between nests of territories closest to one another. A second buffer distance of 6.18 miles is also depicted and is based on ½ the maximum distance between active or potentially active nests within the two active territories. A third buffer distance of 3.1 miles, suggested in the 2011 Draft ECP Guidance, is also depicted here.

3.1.2 Concentration Areas (Communal roosts, foraging areas, migration corridors, and migration stopovers)

The golden eagle data collected prior to development of the Project suggested that golden eagles use the OWEF on a limited basis for foraging and during the migration season. The data suggested that there were no high golden eagle use areas or golden eagle concentration areas, including communal roosts or concentrated foraging areas, within the OWEF. The migration counts conducted suggested that the OWEF was not an important migration corridor or migration stopover for golden eagles. The results of post-construction monitoring efforts provide further support for the conclusions based on the pre-construction survey efforts (see Section 5.0 below).

3.1.3 Eagle Risk Factors

An assessment of the factors known or thought to be associated with increased probability of collisions between eagles and other raptors and wind turbines (from the 2013 ECP Guidance) for the OWEF is provided in Table 9 (located at the end of this section). The risk factors and the science behind the risk factors have been adopted from the 2013 USFWS ECP Guidance (USFWS 2013). In addition to abundance, the two main risk factors identified in the 2013 USFWS ECP Guidance are 1) the interaction of topographic features, season, and wind currents that create conditions for high-risk flight behavior near turbines; and 2) behavior that distracts eagles and presumably makes them less vigilant (e.g., active foraging or inter- and intra-specific interactions such as territorial defense).

TOPOGRAPHY AND WIND

The topography of the OWEF at a landscape scale is provided in Figure 3. The topography of the site is highest in the southwest corner and falls away towards the northeast. A rose diagram depicting the prominent wind direction at the OWEF is provided in Figure 11. The prominent wind direction at the OWEF is strongly oriented in a northeast direction. The orientation of the overall topography at a landscape scale and the prominent wind direction in relation to the OWEF suggest that the OWEF should be less risky to golden eagles since the OWEF is sited on the downwind side of the Jacumba Mountains and would be less likely to have conditions suitable for strong updrafts of wind.

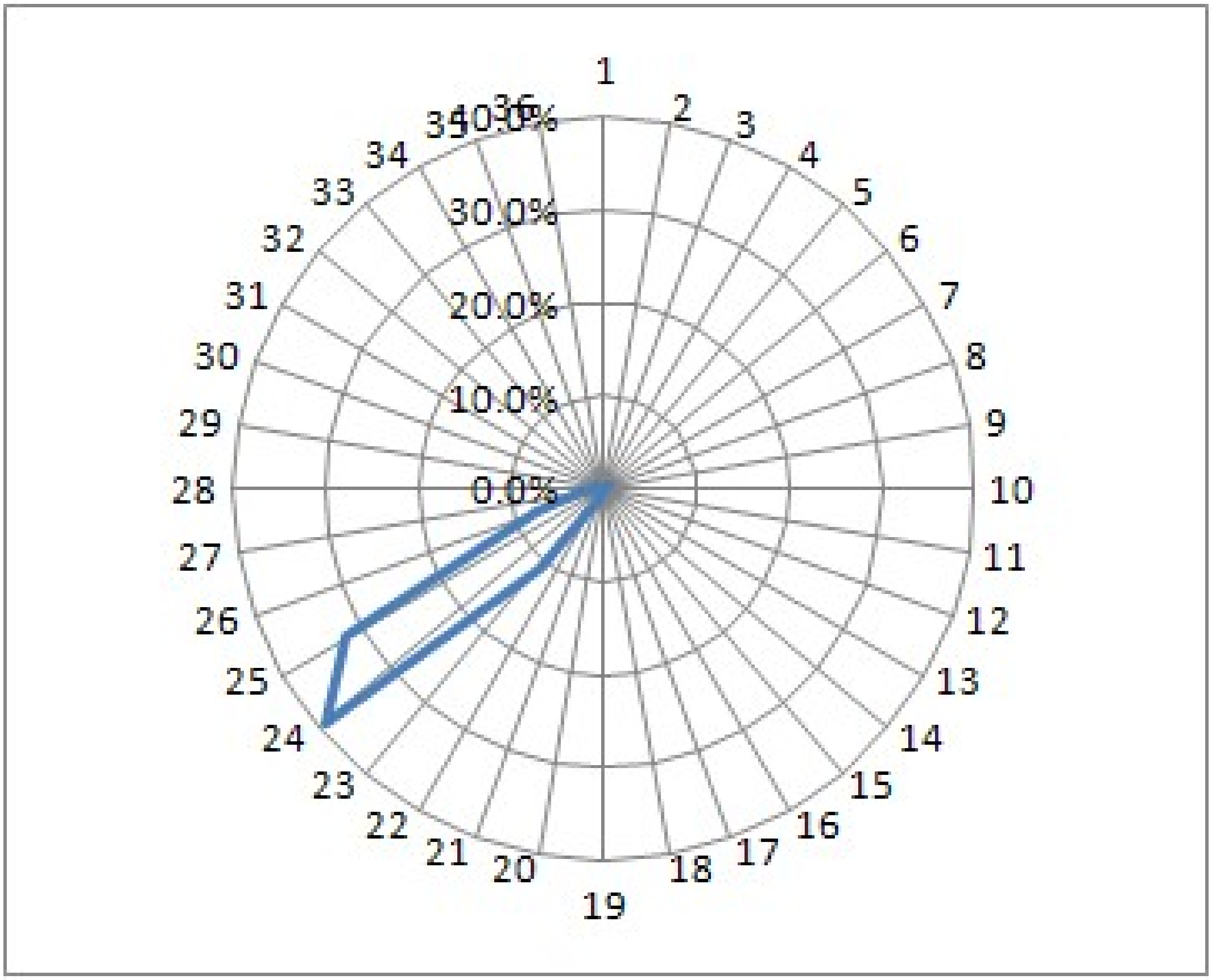


Figure 11. Rose diagram of prominent wind at the Ocotillo Wind Energy Facility.

The slope and aspect of individual turbines were reviewed and assessed on an individual turbine basis within the OWEF. Some research has suggested turbines in saddles or canyons or on the upwind side of ridges may potentially be of more risk to golden eagles. Figures 12 and 13 show the current layout relative to the slope and aspect within 0.25 miles (400 meters) of turbines. Based on limited scientific study, it is assumed turbines on steeper slopes, especially on upwind sides of ridges and turbines in saddles or low-lying areas may be more risky. Generally, none of the turbines are located in low-lying areas, steep slopes, saddles, or on upwind slopes (southwest and westerly aspects). Appendix B contains a list of turbines and the estimated slope, aspect, and elevation of the turbines. Only two turbines are estimated to occur on a slope greater than five percent (turbine 16 and turbine 29), and aspect is east (~73 degrees) and southeast (~155 degrees; respectively). Numerous turbine locations were eliminated from these types of areas or moved to avoid these areas. For example, no turbines were placed in the saddles/drainages between turbines 30 and 31, 19 and 43, 15 and 16, 72 and 73, 95 and 92. There are no turbines sited on southwesterly aspects, and very few turbines are sited on westerly or southern aspects. Based on the information provided above, turbines have been sited in areas that would not be considered high risk locations within the project.

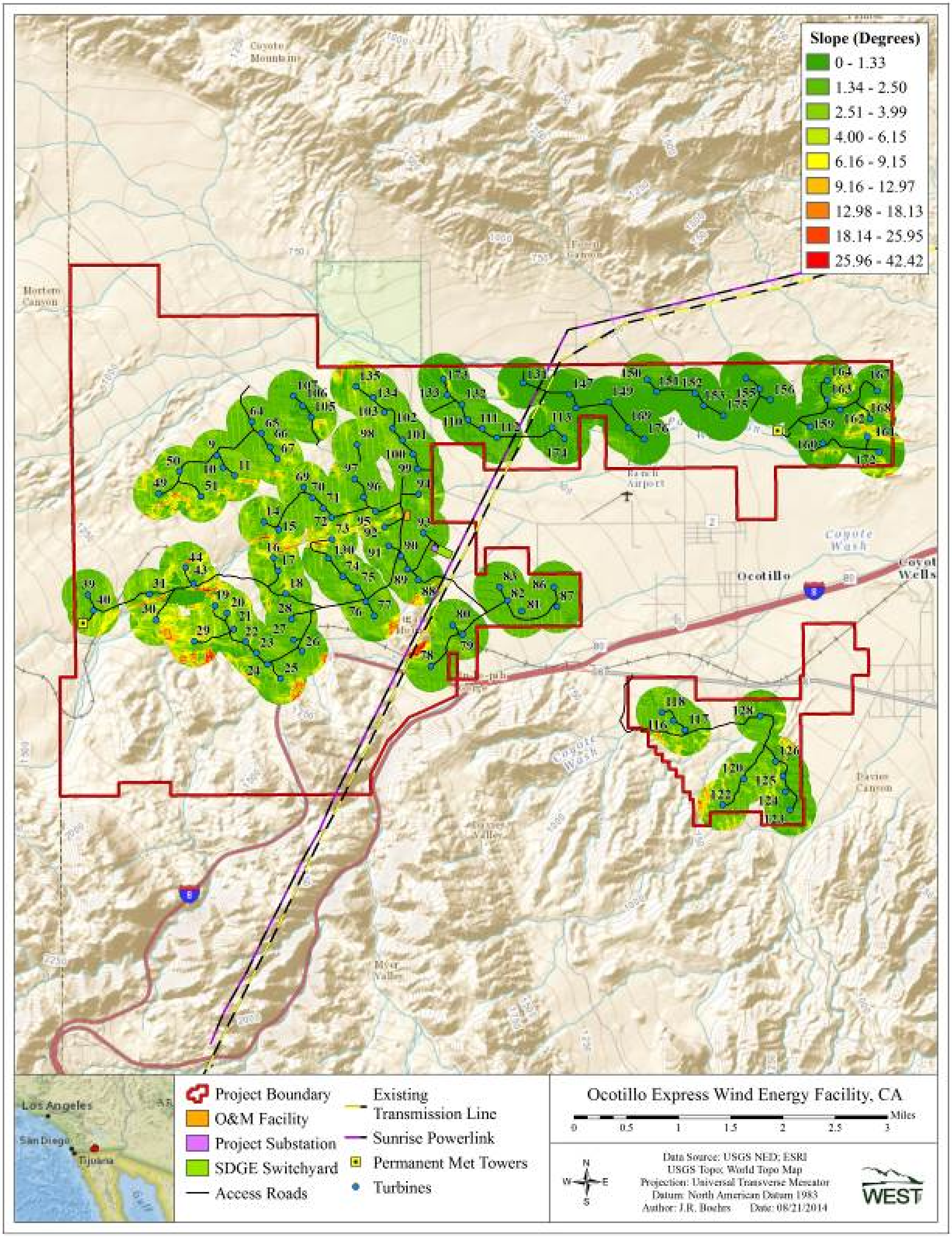


Figure 12. Slope calculations for areas within 0.25 miles (400 m) of turbines at the Ocotillo Wind Energy Facility.

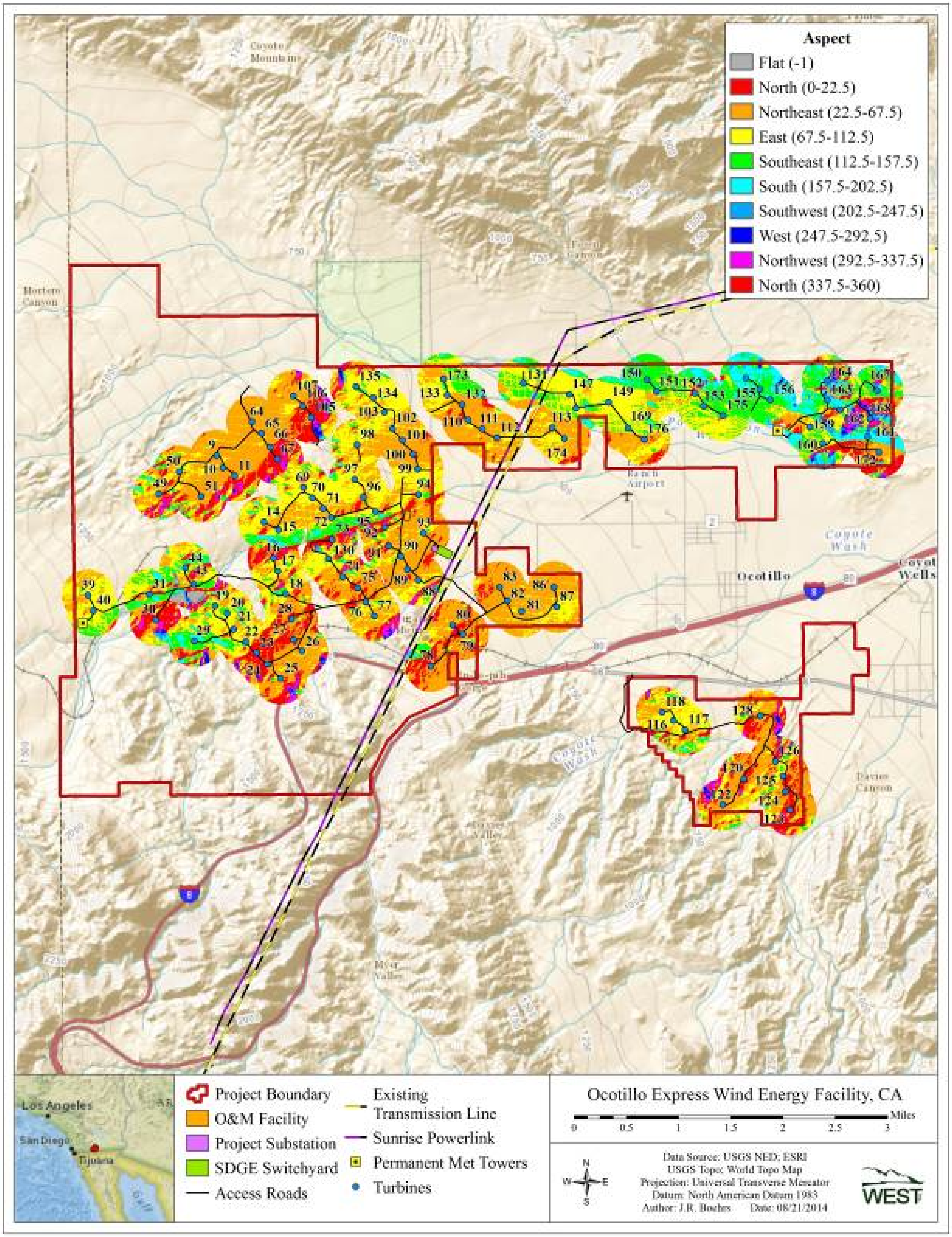


Figure 13. Aspect for areas within 0.25 miles (400 m) of turbines at the Ocotillo Wind Energy Facility.

The results of the landscape-scale assessment of topography and wind, as well as the individual turbine assessment suggest that topography and wind conditions at the OWEF are a low risk to golden eagles overall in relation to facility and individual turbine siting.

INTRA-SPECIFIC INTERACTIONS AND FORAGING BEHAVIOR

Assuming that intra-specific competition and territorial defense increases collision risk, the project area has some potential for having these behaviors occur on the project between the territories to the north of the project and south of the project. While we agree that this may be a plausible risk factor, we are not aware of any studies that have clearly demonstrated that intra-specific interactions increase risk to golden eagles.

As indicated above, the golden eagle data collected prior to development of the Project suggested that golden eagles may utilize the OWEF on a limited basis for foraging. The data suggested that there were no high golden eagle use areas or golden eagle concentration areas, including concentrated foraging areas, within the OWEF. The results of post-construction monitoring efforts provide further support for the conclusions based on the pre-construction survey efforts (see Section 5.0 below; Appendix C).

Table 9. Risk factors listed in the Draft Golden Eagle Conservation Plan Guidance and a discussion of these factors for this project.

Risk Factor	Scientific Evidence/Support	Citations	OWEF Situation	Qualitative Assessment
Bird Density	Mixed findings; likely some relationship but other factors have overriding influence across a range of species	Barrios and Rodriguez (2004), De Lucas et al. (2007), Hunt (2002), Smallwood et al. (2009), Ferrer et al. (2011)	Golden eagle use (abundance) of the OWEF was determined to be less than 0.02 eagle obs./hr based on preconstruction data and is approx. 0.002 eagle obs/hr based on the operational biological monitoring (see section 5.0 below)	Low
Bird Age	Mixed findings. Higher number of fatalities among sub-adult and adult golden eagles in one area. Higher fatalities among adult white-tailed eagles in another	Hunt (2002), Nygard et al. (2010)	Data collected to date suggest a fairly even mix of adults and sub-adult eagle with fewer juveniles observed at the OWEF.	Moderate
Proximity to Nests	White-tailed eagle nesting areas close to turbines have been observed to have low nest success and be abandoned over time.	Nygard et al (2010)	There are no turbines sited within 3 miles of a known/historic eagle nest. Further, known territories within 10 miles of the Project generally have not been consistently active, occupied, or productive for the last decade.	Low
Bird Residency Status	Mixed findings. Higher risk to resident adults in Egyptian vultures (*Neophron percnopterus*). Higher number of mortalities among sub-adults and floating adults in golden eagles in one other study	Barrios and Rodriguez (2004), Hunt (2002)	Data collected to date is insufficient to address this potential risk factor. However, the low use numbers in general suggest few floating birds around	Unknown
Season	Mixed findings. In some cases for some species, risk appears higher in seasons with greater propensity to use slope soaring (fewer thermals) or kiting flight (windy weather) while hunting.	Barrios and Rodriguez (2004), De Lucas et al. (2008), Hoover and Morrison (2005), Smallwood et al. (2009)	Golden eagles appear to be most abundant in the winter and fall due to slightly higher use based on site-specific data collection (both pre-construction and operational biomonitoring).	Abundance is higher in winter and fall relative to other seasons; however abundance is still low in all seasons
Flight Style	Species most at risk perform more frequent flights that can be described as kiting, hovering, and diving for prey.	Smallwood et al. (2009)	Some potential for these flight behaviors within the Project; however, observations during operational biomonitoring indicate eagles are rarely observed kiting, hovering, or diving for prey in the Project area.	Low
Interaction with Other	Higher risk when interactive behavior is occurring.	Smallwood et al. (2009)	Based on the average nearest-neighbor distance of all nests in the two territories identified as occupied in 2010, there is low	Low, needs further study to determine actual

Table 9. Risk factors listed in the Draft Golden Eagle Conservation Plan Guidance and a discussion of these factors for this project.

Risk Factor	Scientific Evidence/Support	Citations	OWEF Situation	Qualitative Assessment
Birds			potential for territorial defense to occur where turbines are sited.	influence to risk
Active Hunting/Prey Availability	High risk when hunting close to turbines, across a range of species	Barrios and Rodriguez (2004), De Lucas et al. (2008), Hoover and Morrison (2005), Hunt (2002), Smallwood et al. (2009)	Although no specific prey surveys were conducted, overall prey availability within the OWEF is considered low throughout the majority of the year due to the harsh arid conditions and the fact that prey availability is low throughout much of the desert. Exception would be a few months in the spring following the raining season. However, spring use of the site by eagles is very low based on site-specific data collection. No concentrated prey resources have been identified in the Project and only rarely has active hunting been observed in the vicinity of the Project during three years of operational biomonitoring	Low
Turbine Height	Mixed, contradictory findings across a range of species	Barclay et al. (2007), De Lucas et al. (2008)	25 of 36 eagle observations during pre-construction and 13 of 41 eagle observations during operational biomonitoring within RSH but overall numbers still very low	Moderate
Rotor Speed	Higher risk associated with higher blade-tip speed for golden eagles in one study, but this finding may not be generally applicable.	Chamberlain et al. (2006)	State of the art technology, low RPM's, more space between rotor sweeps, however tip speeds generally the same	Low
Rotor-swept Area	Meta-analysis found no effect, but variation among studies clouds interpretation.	Barclay et al. (2007),	25 of 36 eagle observations recorded during pre-construction and 13 of 41 eagle observations during operational biomonitoring within the RSH. However, larger rotors generally have more space and time between sweeps. More research is needed to understand this risk factor.	Unknown
Topography	Several studies show higher risk of collisions with turbines on ridge lines and on slopes. Also a higher risk in saddles that present low-energy ridge crossing points.	Barrios and Rodriguez (2004), De Lucas et al. (2008), Hoover and Morrison (2005), Smallwood and	Based on the prevailing wind direction in relation to topography including slope, aspect, and elevation.	Low

Table 9. Risk factors listed in the Draft Golden Eagle Conservation Plan Guidance and a discussion of these factors for this project.

Risk Factor	Scientific Evidence/Support	Citations	OWEF Situation	Qualitative Assessment
		Thelander (2004)		
Wind Speed	Mixed findings; probably locality dependent	Barrios and Rodriguez (2004), Hoover and Morrison (2005), Smallwood et al. (2009)	Based on the prevailing wind direction in relation to topography including slope, aspect, and elevation.	Low

3.2 Fatality Predictions

The models being used to predict eagle fatality rates at wind energy projects (e.g., USFWS Bayesian model) are based on the assumption that eagle use is positively correlated to fatality rates. In their analysis of avian fatalities at the Tehachapi Pass wind complex, Anderson et al. (2004) found a direct relationship between raptor use and raptor fatalities: areas with the most raptor use had more fatalities than areas with the least raptor use.

The first approach looks at the level of mortality observed at wind projects in the western U.S. in comparison to the level of golden eagle use measured during pre-construction surveys. The paired use and mortality studies included in this assessment were also included in a peer-reviewed publication that provides a collision risk prior distribution for modeling eagle mortality (Bay et al. 2016). Survey protocols were generally similar in that points were selected to provide a good viewshed, suggesting reasonable comparability. The following criteria were used to determine if pre-construction studies should be included in comparisons: 1) must have three of four seasons of data; 2) observations were standardized to 800 m; 3) used fixed-point survey methodology; and 4) all use values were standardized to 20 minutes. The following criteria were used to determine if post-construction studies should be included in comparisons: 1) appropriate bias trials (searcher efficiency and carcass removal) were used to determine fatality estimates; and 2) seasons in which species were expected to be present were surveyed (all four seasons surveyed), although the study may have small gaps in the summer.

Projects reported to have very low and low golden eagle use have not had reported golden eagle fatalities, whereas sites with relatively high golden eagle use have reported golden eagle fatalities (Figure 14). Although this data does not include information from all projects that have documented eagle fatalities (see Pagel et al. 2013), as survey data may not be publicly available or comparable, it does provide support for the common sense premise that eagle use is positively correlated to eagle risk. It is not intended to suggest that facilities with low eagle use estimates will not incur an eagle take over the life of the project, but rather low-use facilities are likely to incur low levels of take (if any occurs) relative to high-use facilities.

As previously described, Table 6 summarizes all the observations during the large effort that occurred during the 2009, 2010, and 2011 surveys. These observations result in a golden eagle use estimate of 0.01 golden eagles per observation hour. Overall mean golden eagle use at the OWEF, adjusted for 20-min surveys in 2009, 2010, and 2011 is low compared with other wind-energy facilities that implemented similar protocols (Figure 14).

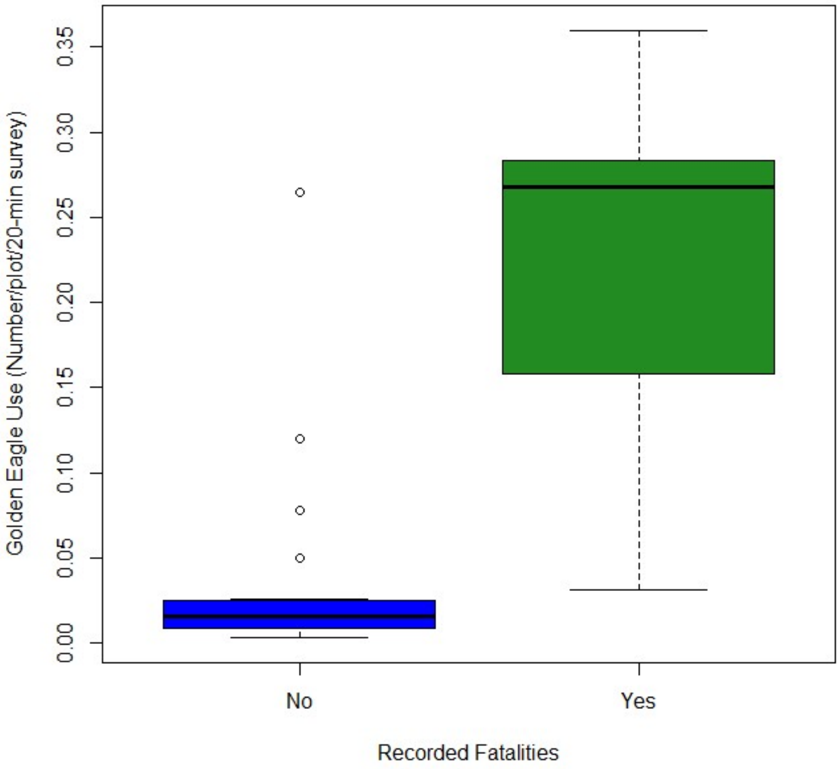


Figure 14. Average pre-construction golden eagle use values for facilities with and without observed golden eagle fatalities.

Data from the following sources:

Wind Energy Facility	Use Estimate	Fatality Estimate
Alta I, CA	Erickson and Chatfield 2009	A. Chatfield, WEST, Inc., unpubl. data
Alta II – V, CA	Erickson and Chatfield 2009	A. Chatfield, WEST, Inc., unpubl. data
Campbell Hill, WY	Taylor et al. 2008	K. Taylor, WEST, Inc. unpubl. Data
Combine Hills, WA	Young et al. 2003c	Young et al. 2006
Diablo Winds, CA	WEST 2006	WEST 2006, 2008
Dry Lake, AZ	Young et al. 2007	Thompson and Bay 2012
Elkhorn, OR	WEST 2005	Jeffery et al. 2009, Enk et al. 2011
Foot Creek Rim Phase I, WY	Johnson et al. 2000	Young et al. 2003b
Foot Creek Rim Phases II and III, WY	Johnson et al. 2000	Young et al. 2003d
High Winds, CA	P. Kerlinger, Curry and Kerlinger, LLC, unpubl. Data	Kerlinger et al. 2006a
Hopkins Ridge, WA	Young et al. 2003	Young et al. 2007
Kittitas Valley, WA	Erickson et al. 2003c	Stantec Consulting Services, Incorp unpubl. data
Klondike, OR	Johnson et al. 2002	Johnson et al. 2003
Leaning Juniper, OR	Kronner et al. 2005	Kronner et al. 2007; Gritski et al. 2008
Nine Canyon, WA	Erickson et al. 2001	Erickson et al. 2003
Shiloh I, CA	Kerlinger et al. 2006b	Kerlinger et al. 2009
Shiloh II, CA	Kerlinger et al. 2006b	Kerlinger et al. 2010
Stateline, OR/WA	Erickson et al. 2002	Erickson et al. 2004b
Tuolumne, WA	G. Johnson, WEST, Inc. unpubl. Data	T. Enz and K. Bay, WEST, Inc., unpubl. data
Vansycle, OR	Erickson et al. 2002	Erickson et al. 2000
Vantage, WA	Jeffrey et al. 2007	Ventus Environmental Solutions, unpubl. data
Vasco, CA	Brown et al. 2013	Brown et al. 2013
Wessington Springs, SD	C. Derby, WEST, Inc., unpubl. Data	C, Derby, WEST, Inc. unpubl. Data
White Creek, WA	G.D. Johnson, WEST, Inc.	S. Downes and R. Gritski, NWC, Incorporated,

	Unpub. Data	unpubl. Data
Wild Horse, WA	Erickson et al. 2003b	Erickson et al. 2008
Windy Flats, WA	Johnson et al. 2007	T. Enz, unpubl. Data

The information in Figure 14 suggests that we would expect low golden eagle mortality in any given year at the OWEF. A conservative prediction would be an average of less than one eagle fatality per year, assuming the level of use observed during the pre-construction studies continued. The likelihood of mortality in a given year might be influenced by whether the territories near the project are occupied and are successful. Based on the recent past, these territories are often unoccupied and production has been very low. As of June 2017, there have been no eagle fatalities identified at the OWEF to date (which is approx. 4 ½ years since the first turbine was spinning and approx. 3 ½ years since the entire 112 turbine Project became fully operational) suggesting that the eagle fatality rate will be low (i.e., considerably less than one per year) over the longer term.

In the second approach, data collected during avian point count surveys and migration surveys at the OWEF were used with the current USFWS Bayesian Collision Risk Model (USFWS 2013) to calculate golden eagle fatality estimates. Collision risk modeling estimates the number of annual eagle fatalities that are expected at a proposed wind-energy facility from eagle use minutes recorded during on-site eagle use surveys. Assuming that eagle mortality is proportional to pre-construction eagle activity, a Bayesian correction factor has been established by the USFWS based on pre- and post-construction golden eagle surveys conducted at four wind energy facilities, as reported in Whitfield 2009. Bayesian analyses incorporate a prior belief (or best guess estimate) regarding model parameters as supporting evidence in determining a posterior distribution of eagle exposure and mortality. In order to obtain an estimate of eagle fatalities at the OWEF using the USFWS methodology, the following information was used: 1) an estimate of the number of golden eagle flight minutes recorded within 800 m from observers based on an analysis conducted by USFWS; 2) an estimate of annual daylight hours at the OWEF; 3) the quantity of turbines and rotor radius of the turbines at the OWEF; and 4) the prior Bayesian collision correction factor as recommended by the USFWS (USFWS 2013). Tables 10 through 12 contain parameters used to calculate models of collision risk based on turbine specifications provided by OE LLC for the turbine types in operation at the OWEF.

In total, 3,271.1 hours of pre-construction avian use and raptor migration surveys were completed at the OWEF (see Section 2.0 above; Table 10 below). No eagle flight minutes were recorded during these surveys; therefore, a USFWS estimate of golden eagle flight minutes based on the duration of pre-construction eagle observations and length of mapped flight paths was used for modeling. The USFWS estimate of eagle flight minutes was 47 minutes (see Appendix D).

Exposure Rate Calculations

Exposure rate (λ), as defined by the USFWS (2013), is the expected number of flight minutes below 200 m per daylight hour across the surveyed area (km^2). Based on the USFWS analysis, 47 golden eagle flight minutes are assumed for modeling (Table 10). A $Gamma(\alpha = 0.97, \beta = 2.76)$ prior distribution with mean (0.35) and standard deviation (0.357) is recommended by the USFWS. A posterior distribution of golden eagle use at the OWEF was estimated as a $Gamma$ distribution with the α parameter equal to the sum of the prior α and total flight minutes below 200 m, and the β parameter equal to the sum of the prior β and effort (hours of surveys x km^2 of area surveyed), respectively:

$$Posterior\ \lambda \sim$$
$$Gamma\left[\alpha + (U_{GE})(n_{surveys})(flight\ minutes), \beta + (survey\ length\ in\ hrs) \cdot (n_{surveys}) \cdot 2.01\right]$$

For all the golden eagle observations combined, this resulted in a posterior distribution for exposure rate of *Gamma* (47.97, 6,579.697) with mean 0.007 eagle flight minutes observed per hour of survey per square km for the baseline data (Table 10).

Table 10. Values used to calculate exposure rate (λ).

Variable	Value
1) Estimated Flight Minutes	47
2) Length of Surveys	Combination
3) Survey Hours	3,271.10
4) Survey Radius (meters)	800
5) Eagle Flight Minutes (alpha: Line 1 + 0.97)	47.97
6) Effort (Beta; survey hours x sq km of area surveyed)	6,579.697
7) Mean Exposure Rate (Line 5 / Line 6)	0.007

Expansion Factor

A facility-specific expansion factor is multiplied by the eagle exposure rate $\left(\frac{\text{eagle}\cdot\text{flight minutes}}{\text{hour}\cdot\text{km}^2}\right)$ to estimate the potential annual eagle-wind turbine interactions (minutes of flight within the turbine hazardous area). The expansion factor scales the exposure rate to annual daylight hours (τ) across the total hazardous areas (δ_i) surrounding all existing turbines (n_t; USFWS 2013):

$$\varepsilon = \tau \sum_{i=1}^{n_t} \delta_i$$

The USFWS defined the turbine hazardous area (δ_i) as the rotor-swept area around each turbine or proposed turbine location (km^2; USFWS 2012). The expansion factor (ε) was calculated for the combined pre-construction raptor migration surveys and avian point count surveys for the 112 turbines in operation at the OWEF (Table 11).

Table 11. Values used to calculate expansion factor (ε).

Variable	Value
8) Estimated Daylight Hours	4,445.74
9) Rotor Radius (meters)	54
10) Turbine Hazardous Area (pi * radius of turbine in km^2)	0.009
11) Number of Turbines	112
12) Expansion Factor (Line 8 x Line 10 x Line 11)	4561.416

Collision Correction Factor

The collision correction factor (collision probability; C) was defined as the probability of an eagle colliding with a turbine given each minute of eagle flight in the turbine hazardous area. The prior distribution for collision probability was developed by the USFWS using the four previous fatality studies (Foote Creek Rim, WY; San Gorgonio, CA; Tehachapi, CA; and Altamont, CA) reported in Whitfield (2009). A mean of the estimated golden eagle flight minutes within the turbine hazardous area to recorded golden eagle collision events at those facilities was used to determine a *Beta* (2.31, 396.69) prior distribution for collision probability with mean and standard deviation of 0.0058 and 0.0038 eagle fatalities per minute of flight in the turbine hazardous area, respectively (Table 12). WEST has also applied the model using an updated collision correction factor developed from pre- and post-construction studies at 24 modern facilities (Bay et al. 2016). The updated collision prior is *Beta* (9.28, 3,224.51) or collision probability with mean of 0.00287 eagle fatalities per minute of flight in the turbine hazardous area (Table 12). At this time, the estimates do not incorporate site specific information regarding collision probability. A posterior, site specific, estimate of collision probability might be estimated based on the post-construction monitoring that has been conducted for the Project; however, the biological monitoring program and curtailment of turbines when eagles are at risk of collisions (see Section 5.0 below) complicates the ability to update the collision probability for the OWEF.

Table 12. Values used to calculate collision correction factor (*C*)

Variable	USFWS	Bay et al. 2016
13) Prior Fatalities	2.31	9.28
14) Prior Exposure Events Not Resulting in Fatality	396.69	3,224.51
15) Prior Mean Collision Correction Factor (Line 13/(Line 13 + Line 14))	0.0058	0.00287

Estimation of Take

The USFWS Bayesian collision risk model (USFWS 2013) assumes that higher site-specific eagle flight activity corresponds to higher annual eagle mortality once the wind energy facility is operational. Under this assumption, predictions of annual eagle mortality (F) were modeled as the pre-construction measure of eagle exposure (λ) within areas of potential eagle-wind turbine interactions (ε) multiplied by a collision correction factor (C):

$$F = \varepsilon\lambda C$$

Credible intervals (i.e., a Bayesian confidence interval) were calculated using a simulation of 10,000 Monte Carlo draws from the posterior distribution of eagle exposure (λ) and the collision probability distribution $(C;$ Manly 1991). The product of each of these draws with the exposure area was used to estimate the distribution of possible fatalities at the OWEF. The upper 80th percentile of this distribution is recommended by the USWFS as a conservative estimate of take for the project of interest (USFWS 2013).

Predicted eagle mortalities per year using the USFWS Bayesian Collision prior are 0.19 golden eagle/year (point estimate) and 0.28 golden eagle/year (upper 80th credible interval; Table 13). The predicted number of eagle mortalities per year using the Bay et al. 2016 collision prior is 0.095 (upper 80th = 0.12; Table 13). To date, there have been no golden eagle carcasses identified at the OWEF.

Table 13. Predicted eagle fatalities per survey effort and within rotor swept height only (F)

	Predicted Estimate	
Variable	**USFWS**	**Bay et. al 2016**
Estimated Annual Eagle Fatalities (Line 8 x Line 13 x Line 16)	0.19	0.095
Upper 80th Percentile	0.28	0.12

The upper 80th percentile calculations would result in an estimate of 1.4 golden eagle fatalities in five years based on the original USFWS prior collision probability distribution and an estimate of 0.6 golden eagle fatalities in five years based on the Bay et al. 2016 prior collision probability distribution.

The methods used for estimating eagle fatalities suggest a low level of eagle fatality (if any) at the OWEF. The Bayesian modeling approach suggests up to 1.4 golden eagles in five years using the original USFWS prior collision probability distribution. The models are predicated on several assumptions, including eagle use continuing to be low as measured during the two years of pre-construction work (the results of post-construction monitoring efforts conducted to date further support the low level of eagle use observed pre-construction; see Section 5.0 below). A conservative approach might be to assume an average of two eagles taken per five year period. If nesting/territory occupancy and production were much higher than observed during the past 10 years in this region, then actual mortality of eagles may be higher.

3.3 Cumulative Impacts

3.3.1 Population Status and Local Area Population Thresholds

The project lies within the Sonoran and Mojave Desert Bird Conservation Region (BCR). According to the 2013 USFWS ECP Guidance, golden eagle density estimates within the Sonoran and Mojave Desert BCR are 0.0063 golden eagles per mi^2 with an estimated population size of 600 golden eagles within the Sonoran and Mojave Desert BCR (USFWS 2013).

The USFWS has previously identified annual take levels of 5% of annual production to be sustainable for a range of healthy raptor populations, and annual take levels of 1% of annual production as a relatively benign harvest rate over at least short intervals, when population status was uncertain (Millsap and Allen 2006; USFWS 2013). This was the approach used to establish take thresholds at the eagle management unit scale (BCR level for golden eagles and Bald Eagle Management Units for bald eagles; USFWS

2009). However, in 2009, the USFWS determined that golden eagle populations might not be able to sustain any additional unmitigated mortality, and as a result, set the thresholds for golden eagles to zero at the eagle management unit (BCR) scale. Given a threshold of zero at the eagle management unit scale, USFWS have determined that any new authorized take of golden eagles must be offset by compensatory mitigation.

The USFWS has identified take rates of between 1% and 5% of the estimated total eagle population size at the local-area population scale (140-mile buffer surrounding the Project for golden eagles) as benchmarks; with 5% being at the upper end of what might be appropriate under the BGEPA preservation standard, whether offset by compensatory mitigation or not (USFWS 2013). The 2013 USFWS ECP Guidance (USFWS 2013) recommends calculating the local-area 5% benchmark as follows:

(Local-area * Regional Eagle Density) * 0.05.

A 140-mile buffer surrounding the Project encompasses the following areas within two BCR's in the United States: Coastal California (14,181.46 mi^2) and Sonoran and Mojave Desert (32,739.44 mi^2). According to the USFWS ECP Guidance, regional density estimates for resident golden eagles are (0.0150 $eagles/mi^2$) in the Coastal California BCR and (0.0063 $eagles/mi^2$) in the Sonoran and Mojave Desert BCR. Using the equation above, the Project's estimated local area population size (including only those areas within the United States) is approximately 419 golden eagles. Based on this analysis, the local-area 5% benchmark would be 21 golden eagles annually. Assuming a mortality rate of 0.28 golden eagles per year, this amount of mortality comprises less than 0.1% of the total estimated local area population and less than 2.0% of the local-area 5% benchmark for golden eagle mortality.

3.3.2 Assessment of Cumulative Impacts Due to Other Projects

As described in the Environmental Impact Report (EIR)/EIS for the OWEF, a cumulative impacts assessment was conducted for a geographic area extending throughout western Imperial County and southeastern San Diego County. The assessment assumed that all projects would be built and operating during the operating lifetime of the OWEF. Fourteen current projects or projects considered reasonably foreseeable, including other proposed or approved renewable energy projects, various BLM authorized actions/activities, proposed or approved projects within the counties jurisdictions, and other actions/activities that lead agencies consider reasonably foreseeable were including in the assessment. For golden eagles, the cumulative impact assessment included a 10-mile buffer surrounding the OWEF.

Direct and indirect impacts to golden eagle associated with the OWEF combined with impacts associated with past, present, and future projects are considered a cumulative impact to golden eagle because the impacts have a potential to reduce the extent and population size of golden eagle in the cumulative impacts analysis area and because compensation for those impacts may not be achievable. Although some of the current and reasonably foreseeable projects would result in impacts to golden eagle nest sites, the OWEF would not impact golden eagle nest sites and, therefore, the OWEF would not contribute to cumulative impacts to such nest sites.

Impacts to golden eagle foraging habitat associated with the OWEF combined with losses associated with past, present, and future projects are considered a cumulative impact to golden eagle because the impacts have a potential to limit the extent of the species within the cumulative impacts analysis area. The magnitude of the cumulative impact to golden eagle foraging habitat is small given that there is over 250,000 acres of suitable foraging habitat within the cumulative impacts analysis area. The OWEF's permanent impacts to 122.1 acres of habitat amounts to less than 0.1 percent of the available foraging habitat for the species within the cumulative impacts analysis area. The OWEF and the other projects could be required to mitigate impacts to golden eagle foraging habitat. Implementation of mitigation measures (if warranted as identified in this ECP and the EIR/EIS) would reduce the OWEF's contribution to this cumulative impact.

Resident and migratory golden eagles are at risk of collision with project features associated with the OWEF and past, current, and reasonably foreseeable projects in the cumulative analysis area. These features include such structures as wind turbines, meteorological towers, and overhead transmission lines. Impacts to golden eagle associated with the OWEF combined with losses associated with past, present, and future projects are considered a cumulative impact to golden eagles because the impacts have potential to limit the population of golden eagles within the cumulative impacts analysis area. The OWEF and the other projects could be required to minimize potential collision risk by implementing mitigation measures. For the OWEF, the development and implementation of this ECP as well as other mitigation measures identified in the EIR/EIS would reduce the OWEF's contribution to this cumulative impact.

Overhead transmission lines associated with the OWEF and many of the other current and reasonably foreseeable projects also pose an electrocution risk for golden eagles (APLIC 2006). Impacts to golden eagles associated with the OWEF combined with losses of individual birds from electrocution associated with past, present, and future projects are considered a cumulative impact to these species because the impacts have the potential to limit populations of the species within the cumulative impacts analysis area. For the OWEF, potential impacts associated with electrocution would be minimized through the development and implementation of this ECP, the OWEF ABPP, and designing transmission towers and lines to conform with APLIC standards. The other current and reasonably foreseeable projects would be required to implement similar mitigation to reduce potential electrocution impacts. Implementation of the OWEF's mitigation measures would reduce the OWEF's contribution to this cumulative impact.

Given the low level of eagle mortality anticipated at the OWEF, the avoidance and minimization measures, compensatory mitigation, and the adaptive management strategy being implemented to ensure any unforeseen impacts are addressed, we anticipate that the project will result in no net loss of golden eagles within a regional population level.

3.4 Categorizing Site according to Risk

Based on a "weight of evidence" approach using the 2013 USFWS ECP Guidance, the site specific data collected to date and the risk assessments, it appears that the OWEF may meet a Category 3 designation or a very low risk Category 2 designation.

4.0 AVOIDANCE AND MINIMIZATION OF RISK USING CONSERVATION MEASURES AND COMPENSATORY MITIGATION (STAGE 4)

The site-specific golden eagle data collected for the OWEF suggests the site might receive a Category 3 designation or at least a very low risk Category 2 designation according to the 2013 USFWS ECP Guidance. However, OE LLC is currently implementing a variety of Conservation Measures and Advanced Conservation Practices (ACPs) to reduce the risk to golden eagles from the project. Given the 2013 USFWS ECP Guidance, and the current understanding of golden eagle risk at the OWEF, OE LLC would like to revisit the experimental ACPs that are being implemented at the Project (see Section 6.0 Adaptive Management below). The following Conservation Measures and ACPs have been or are being implemented at the OWEF during the pre-construction, construction, and operation phase of the project.

4.1 Conservation Measures Pre-Construction

OE LLC collected available site-specific information on golden eagle use to guide project siting to avoid and minimize impacts to golden eagles. The golden eagle data collected to date did not provide strong evidence for modifying any of the preliminary turbine locations to avoid/minimize potential impacts to golden eagles. Other conservation measures implemented during the pre-construction phase of the OWEF include:

- The area and intensity of disturbances was minimized during pre-construction monitoring and testing activities.
- Existing roads and transmission corridors were used to the extent possible while developing site plans.
- Structures are not sited near any high avian use areas or high use flight zones.
- The Avian Power Line Interaction Committee (APLIC) guidance on power line siting (APLIC 1994) was followed while planning.
- Site plans minimized the extent of the road network needed for the OWEF.
- No lattice or structures that are attractive to birds for perching were included in the OWEF facility designs other than two SDG&E replacement structures needed to accommodate the switchyard.
- No guy wires were included on permanent MET towers.
- Lighting plans for the facility were minimized while still meeting requirements.
- All security lighting is motion or heat activated, instead of being left on throughout the night.
- All security lighting is down-shield and related to infrastructure lights.
- The facility was not sited in any areas containing high concentrations of ponds, streams, or wetlands.

4.2 Conservation Measures during Construction

The following conservation measures were implemented at the OWEF during construction:

- The area and intensity of disturbance was minimized to the extent possible during construction.
- Existing roads were used for access during construction to the extent possible.
- Non-operational MET towers were dismantled during construction.
- Powerlines were buried to the extent possible to reduce avian collision and electrocution.
- The Avian Power Line Interaction Committee (APLIC) guidance on power line construction (APLIC 2006) was followed.
- A transportation plan was implemented during construction that included road design, locations and speed limits to minimize habitat fragmentation and wildlife collisions, and minimize noise effects. This helped to minimize carrion availability for golden eagles.
- A minimum of a two mile spatial and seasonal buffer was implemented from turbines to protect all currently known nest sites and/or known roost sites during construction, such as maintaining a buffer between activities and nests/communal roost sites and keeping natural areas between the project footprint and the nest site or communal roost by avoiding disturbance to natural landscapes.

4.3 Conservation Measures during Operation

OE LLC has been implementing an intensive operational golden eagle monitoring and research program for the OWEF. A detailed protocol was developed for the golden eagle monitoring and research program that identified specific hypothesis to be tested through the program. The golden eagle monitoring and research program included implementation of a full time golden eagle biological monitor to observe any golden eagles flying within the OWEF and to curtail turbines when eagles are at risk of collision. Observations have been conducted from a biological monitoring tower that is centrally located at the facility. OE LLC has staffed biologists on site during the day year-round to monitor the movements of eagles and other wildlife through the site with a current commitment extending for the first ten years of operations; however in light of the December 2013 eagle permit rule change, the 2013 USFWS ECP Guidance, and our current understanding of risk to eagles at the site, OE LLC would like to revisit the need to implement this costly experimental ACP at the OWEF. It is still the goal of OE LLC to implement a monitoring system and an adaptive management program that can respond to any unforeseen impacts to eagles and results in no net loss of golden eagles from the OWEF over the life of its operations. While OE LLC does not believe there is a reasonable scientific basis to implement the existing experimental ACP at the OWEF, OE LLC believes that we can and should learn from the program that has been implemented at the facility. Results of the intensive operational golden eagle monitoring and research program that has been implemented at OWEF are provided in Section 5.0 below (results of post-construction monitoring efforts). These experimental ACPs and this research are likely not feasible or practical at all facilities, but there are opportunities to learn and evaluate the effectiveness of the monitoring program in reducing mortality.

In addition to the intensive monitoring and research program, the following conservation measures are being implemented during operation of the OWEF:

- Management activities such as seeding forbs or maintaining rock piles that attract potential prey are avoided.
- Parts and equipment which may be used as cover by prey are not stored in the vicinity of wind turbines.
- Under the appropriate permit/authorizations, any carcasses (with the exception of carcasses being used for post-construction bias trials) found within the OWEF are removed immediately.
- Low level speed limits (< 25 mph) are maintained on all roads within the OWEF.
- Personnel are trained to be alert for wildlife at all times, especially during low visibility conditions.
- Personnel, contractors, and visitors are instructed to avoid disturbing wildlife, especially during the breeding seasons and seasonal periods of stress.
- Fire hazards are reduced from vehicles and human activities (e.g., use spark arrestors on power equipment, avoid driving vehicles off roads, and allow smoking in designated areas only).
- Federal and state measures for handling toxic substances are followed.
- Effects to wetlands and water resources are minimized by following provisions of the Clean Water Act (1972).

4.4 Re-evaluation of Risk Considering ACPs

Given the current understanding of risk to eagles at the OWEF along with the 2013 ECP Guidance, OE LLC believes the site may qualify for a Category 3 designation (or at a minimum a very low risk Category 2 designation) without the need for the implementation of the intensive monitoring and research program but, rather an adaptive management strategy (see Section 6.0 below) to address any unforeseen impacts, ensuring no net loss to eagles.

4.5 Compensatory Mitigation

Compensatory mitigation occurs in the eagle permitting process if the conservation measures and ACP's do not remove the potential for take, and the projected take exceeds calculated thresholds for the species-specific eagle management unit in which the project is located. For new wind development projects, if compensatory mitigation is necessary, the compensatory mitigation action (or a verifiable, legal commitment to such mitigation) will be required up front before project operations commence because projects must meet the statutory and regulatory eagle preservation standard before the USFWS may issue a permit (USFWS 2013).

OE LLC will develop a compensatory mitigation plan in communication with the USFWS to offset predicted eagle take as determined through eagle fatality modeling for the Project. Following the resource equivalency analysis (REA) example in the USFWS ECP Guidance (2013), OE LLC has calculated the number of power-pole retrofits needed to offset the anticipated level of golden eagle take at the Project given the results of the modeling efforts. To be conservative, OE LLC is assuming two eagles taken in a five year period. The following assumptions were included in the analyses: 1) the power pole retrofits would occur prior to taking golden eagles; 2) Project life is 30 years; and 3) life of the retrofits is 30 years and/or the retrofits will be maintained for 30 years. Under these assumptions, the REA analysis indicates that 26 poles will need to be retrofitted upfront to offset two eagles during the first five years of operations.

If observed take is less than mitigated take after a five-year review period, the excess take will be credited to the OWEF. If take is higher, increased mitigation will be required. In either case, compensatory mitigation for the subsequent five-year period would be re-evaluated based on actual results as compared with permitted levels of take.

Based upon communication with the USFWS, OE LLC will also consider other options for compensatory mitigation to offset eagle take, as appropriate. Other options for compensatory mitigation might include a lead abatement program, a carcass removal program along highways, or funding mitigation banking efforts. However, a resource equivalency analysis would first need to be developed for any alternative compensatory mitigation options, to demonstrate that the amount of anticipated eagle take from the Project would be fully offset by the alternative mitigation measures. USFWS would not accept any alternative compensatory mitigation options until a credible analysis was completed and accepted.

5.0 POST-CONSTRUCTION MONITORING (STAGE 5)

A post-construction monitoring program is being implemented at the OWEF. The post construction monitoring described in this ECP is for the OWEF only and does not apply to the SDG&E switchyard. SDG&E constructed and operates the switchyard independently from OE LLC. The observations made during post-construction monitoring have been and will be reported to USFWS, which may respond with appropriate management decisions depending on the results of the monitoring program. Notwithstanding the foregoing, the parties acknowledge that fatality reduction or other measures may be required pursuant to applicable law, inc1uding but not limited to the federal Endangered Species Act (1973), Bald and Golden Eagle Protection. Act (1940), Migratory Bird Treaty Act (1918) or the California Endangered Species Act (California Fish and Game Code, §§ 2050, *et seqJ*).

Since post-construction monitoring methods are constantly improving as researchers develop new and more accurate methods of survey, the USFWS and OE LLC should consider recommendations to adopt new survey techniques and protocols as they become available. Post-construction monitoring includes collecting field data on behavior, utilization, and distribution patterns of affected avian and bat species, in addition to fatalities. The final post-construction monitoring protocol was developed and approved in consultation with the USFWS prior to implementation. Results of the post-construction monitoring efforts conducted to date can be found in Appendix C.

5.1 Biological Monitoring

Since December of 2012, OE LLC staffed biologist(s) on site to monitor eagle and other wildlife activity in real time anytime turbines were in operation during the day year-round throughout the site. A protocol was developed to guide the implementation of the biological tower monitoring efforts. The methods were developed to facilitate the biological monitor(s) in processing targets and actions to be taken; however, it was anticipated that the methods might be refined over time to maximize the effectiveness of the process. Essentially, the biological monitors utilized the tools available to detect eagles over the entire OWEF and surrounding vicinity. In the event that an eagle or a possible eagle was detected, turbines were curtailed when that eagle or possible eagle was determined to be at risk (within a ½ mile buffer of a turbine). While the primary duty of the biological monitor was to utilize all available tools to reduce the likelihood of golden eagle mortality at the OWEF, as time warranted, the bio-monitor(s) also collected information on any large bird target detected. Data collected included the following: date, start and end time of observation period, species or best possible identification, number of individuals, sex and age class, estimated distance, mapping of flight paths or perch locations, behavior, habitat, flight direction, height, and weather information (e.g. temperature, wind speed, wind direction, cloud cover).

No golden eagle carcasses have been identified within the OWEF between commencement of operation and the date of this ECP. From early December of 2012 through June 30, 2017, the biological monitors have spent approximately 19,687 hours conducting observations from the biological monitoring tower during daylight hours (i.e. 19,687 hours of survey effort). Through June 30, 2017, a total of 41 golden eagle observations including 48 individuals (approximately 0.002 golden eagles/hour irrespective of distance from the tower) were recorded (Table 14; Figure 15). Of these 35 golden eagle observations, turbines were shut-down 16 times for a total of 8.49 hours with the average length of shut-down equal to approximately 31.8 minutes (Table 14).

As mentioned previously, given the current understanding of risk to eagles at the OWEF along with the 2013 ECP Guidance, OE LLC intends to work with the USFWS to pursue an eagle take permit as long as obtaining the permit will enable the BLM ROW grant to be amended to discontinue the existing experimental ACP program at the OWEF and implement an adaptive management program to address any unforeseen impacts to eagles. In spite of this, OE LLC believes that there are opportunities to learn from the program that was implemented at the facility and it is anticipated that lessons learned from the experimental ACP program at the OWEF may be used to help inform similar research programs at other wind facilities.

Table 14. Golden eagle observations recorded during bio-monitoring efforts from December 2012 through June 2017 at the Ocotillo Wind Energy Facility, Imperial County, California.

Unique ID	Number of Individuals	Age	Date	Time	Wind Direction	Wind Speed (km/hr)	Shutdown Time (min)	Activity
1	2	juv; unk	12/9/12	13:28	E	8	NA[1]	soaring
2	1	1-3 yrs	12/2512	12:48	E	11	32	flapping, soaring
3	1	unk	1/4/13	13:48	NE	2	NA	flapping
4	1	1-3 yrs	1/8/13	10:06	S	7	22	circling
5	1	adult	1/9/13	12:27	SE	4	NA	flapping, soaring
6	1	unk	1/16/13	12:33	SE	7	NA	flapping, soaring
7	1	unk	1/26/13	11:56	E	9	56	flapping, soaring, stooping
8	1	unk	2/6/13	11:03	SE	5	NA	flapping, soaring
9	1	1-3 yrs	3/5/13	16:05	SW	15	30	soaring
10[2]	1	unk	3/8/13	15:08	SW	28	NA	soaring
11	1	unk	4/28/13	10:58	SE	3	NA	soaring
12	1	unk	4/30/13	10:39	SW	10	32	soaring, flapping, hunting
13	1	adult	7/17/13	9:45	SSE	6	29	soaring
14	3	adult; juv	8/30/13	13:07	E	6	43	soaring, flapping
15	1	1-3 yrs	9/7/13	11:20	E	6	50	soaring, perched, flapping, being mobbed
16	1	1-3 yrs	9/11/13	9:17	E	3	NA	soaring, flapping
17	1	adult	9/13/13	13:00	S	0-5	20	soaring, flapping, diving
18	1	1-3 yrs	9/18/13	13:54	SW	10	25	flapping, soaring
19	1	adult	9/23/13	14:00	E	4	35	circling
20	1	1-3 yrs	10/5/13	10:48	NE	13	NA	soaring, being mobbed
21	1	adult	10/16/13	13:40	E	6	NA	soaring
22	1	adult	12/6/2013	11:24	E	8	23	soaring
23[3]	1	adult	12/6/13	11:37	E	8	NA	soaring
24	2	unk; unk	3/13/2014	11:55	E	6	NA	soaring
25	1	1-3 yrs	3/28/2014	16:22	E	9	13	soaring
26[2]	1	1-3 yrs	4/9/2014	11:37	E	7	NA	soaring
27	1	adult	5/23/2014	15:24	E	10	NA	soaring, flapping, being mobbed
28	1	unk	0/29/2014	17:38	E	10	NA	soaring
29	1	1-3 yrs	10/17/2014	10:48	SW	21	NA	soaring, flapping
30	1	adult	12/21/2014	13:38	E	10	35	soaring

Table 14. Golden eagle observations recorded during bio-monitoring efforts from December 2012 through June 2017 at the Ocotillo Wind Energy Facility, Imperial County, California.

Unique ID	Number of Individuals	Age	Date	Time	Wind Direction	Wind Speed (km/hr)	Shutdown Time (min)	Activity
31	1	1-3 yrs	2/14/2015	11:25	E	9	NA	soaring, stooping, mobbing, flapping
32[2]	2	unk	2/26/2015	8:46	NE	8	NA	soaring
33	1	adult	5/25/2015	14:38	E	13	40	soaring
34	1	adult	7/30/2015	15:45	SW	19	24	soaring, flapping
35	1	adult	11/19/2015	12:52	E	9	NA	soaring, flapping
36	2	juv; adult	02/07/2016	14:14	N	16	NA	soaring
37	1	adult	06/10/2016	17:14	E	28	NA	soaring
38	1	adult	06/21/2016	7:10	W	6	NA	soaring
39	1	unk	09/26/2016	10:04	NE	16	NA	soaring
40	2	juv; adult	11/19/2016	14:36	E	13	NA	soaring, flapping
41	1	adult	02/14/2017	14:46	E	7	NA	soaring

[1] Turbines were shut-down anytime an eagle was identified within ½ mile of spinning turbines.

[2] Flight paths were not mapped as the observations were off the datasheet.

[3] This is believed to be the same individual as observation 22 however, the observer lost sight of the eagle and then re-sighted. The turbines were already shutdown as a result of observation #22.

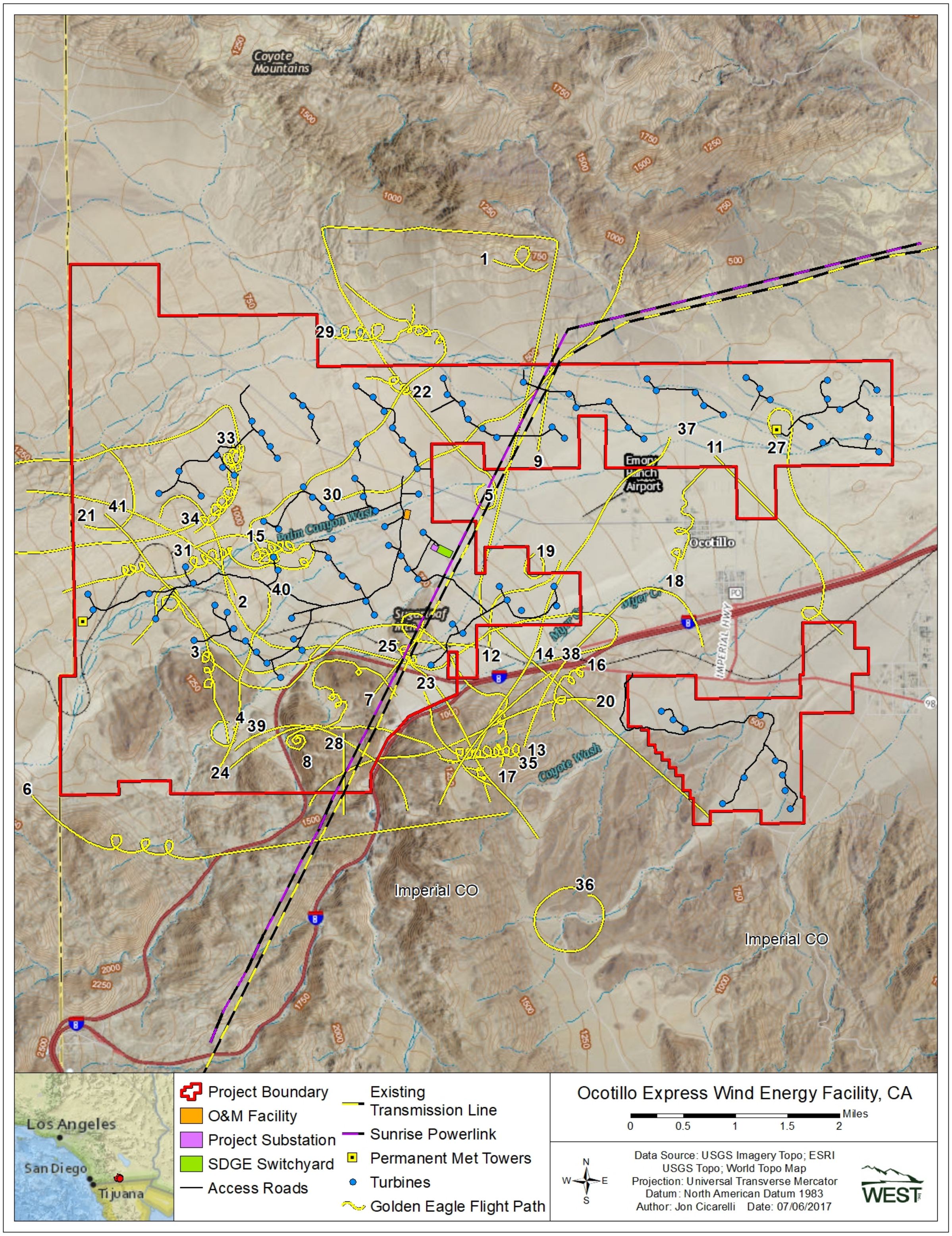


Figure 15. Location of mapped golden eagle flight paths recorded during bio-monitoring efforts from December 2012 through June 2017 at the Ocotillo Wind Energy Facility, Imperial County, California. *Note that the flight path for observations #10, #26, and #32 were not mapped as the observations were off the data sheets.

To date, the majority of golden eagle observations have occurred in September (seven observations) followed by January, December, and February (five observations per month; Table 14). Four golden eagle observations have been recorded in March, three observations in October, two golden eagle observations were recorded in both May, July, November, and June and one golden eagle observation was recorded in August. The majority of observations (68%) occurred between the hours of 10 a.m. and 2:00 p.m. and none of the eagle observations were recorded before 7:00 am or after 5:45 p.m. (Table 14). Of the 41 eagle observations, 21 were recorded during easterly winds, six during southwesterly winds, five during southeasterly winds, four during northeasterly winds, two during southerly winds, one during northerly winds, and one during westerly winds. Figure 15 depicts the locations of mapped flight paths for all eagle observations recorded from December of 2012 through June 2017.

As no golden eagle carcasses have been discovered at the OWEF, implementation of the first year of the biological tower monitoring efforts should be considered a success. However, due to the extremely low use of the area by golden eagles, the potential for impacts to golden eagles is considered very low even without implementation of the biological monitors. Based on a USFWS estimate of golden eagle flight minutes from the pre-construction data, we predict approximately 1.4 golden eagle fatalities in five years.

5.2 Fatality Monitoring

OWEF has completed two years of post-construction mortality monitoring (there have been no eagle mortalities at the Project) and is planning to conduct a third year of mortality monitoring beginning in 2018. As part of these mortality surveys, the searcher efficiency rate (i.e., the ability of a surveyor to locate a mortality) and carcass removal rate (i.e., the average time that a carcass persists before a scavenger removes it) have been or will be determined through experimental bias trials. The frequency of monitoring is informed based on the results of the carcass removal studies and is designed to meet the objectives of the monitoring program. During the first two years of mortality monitoring, a subset of 30% of the turbines was searched twice per month along with additional interim eagle/large bird searches at turbines located greater than 2.5 miles from the biological monitoring tower. For the third year of mortality monitoring, the same subset of 30% of the turbines will be searched consistent with the methods implemented during the first two years of study; however, additional eagle-specific searches will be conducted at the remaining 79 turbines. The eagle specific searches will be conducted once a month by walking transects spaced up to 20 m apart within square search plots measuring 160 m in size.

If an additional year of mortality monitoring is determined to be necessary during the five year term of the eagle take permit, the mortality monitoring plan will be designed specifically to search for eagles and approved by BLM and USFWS.

5.3 Golden Eagle Nest Surveys

Three years of golden eagle nest surveys have been conducted since the Project began operations. Due to concerns over bighorn sheep lambing, ground based golden eagle nest surveys were conducted within a 10-mile buffer of the project area focused on historic/known eagle nests. Monthly follow-up surveys were completed for identified golden eagle or potential golden eagle nests. Nest locations found during surveys were documented by noting the species, dates of activity, Universal Transverse Mercator (UTM) NAD 83 coordinates, nest contents (when possible), and behavior. The data have been provided to the USFWS. The results of the eagle nest monitoring during the first three years of operations supported the pre-construction eagle nest monitoring efforts which indicated that the territories located within 10 miles of the Project have not been consistently active, occupied, or productive for the last decade. However, caution should be exercised when evaluating the status of eagle territories in the desert as it is well known that desert golden eagle territories are not as productive or active as they are in other habitats (USFWS personal communication).

5.4 Reporting

The Monitor has prepared and submitted interim, annual monitoring reports of the first two years of mortality monitoring, and shall prepare and submit a final three year Monitoring Report within six months of completing three years of post-construction monitoring.

All monitoring reports, including all raw monitoring data upon which the reports are based, shall be made available to USFWS. All monitoring reports shall report annual fatalities for golden eagles on a per-turbine, per-megawatt, and per-megawatt hour basis. The monitoring reports also summarize the results of the golden eagle nesting, behavior and use studies, as applicable. The Monitor shall supplement the final three year Monitoring Report with subsequent monitoring data collected. As part of the reporting process, all mortalities will be reported to the USFWS Law Enforcement Branch BIMRS mortality database and all eagle injuries or fatalities will be reported to USFWS within 24 hours of discovery for their direction on collection and/or sending carcasses to the national eagle repository.

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6.0 ADAPTIVE MANAGEMENT

The adaptive management techniques described in this section have been revised given the current understanding of eagle risk at the OWEF, along with the 2013 USFWS ECP Guidance. The adaptive management program at the OWEF has been developed to ensure that potentially significant levels of mortality from operation of the OWEF are effectively avoided or mitigated if necessary. This section describes the adaptive management process that will be applied for golden eagles. Changes in federal status for golden eagles may result in the addition of, or changes to, adaptive management strategies, as determined by OE LLC and USFWS recommendations.

6.1 Adaptive Management Process

The USFWS was provided a running mortality count once a month for review during the two years of standardized mortality monitoring and will be provided the results of the third year of mortality monitoring for eagles. OE LLC will meet with USFWS to discuss mitigation needs if it is determined that a unique or significant event has occurred. If OE LLC and USFWS determine that mitigation is necessary, USFWS and OE LLC will work together to identify and recommend suitable mitigation(s). One or more mitigation measures may be applied if a unique or significant event occurs or if a golden eagle fatality is realized at the OWEF during the five year permit period. A summary of ACPs is provided in Table 15.

Table 15. Summary of adaptive management process for eagle take at the Ocotillo Express Wind Energy Facility. Based on a permitted take rate of two eagles in five years.

Step	Trigger or Threshold	Advanced Conservation Practices
Step 1	One eagle taken in a five year review period.	• Assess eagle fatality to determine if cause or risk factor can be determined (e.g., season, time of day, weather, presence of prey/carrion, fire, or other event) and management response is warranted. • Consult with USFWS. • Take is within the permitted level and fully mitigated.
Step 2	Two eagles taken in the five year permit period.	• Assess eagle fatalities to determine if cause or risk factor can be determined (e.g., season, time of day, weather, presence of prey/carrion, fire, or other event) and management response is warranted. • Consult with USFWS to determine if: Immediate response or management action is needed to ensure take remains within permitted levels such as implementation of ACPs based on discussions with USFWS. • Take is within the permitted level and fully mitigated. Any additional mitigation will be determined in consultation with USFWS.

6.2 Agency Interaction

The development of an effective and successful ECP for the OWEF will depend on frequent coordination between agency biologists and OE LLC. Many of the conservation measures and ACPs implemented at the OWEF are being tested for the first time and will need to be reviewed and evaluated for effectiveness. As the OWEF was one of the first projects that implemented the USFWS draft ECP guidance (2011), and the process has continued to evolve with the 2013 USFWS ECP Guidance and the December 2013 eagle permit rule change, OE LLC believes modifications to the process are warranted in light of the current understanding of eagle risk at the OWEF. OE LLC maintains the commitment to ensure that the goal of stable or increasing breeding populations of eagles is achieved. As suggested in the 2013 USFWS ECP Guidance, OE LLC plans to continue to allow service personnel access to the site to monitor the effects and effectiveness of the conservation measures that have been implemented.

7.0 PUBLIC OUTREACH

OWEF will continue to coordinate with key interest groups within the community to determine how capital contributions from the project can go toward worthwhile community projects. In addition, a project fact sheet describing the project and measures that have been put in place to address avian and bat issues has been prepared and is available at the local BLM El Centro District Office.

8.0 CONCLUSION

The OWEF ECP was written to provide guidance for all required golden eagle conservation measures and monitoring during ongoing and future operations of the OWEF. The OWEF ECP builds upon the 2012 OWEF ECP that was developed under the 2011 USFWS ECP Guidance and included golden eagle conservation measures that were: 1) developed prior to construction; 2) implemented during construction, and during the initial years of operations. The measures described in this document are intended to help protect and reduce potential impacts to golden eagles, as well as to monitor potential impacts to golden eagles during operation of the OWEF. The OWEF ECP will adaptively manage potential impacts to golden eagles resulting from the OWEF, as needed, in conjunction with USFWS and BLM.

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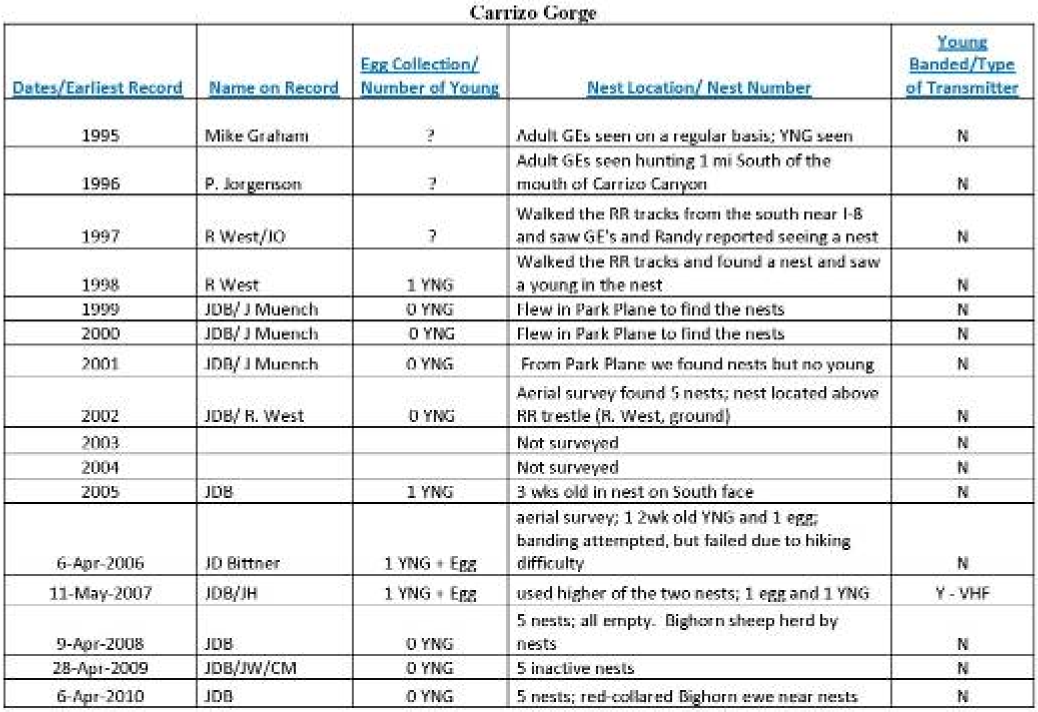
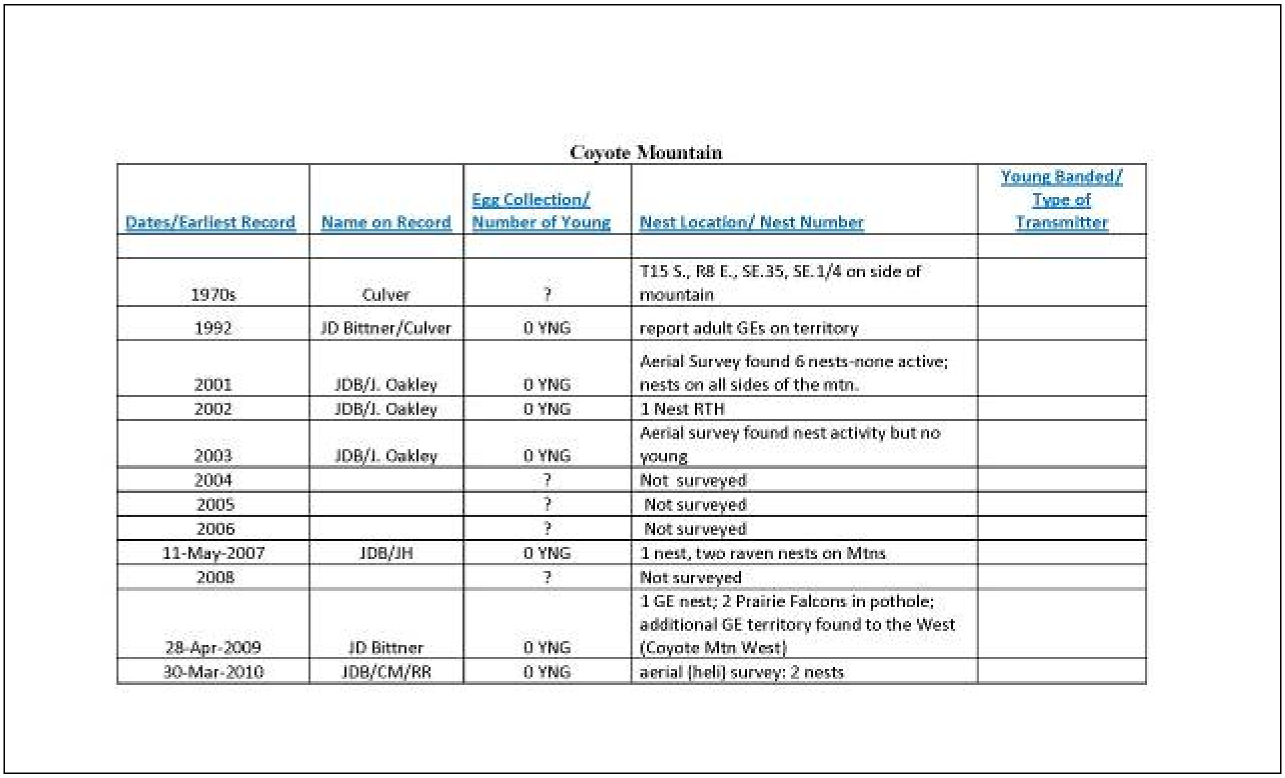
Appendix A: History of Golden Eagle Territories within 10 Miles of the OcotilloWind Energy Facility provided by Wildlife Research Institute (WRI).

Appendix A. History of golden eagle territories within 10 miles of the Ocotillo Wind Energy Facility provided by Wildlife Research Institute (WRI).



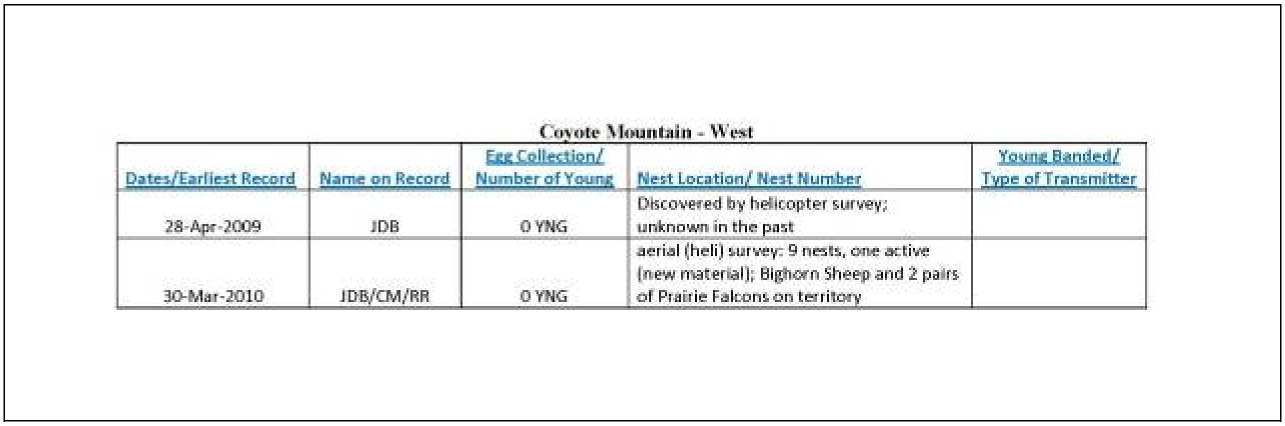
Carrizo Gorge

Dates/Earliest Record	Name on Record	Egg Collection/ Number of Young	Nest Location/ Nest Number	Young Banded/Type of Transmitter
1995	Mike Graham	?	Adult GEs seen on a regular basis; YNG seen	N
1996	P. Jorgenson	?	Adult GEs seen hunting 1 mi South of the mouth of Carrizo Canyon	N
1997	R West/IO	?	Walked the RR tracks from the south near I-8 and saw GE's and Randy reported seeing a nest	N
1998	R West	1 YNG	Walked the RR tracks and found a nest and saw a young in the nest	N
1999	JDB/ J Muench	0 YNG	Flew in Park Plane to find the nests	N
2000	JDB/ J Muench	0 YNG	Flew in Park Plane to find the nests	N
2001	JDB/ J Muench	0 YNG	From Park Plane we found nests but no young	N
2002	JDB/ R. West	0 YNG	Aerial survey found 5 nests; nest located above RR trestle (R. West, ground)	N
2003			Not surveyed	N
2004			Not surveyed	N
2005	JDB	1 YNG	3 wks old in nest on South face	N
6-Apr-2006	JD Bittner	1 YNG + Egg	aerial survey; 1 2wk old YNG and 1 egg; banding attempted, but failed due to hiking difficulty	N
11-May-2007	JDB/JH	1 YNG + Egg	used higher of the two nests; 1 egg and 1 YNG	Y - VHF
9-Apr-2008	JDB	0 YNG	5 nests; all empty. Bighorn sheep herd by nests	N
28-Apr-2009	JDB/JW/CM	0 YNG	5 inactive nests	N
6-Apr-2010	JDB	0 YNG	5 nests; red-collared Bighorn ewe near nests	N



Coyote Mountain

Dates/Earliest Record	Name on Record	Egg Collection/ Number of Young	Nest Location/ Nest Number	Young Banded/ Type of Transmitter
1970s	Culver	?	T15 S., R8 E., SE.35, SE.1/4 on side of mountain	
1992	JD Bittner/Culver	0 YNG	report adult GEs on territory	
2001	JDB/J. Oakley	0 YNG	Aerial Survey found 6 nests-none active; nests on all sides of the mtn.	
2002	JDB/J. Oakley	0 YNG	1 Nest RTH	
2003	JDB/J. Oakley	0 YNG	Aerial survey found nest activity but no young	
2004		?	Not surveyed	
2005		?	Not surveyed	
2006		?	Not surveyed	
11-May-2007	JDB/JH	0 YNG	1 nest, two raven nests on Mtns	
2008		?	Not surveyed	
28-Apr-2009	JD Bittner	0 YNG	1 GE nest; 2 Prairie Falcons in pothole; additional GE territory found to the West (Coyote Mtn West)	
30-Mar-2010	JDB/CM/RR	0 YNG	aerial (heli) survey: 2 nests	



Coyote Mountain - West

Dates/Earliest Record	Name on Record	Egg Collection/ Number of Young	Nest Location/ Nest Number	Young Banded/ Type of Transmitter
28-Apr-2009	JDB	0 YNG	Discovered by helicopter survey; unknown in the past	
30-Mar-2010	JDB/CM/RR	0 YNG	aerial (heli) survey: 9 nests, one active (new material); Bighorn Sheep and 2 pairs of Prairie Falcons on territory	

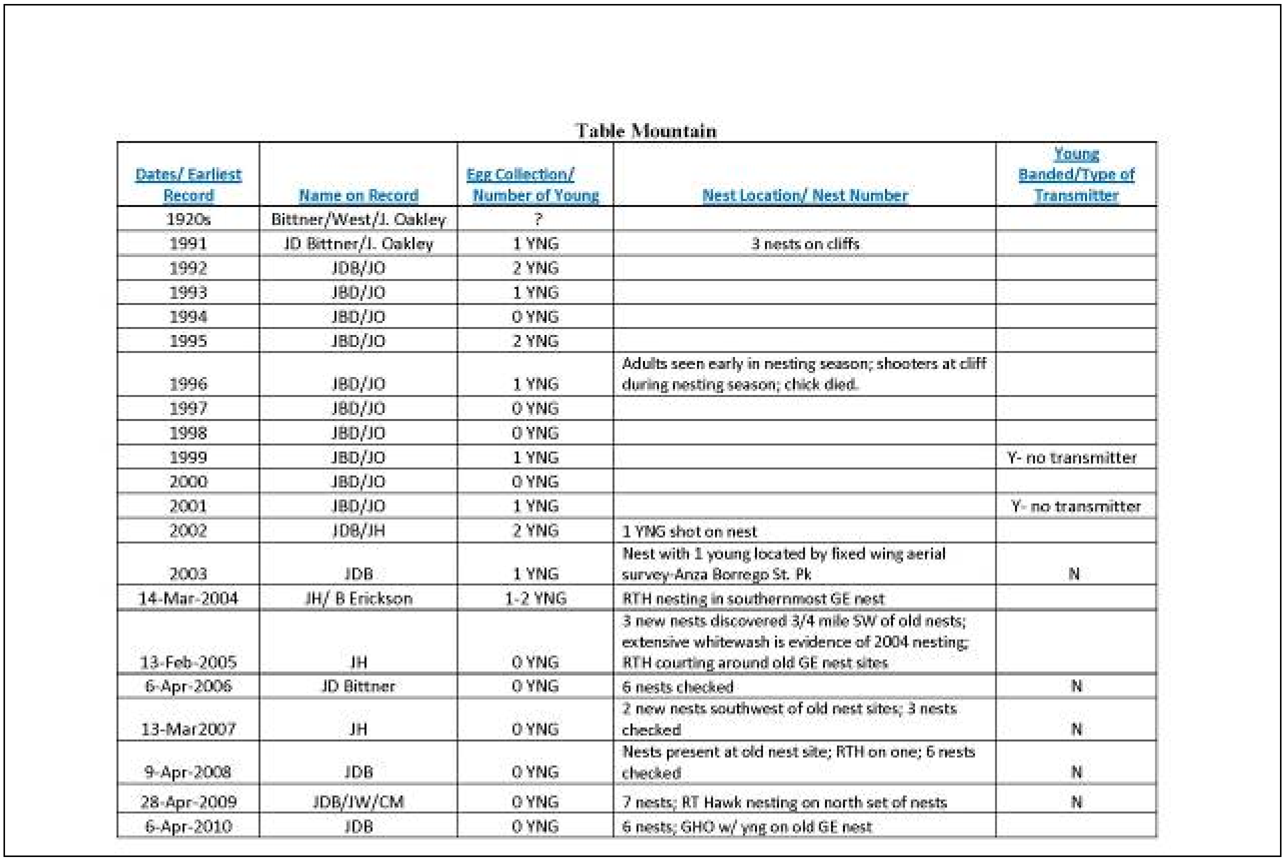


Table Mountain

Dates/ Earliest Record	Name on Record	Egg Collection/ Number of Young	Nest Location/ Nest Number	Young Banded/Type of Transmitter
1920s	Bittner/West/J. Oakley	?		
1991	JD Bittner/J. Oakley	1 YNG	3 nests on cliffs	
1992	JDB/JO	2 YNG		
1993	JBD/JO	1 YNG		
1994	JBD/JO	0 YNG		
1995	JBD/JO	2 YNG		
1996	JBD/JO	1 YNG	Adults seen early in nesting season; shooters at cliff during nesting season; chick died.	
1997	JBD/JO	0 YNG		
1998	JBD/JO	0 YNG		
1999	JBD/JO	1 YNG		Y- no transmitter
2000	JBD/JO	0 YNG		
2001	JBD/JO	1 YNG		Y- no transmitter
2002	JDB/JH	2 YNG	1 YNG shot on nest	
2003	JDB	1 YNG	Nest with 1 young located by fixed wing aerial survey-Anza Borrego St. Pk	N
14-Mar-2004	JH/ B Erickson	1-2 YNG	RTH nesting in southernmost GE nest	
13-Feb-2005	JH	0 YNG	3 new nests discovered 3/4 mile SW of old nests; extensive whitewash is evidence of 2004 nesting; RTH courting around old GE nest sites	
6-Apr-2006	JD Bittner	0 YNG	6 nests checked	N
13-Mar2007	JH	0 YNG	2 new nests southwest of old nest sites; 3 nests checked	N
9-Apr-2008	JDB	0 YNG	Nests present at old nest site; RTH on one; 6 nests checked	N
28-Apr-2009	JDB/JW/CM	0 YNG	7 nests; RT Hawk nesting on north set of nests	N
6-Apr-2010	JDB	0 YNG	6 nests; GHO w/ yng on old GE nest	

Appendix B: Elevation, Slope, and Aspect Characteristics of Proposed Turbines at Ocotillo.

Appendix B. Elevation, slope, and aspect characteristics of proposed turbines at Ocotillo.

Turbine	Elevation (m)	Slope (Degrees)	Aspect (Degrees)	Aspect (Direction)
9	283.72	2.55	56.26	Northeast
10	284.82	2.29	37.54	Northeast
11	285.03	0.97	31.70	Northeast
14	289.31	1.33	76.47	East
15	284.20	2.01	87.62	East
16	286.18	5.61	73.29	East
17	288.57	4.12	88.83	East
18	287.63	3.56	106.71	East
19	336.52	2.79	91.59	East
20	327.17	2.21	121.32	Southeast
21	323.32	4.04	75.20	East
22	318.97	0.84	104.44	East
23	318.51	2.07	353.24	North
24	323.38	2.95	16.79	North
25	324.28	1.94	58.44	Northeast
26	305.75	1.80	52.18	Northeast
27	304.19	2.27	27.69	Northeast
28	294.82	1.09	56.12	Northeast
29	343.17	5.53	154.88	Southeast
30	362.77	4.07	27.09	Northeast
31	358.51	1.64	119.37	Southeast
39	400.02	1.88	71.03	East
40	399.70	2.95	73.10	East
43	334.25	1.74	130.11	Southeast
44	333.74	2.49	31.26	Northeast
49	326.91	1.96	58.54	Northeast
50	308.97	2.59	63.18	Northeast
51	308.72	3.62	49.62	Northeast
64	252.76	2.42	40.80	Northeast
65	253.40	1.98	52.24	Northeast
66	253.93	1.62	40.63	Northeast
67	260.74	3.23	355.52	North
69	260.53	1.47	76.21	East
70	255.55	1.92	78.79	East
71	251.77	2.98	71.71	East
72	248.71	2.75	84.55	East
73	248.99	3.71	348.86	North
74	258.49	1.79	28.93	Northeast
75	257.46	2.50	23.12	Northeast
76	261.30	1.94	61.82	Northeast
77	260.67	1.85	48.40	Northeast
78	255.68	2.57	15.17	North

Appendix B. Elevation, slope, and aspect characteristics of proposed turbines at Ocotillo.

Turbine	Elevation (m)	Slope (Degrees)	Aspect (Degrees)	Aspect (Direction)
79	233.90	1.60	46.63	Northeast
80	231.71	2.09	48.33	Northeast
81	203.97	2.73	68.54	East
82	207.35	2.16	38.52	Northeast
83	204.47	2.12	29.90	Northeast
86	183.82	1.59	40.24	Northeast
87	187.02	1.45	79.53	East
88	230.68	2.71	72.44	East
89	230.14	1.60	40.39	Northeast
90	228.98	2.04	63.90	Northeast
91	232.45	1.88	26.11	Northeast
92	226.61	2.57	11.96	North
93	210.95	2.16	77.29	East
94	200.69	2.95	57.44	Northeast
95	223.34	1.63	89.76	East
96	227.89	1.92	34.77	Northeast
97	228.45	1.64	69.02	East
98	220.19	1.80	93.00	East
99	198.87	1.28	74.39	East
100	195.50	1.92	20.67	North
101	194.06	1.44	46.66	Northeast
102	195.21	1.64	66.82	Northeast
103	196.86	2.36	77.07	East
105	230.93	0.85	318.45	Northwest
106	228.62	0.65	21.07	North
107	228.64	1.92	42.46	Northeast
110	171.00	1.76	46.72	Northeast
111	168.28	1.28	61.35	Northeast
112	165.68	1.36	76.39	East
113	146.16	1.63	54.64	Northeast
116	187.87	1.80	67.28	Northeast
117	182.17	1.38	86.89	East
118	193.99	2.57	70.14	East
120	181.88	2.23	13.57	North
122	201.98	2.32	36.72	Northeast
123	169.30	1.68	8.83	North
124	164.01	1.63	17.81	North
125	158.21	0.87	71.26	East
126	162.16	1.67	59.85	Northeast
128	148.51	1.94	54.48	Northeast
130	259.75	2.08	83.20	East
131	150.50	0.87	114.99	Southeast

Appendix B. Elevation, slope, and aspect characteristics of proposed turbines at Ocotillo.

Turbine	Elevation (m)	Slope (Degrees)	Aspect (Degrees)	Aspect (Direction)
132	166.73	1.70	40.89	Northeast
133	169.89	1.80	76.29	East
134	201.71	2.69	76.81	East
135	212.47	2.83	110.74	East
147	139.07	1.13	96.37	East
148	136.74	0.95	99.33	East
149	130.61	0.70	105.24	East
150	125.75	1.20	154.61	Southeast
151	121.65	0.85	153.86	Southeast
152	117.57	0.20	80.49	East
153	115.15	1.04	122.12	Southeast
154	113.75	0.84	172.68	South
155	109.83	1.00	154.04	Southeast
156	106.26	0.96	164.69	South
159	99.72	1.18	111.66	East
160	97.22	0.44	112.48	East
161	95.04	4.28	185.95	South
162	97.75	0.36	342.34	North
163	100.41	2.05	162.39	South
164	105.22	1.02	256.33	West
167	95.37	1.87	134.11	Southeast
168	102.11	1.33	288.51	West
169	125.93	0.63	109.92	East
172	92.21	1.06	73.56	East
173	172.18	1.01	58.86	Northeast
174	143.45	1.07	72.27	East
175	110.30	1.04	149.53	Southeast
176	123.47	0.83	38.81	Northeast

Appendix C: Post-Construction Monitoring Efforts at the Ocotillo Wind Energy Facility

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

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August 26, 2013 – September 29, 2014

Final Report

Prepared for:

Ocotillo Express LLC

1600 Smith Street, Suite 4025
Houston, Texas 77002

Prepared by:

Western EcoSystems Technology, Inc.

415 West 17th Street, Suite 200
Cheyenne, Wyoming 82001

January 8, 2014

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.

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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.

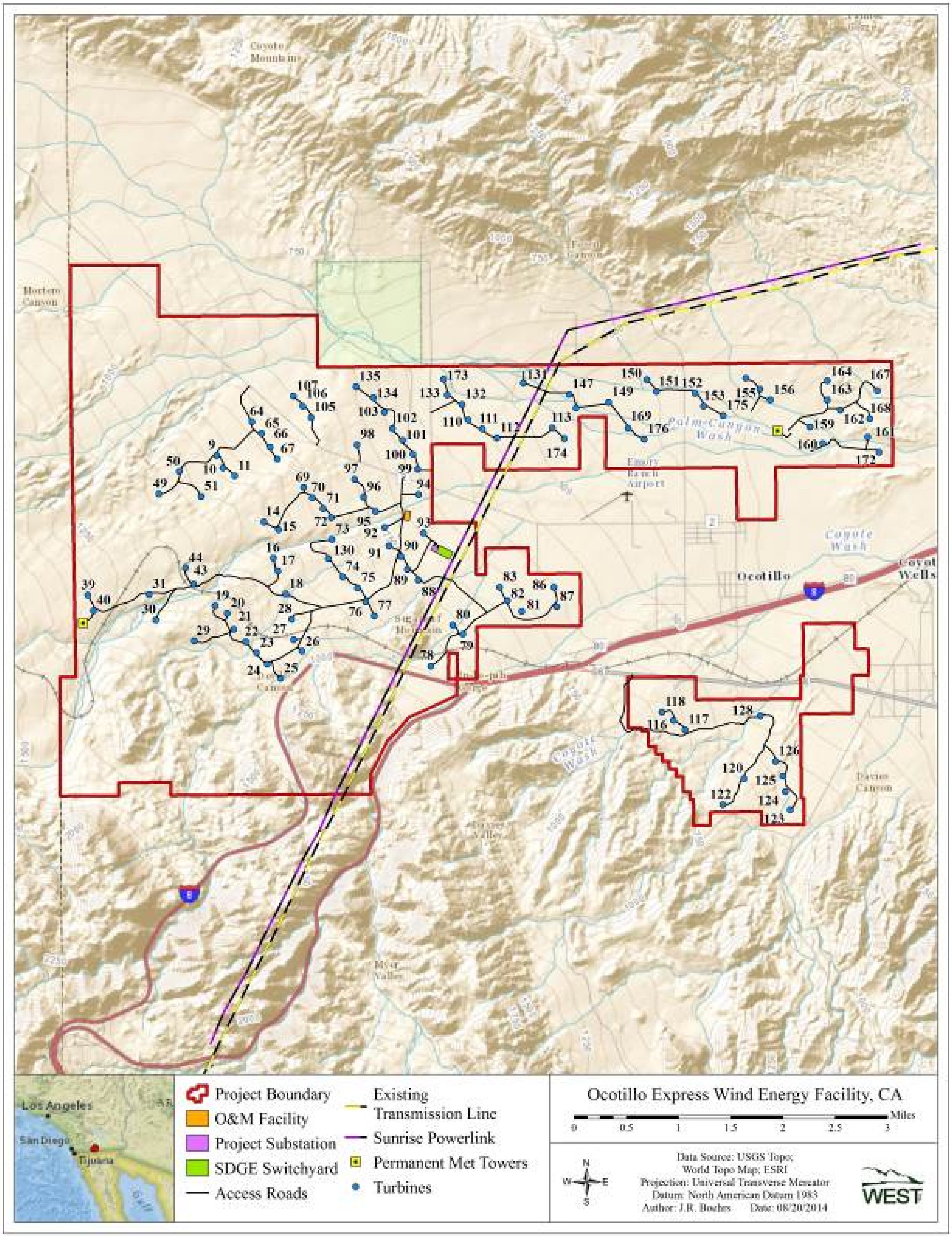

Figure 1. Location of the Ocotillo Express Wind Energy Facility in Imperial County, California.

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.

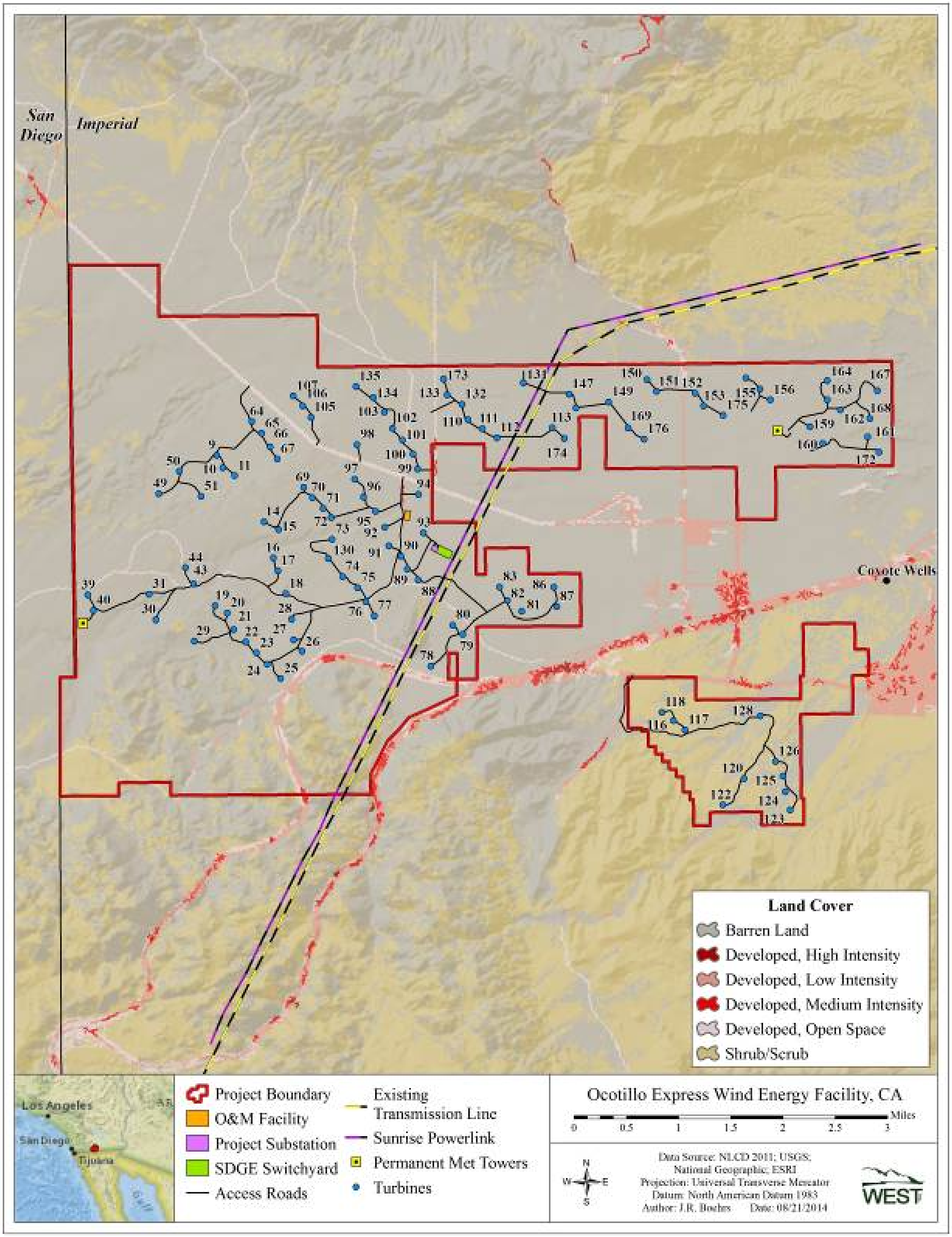

Figure 2. Landuse/landcover information for the Ocotillo Express Wind Energy Facility (USGS NLCD 2001).

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.

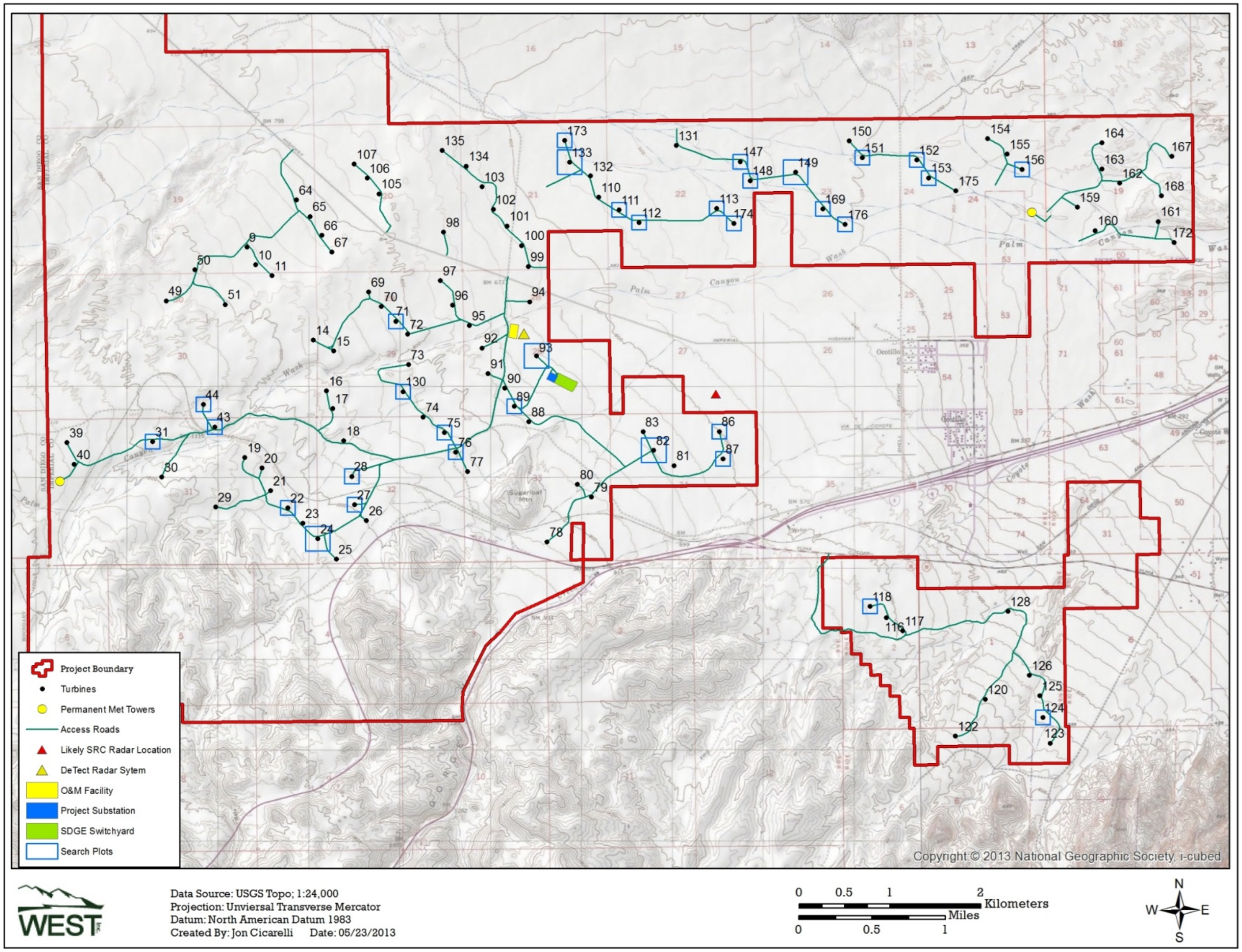

Figure 3. Turbines selected for the Year 1 mortality monitoring study at the Ocotillo Express Wind Energy Facility.

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:

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

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:

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

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:

$$m = \frac{\bar{c}}{\hat{\pi}} \tag{3}$$

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).

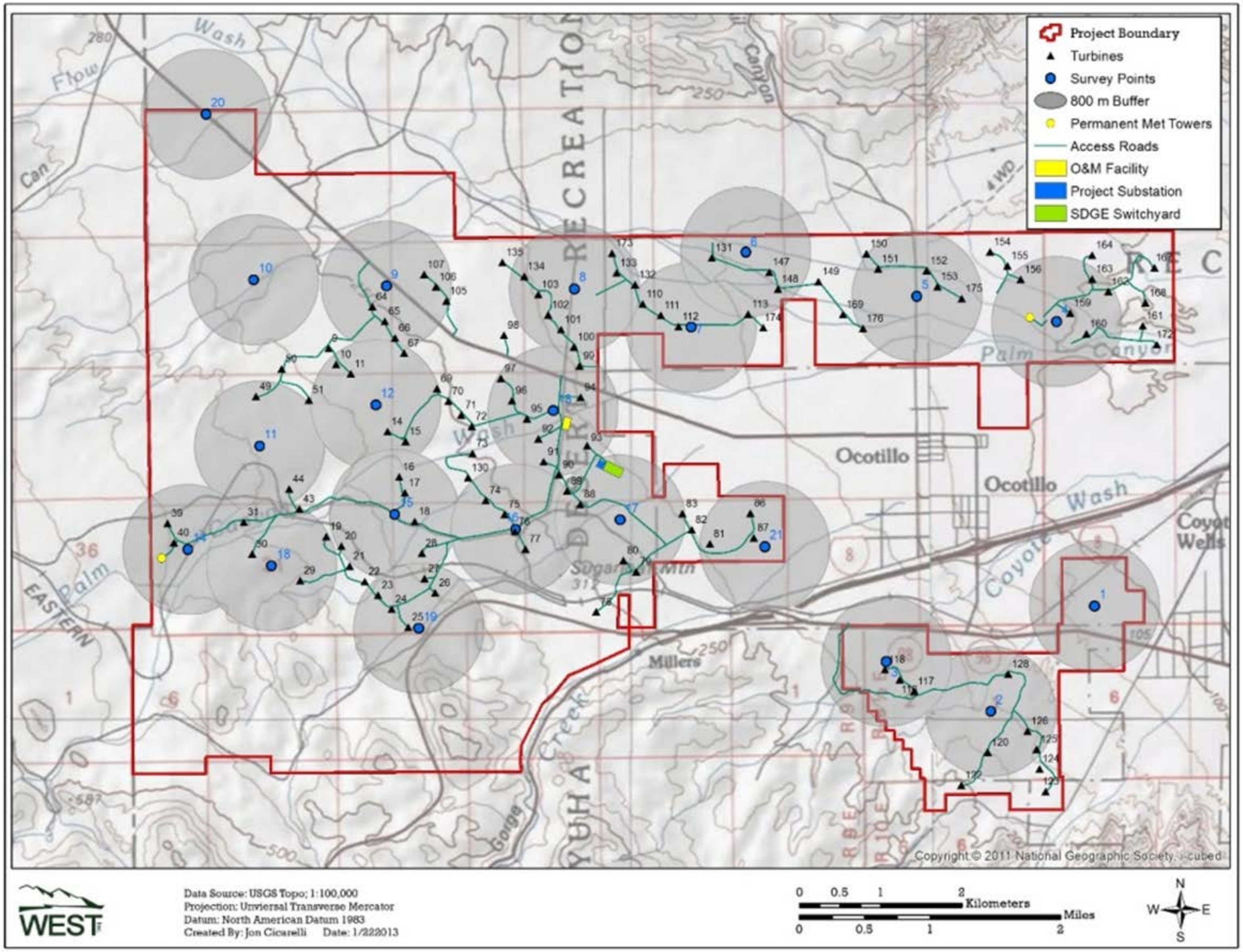

Figure 4. Fixed point locations for avian use surveys at the Ocotillo Express Wind Energy Facility.

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).

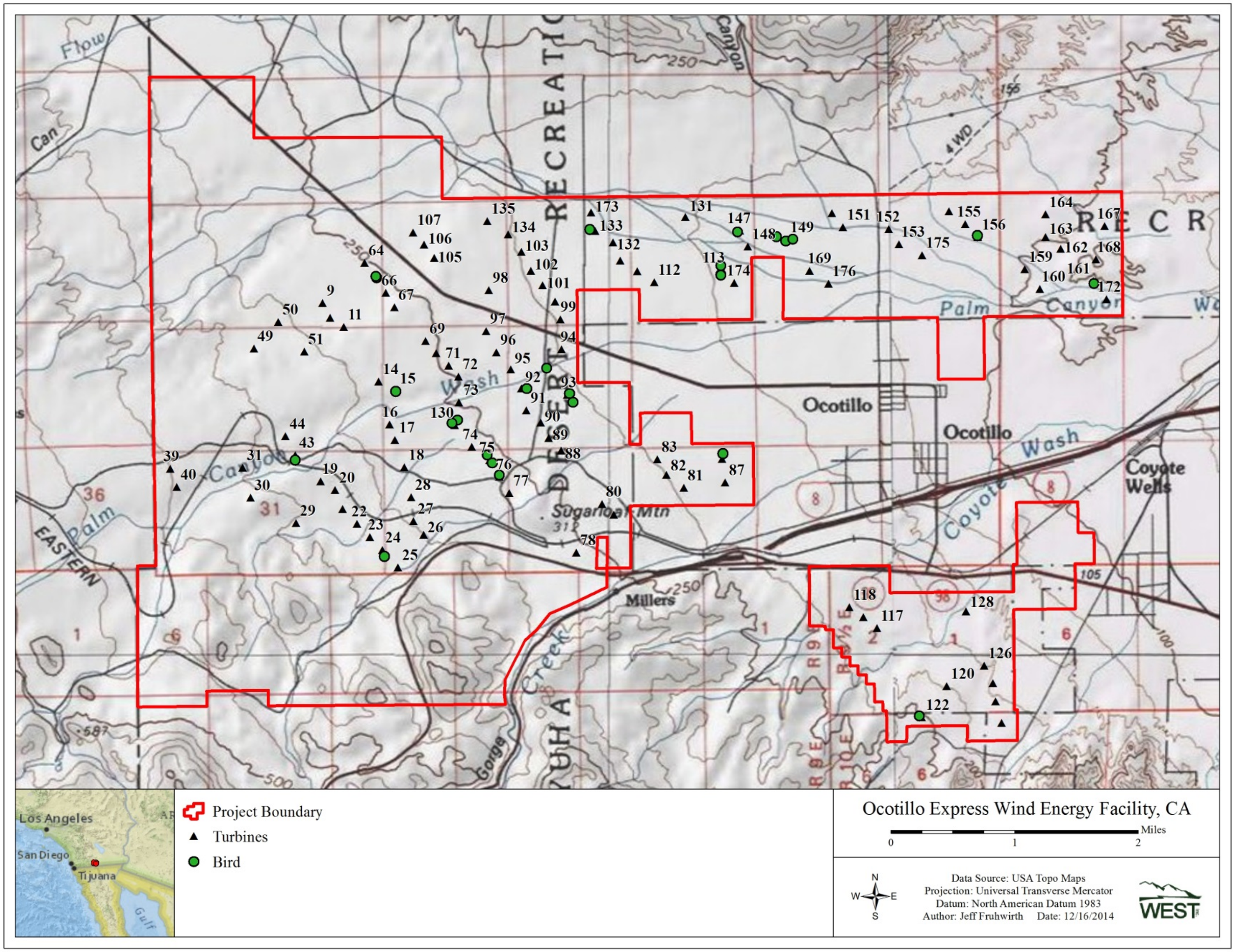

Figure 5. Location of all bird carcasses found during the first standardized year-long fatality study or incidentally during the study period at the Ocotillo Express Wind Energy Facility.

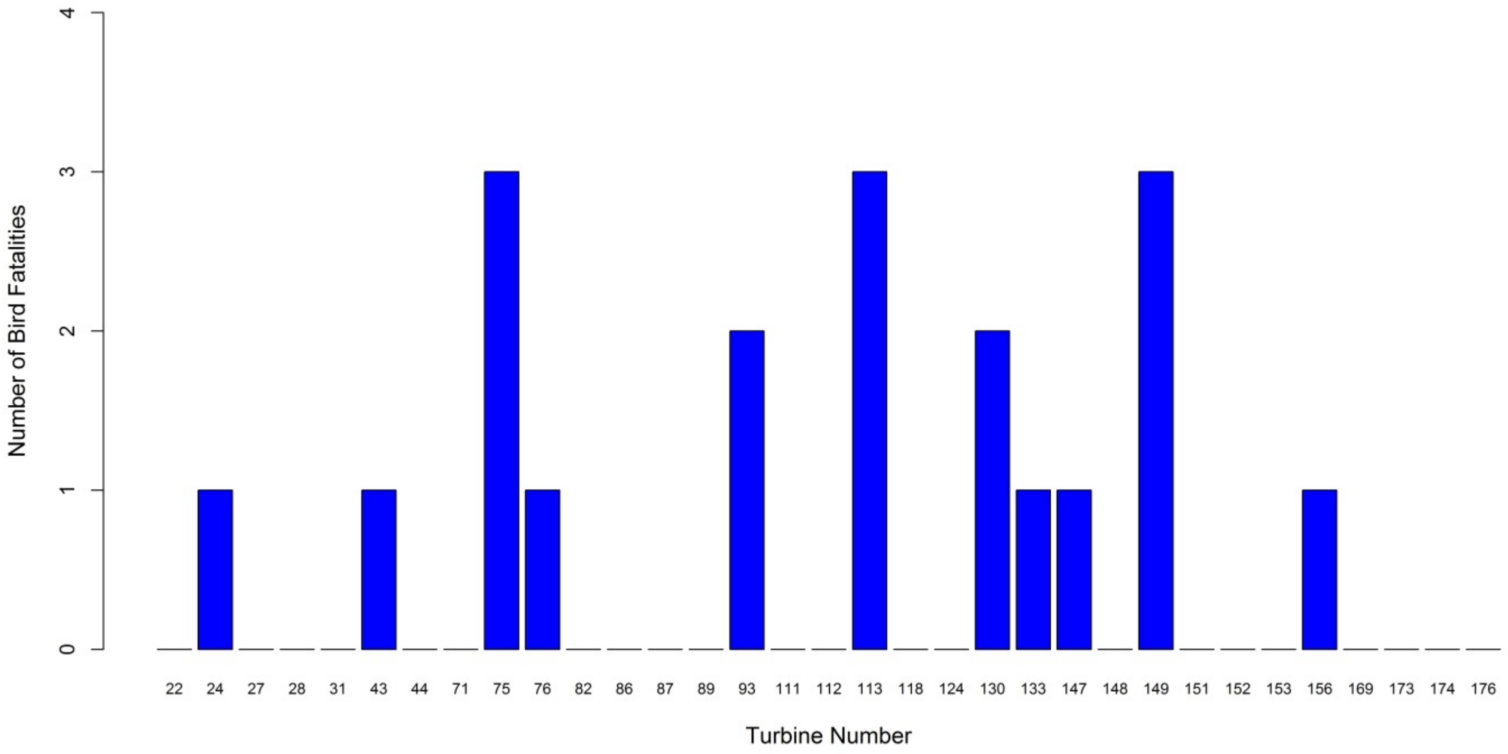

Figure 6a. Number of bird fatalities by turbine found during year-long standardized searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

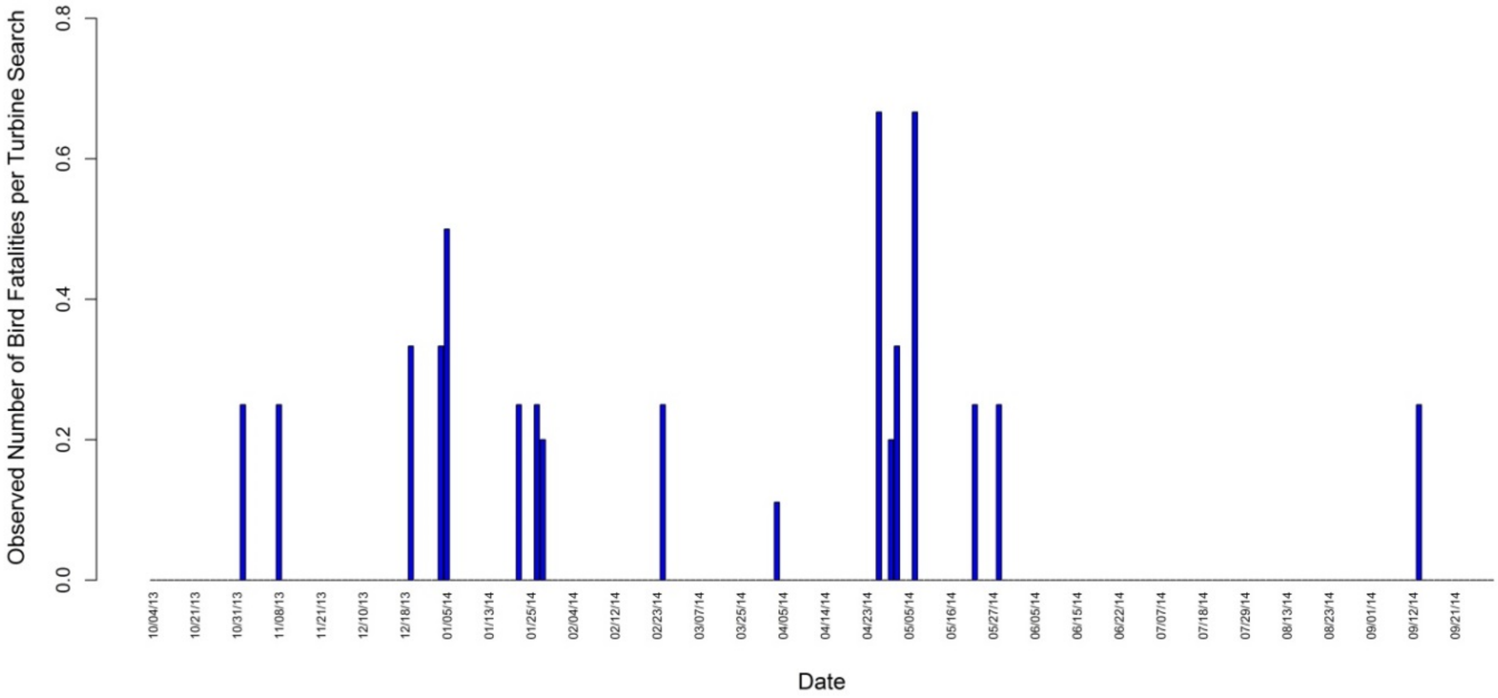

Figure 6b. Timing of bird fatalities by turbine found during scheduled searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

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).

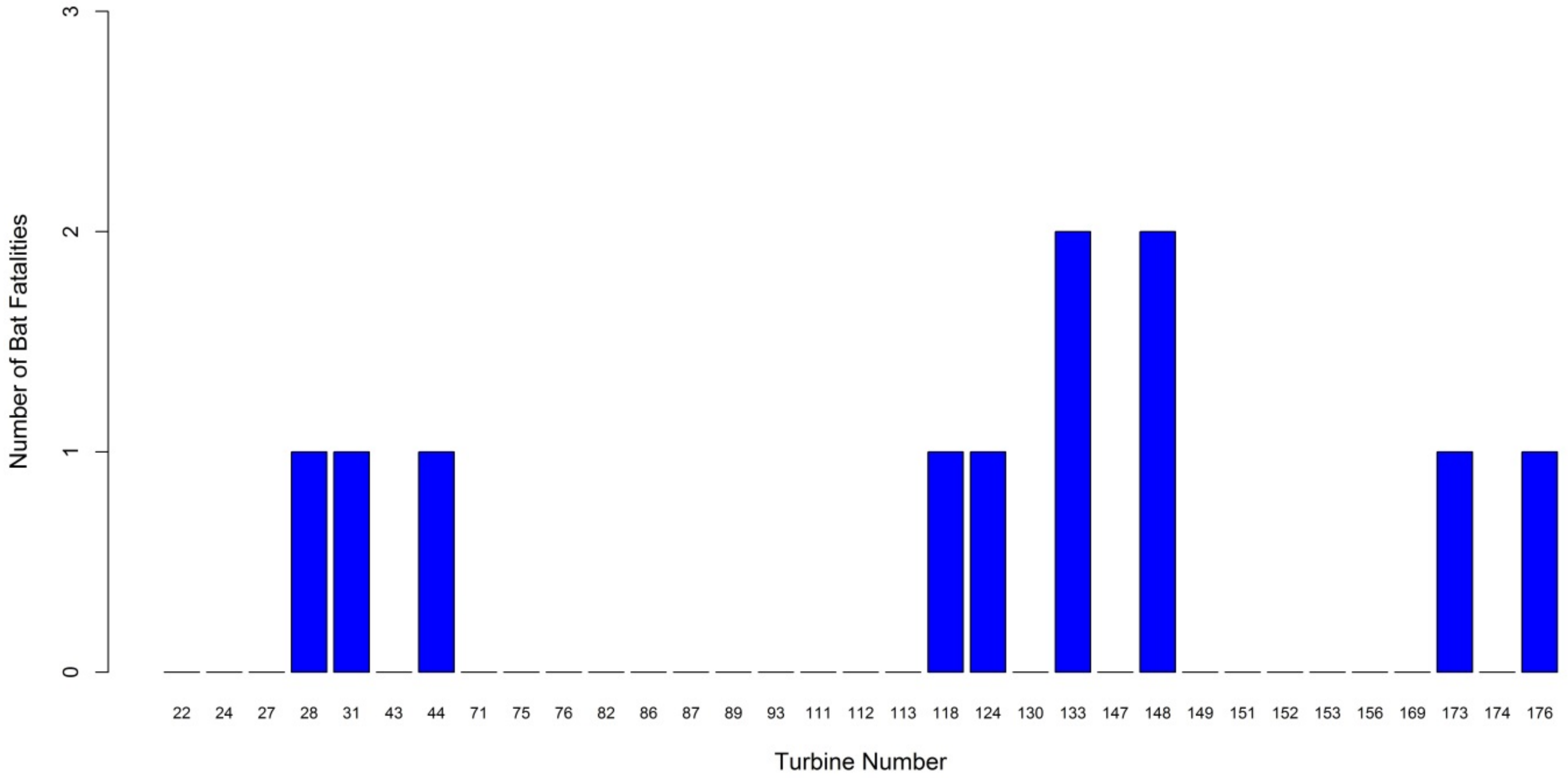

Figure 7a. Number of bat fatalities by turbine found during year-long scheduled searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

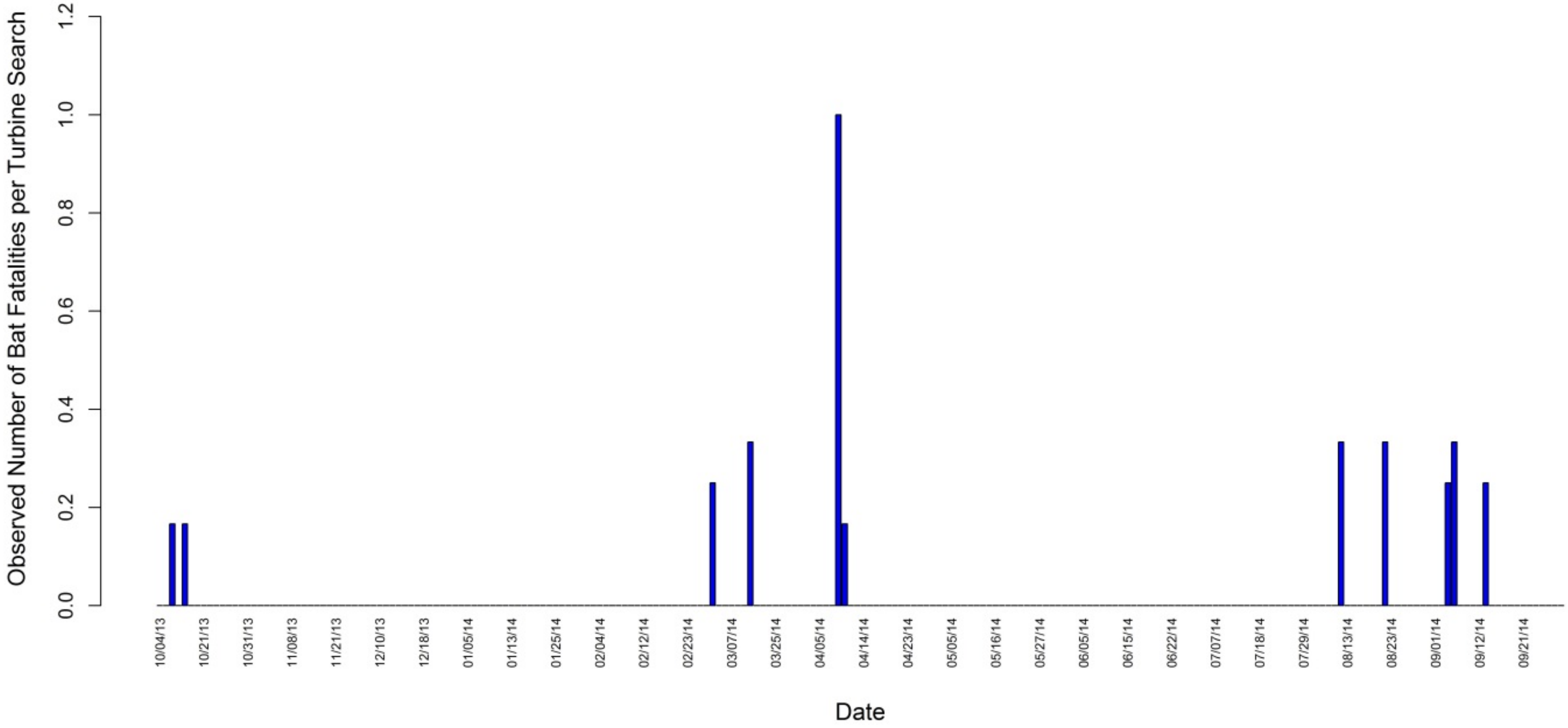

Figure 7b. Timing of bat fatalities by turbine found during scheduled searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

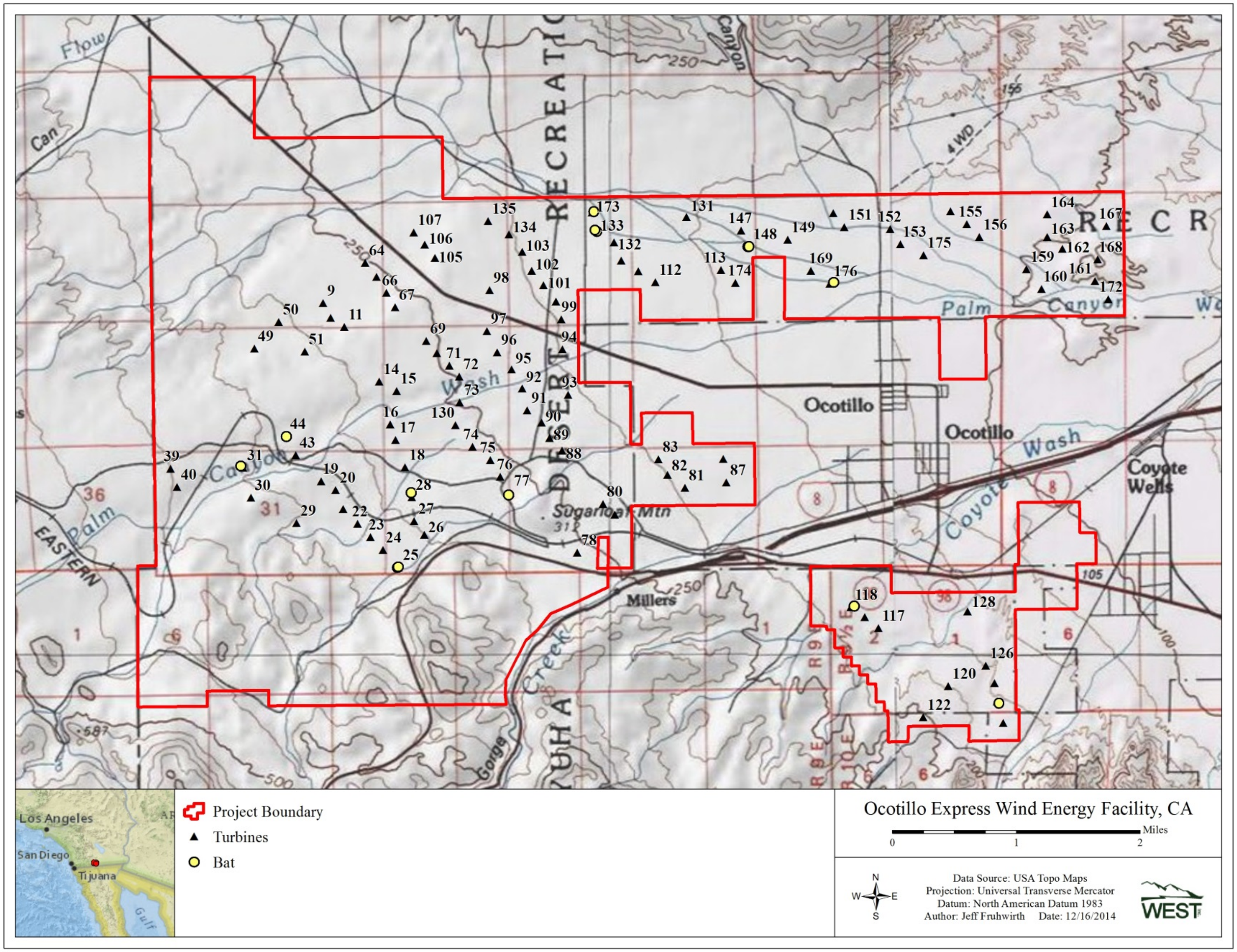

Figure 8. Location of all bat carcasses found during the first standardized year-long fatality study or incidentally during the study period at the Ocotillo Express Wind Energy Facility.

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**

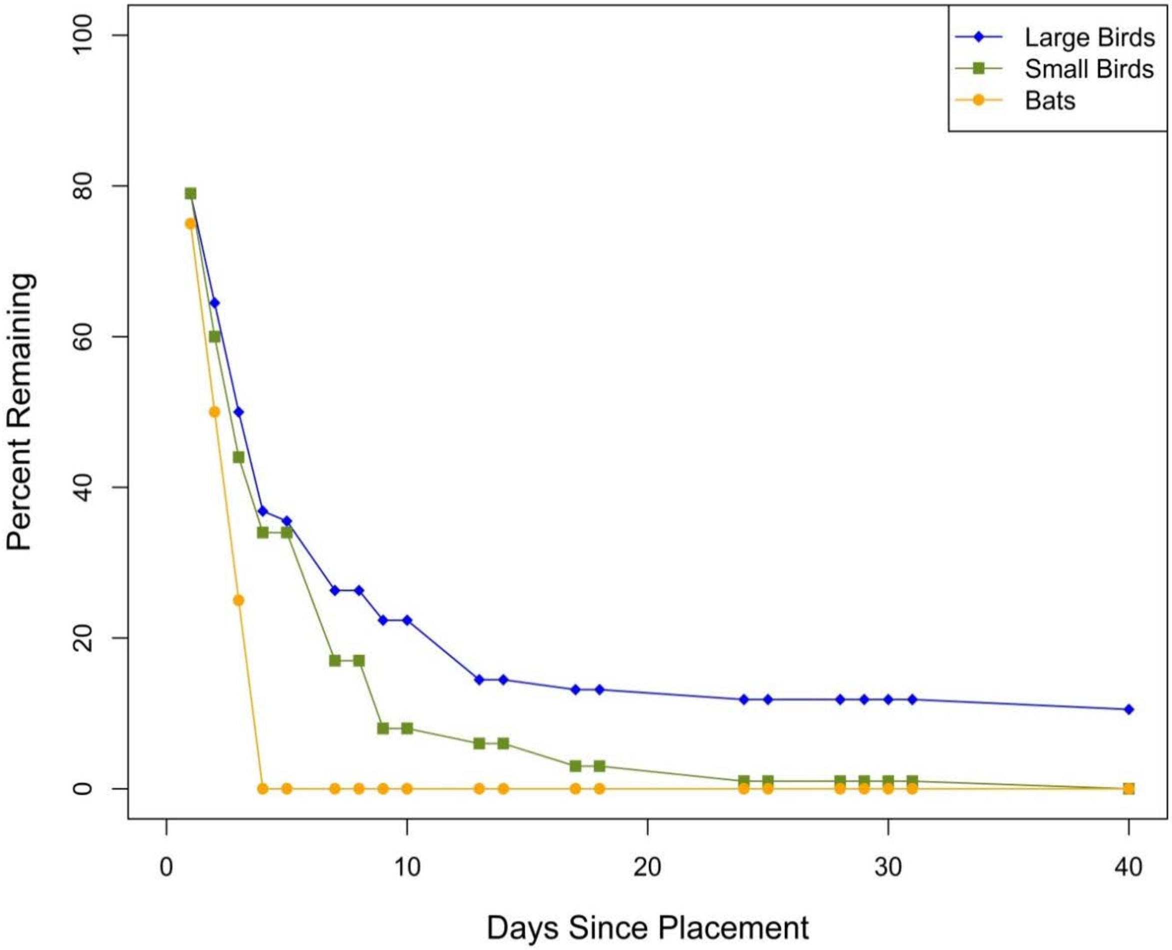

Figure 9. Carcass removal rates at the Ocotillo Express Wind Energy Facility.

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.

	Number	# Surveys	# Unique	Species Richness	
Season	**of Visits**	**Conducted**	**Species**	**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.

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

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).

<u>Bird Use</u>

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.

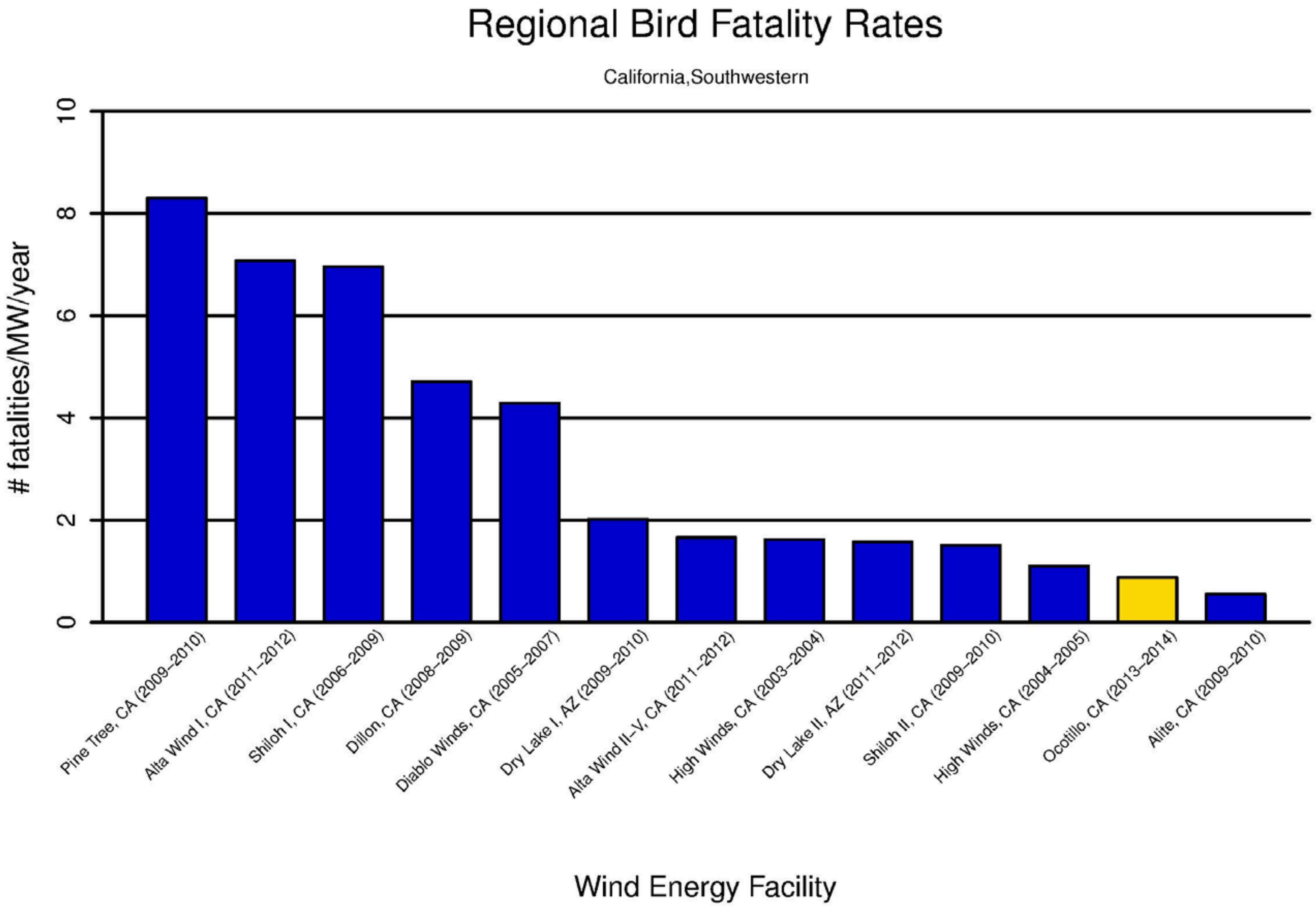

Figure 10. Fatality rates for all birds (number of birds per MW per year) from publicly-available studies of wind energy facilities in California and the desert southwest.

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.

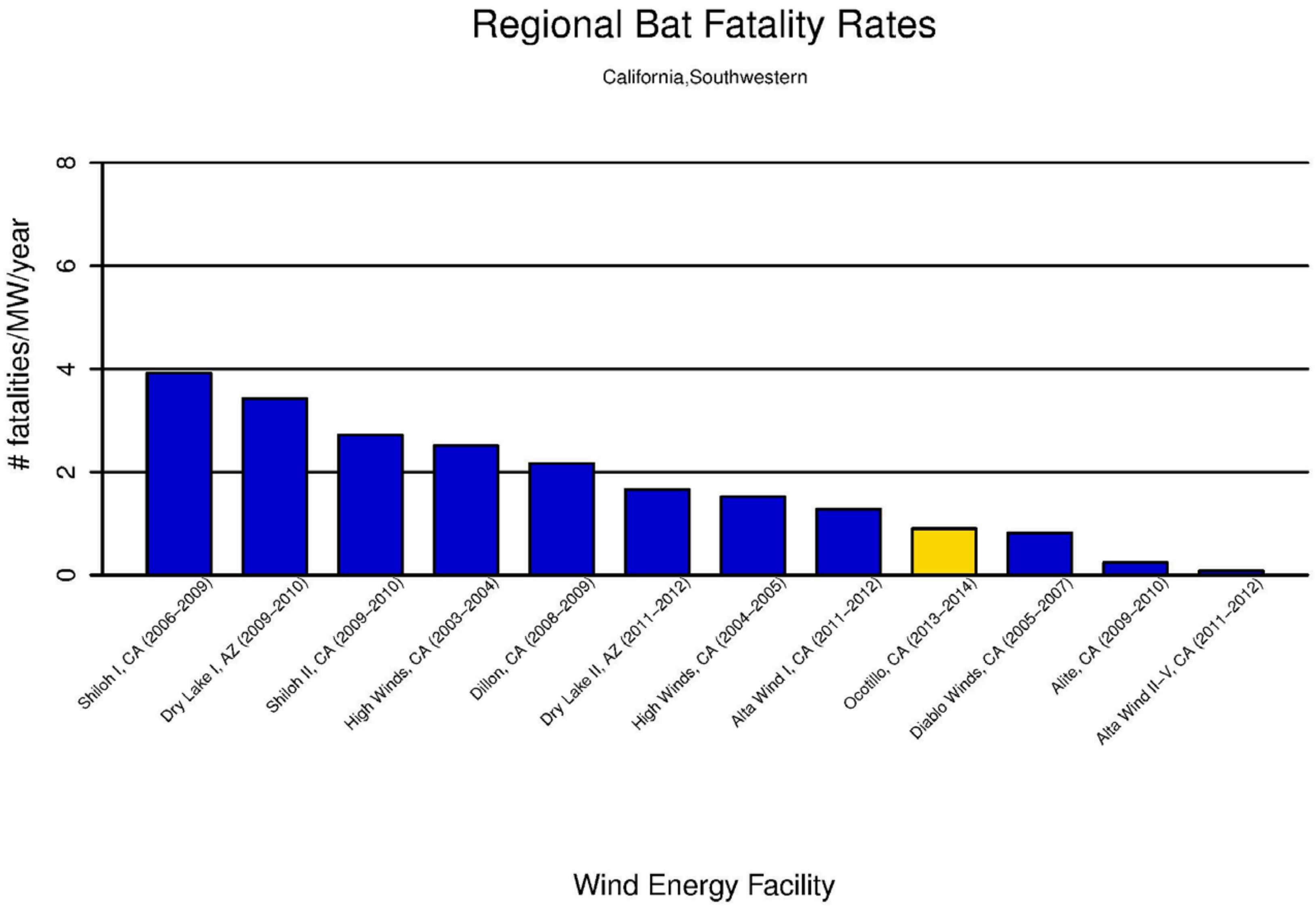

Figure 11. Fatality rates for bats (number of bats per MW per year) from publicly-available studies at wind energy facilities in California and the desert southwest.

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).

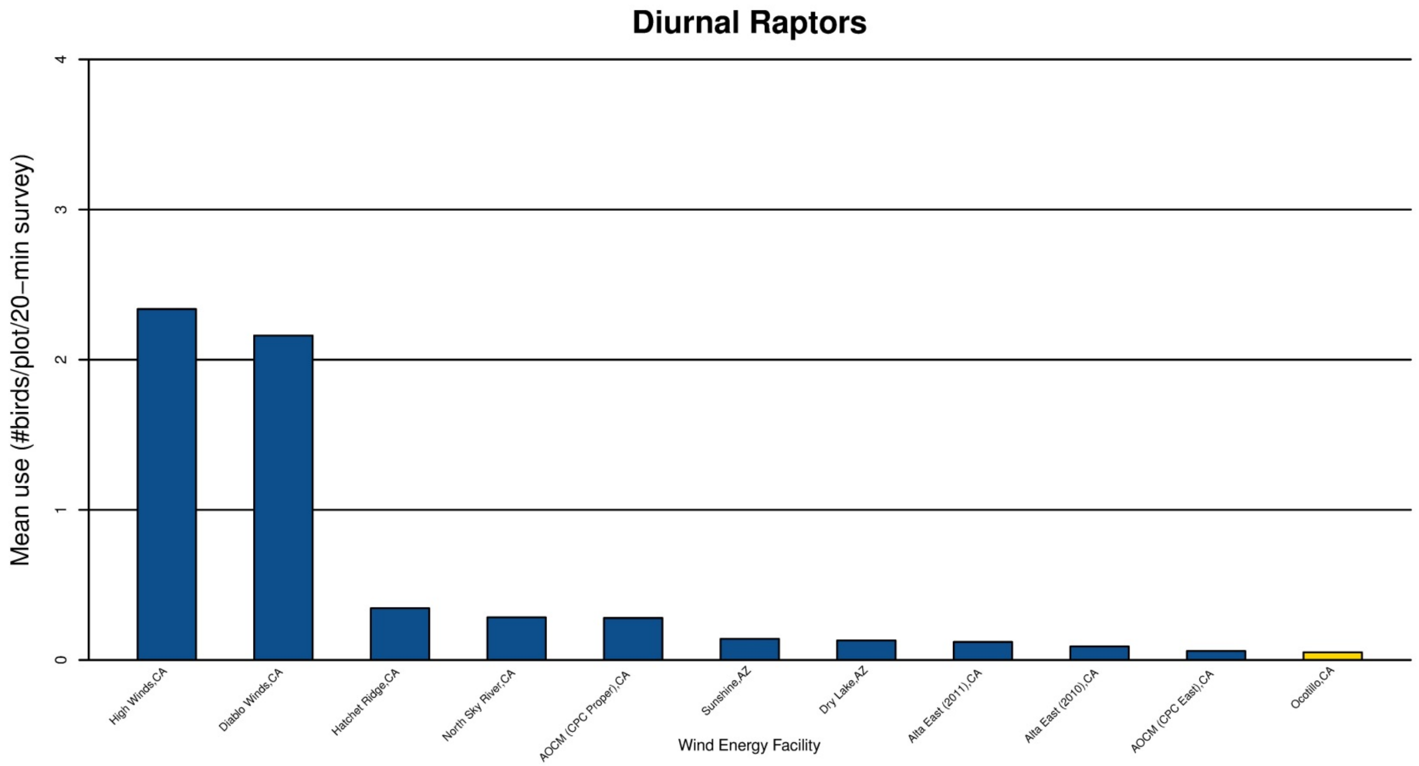

Figure 12. Comparison of estimated annual diurnal raptor use (raptors/800-m plot/20-min survey) during fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014, and diurnal raptor use at other California and desert southwest wind resource areas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

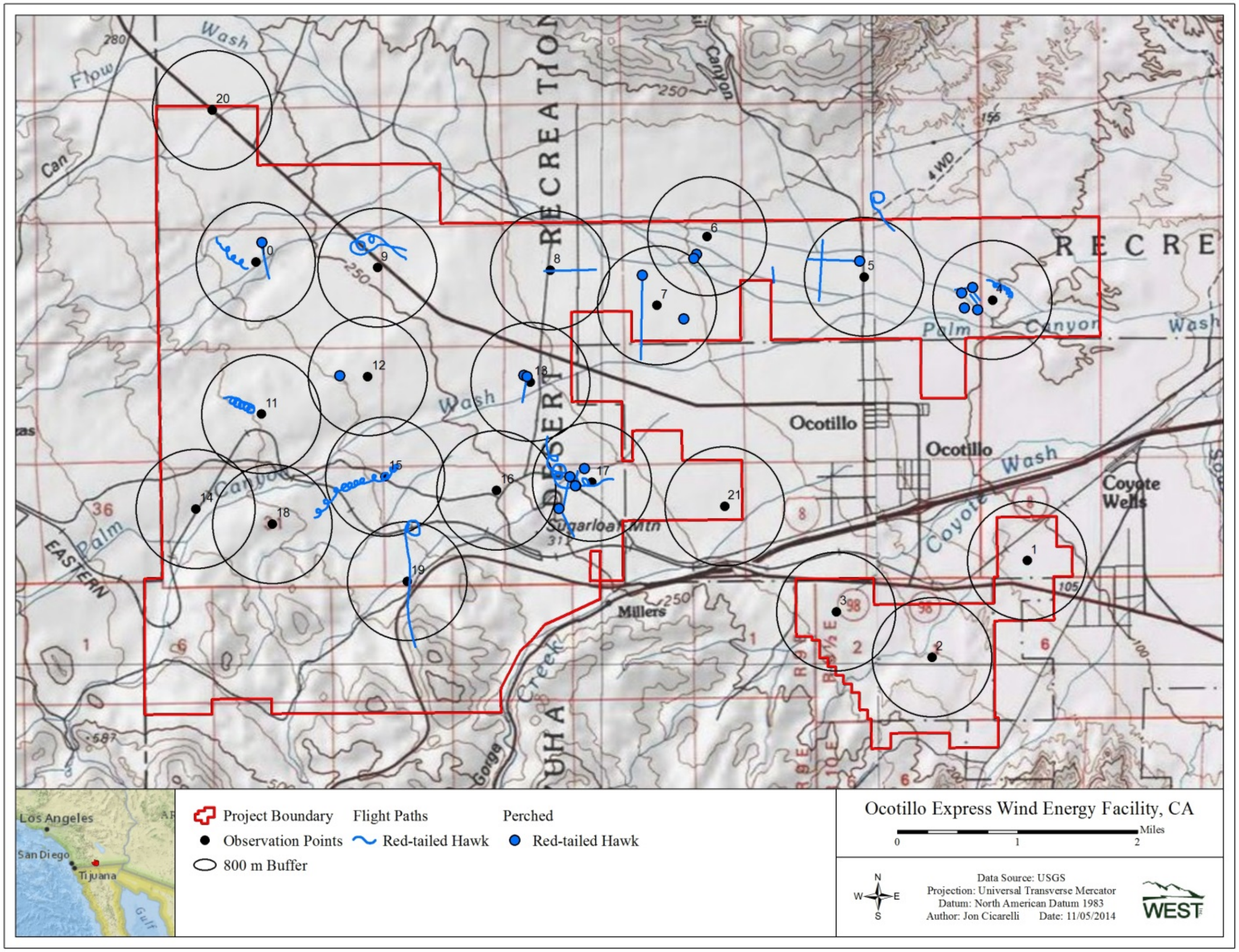
Appendix F. Mean Use by Point for All Birds, Major Bird Types, and Diurnal Raptor Subtypes during Fixed-Point Bird Use Surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014

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.

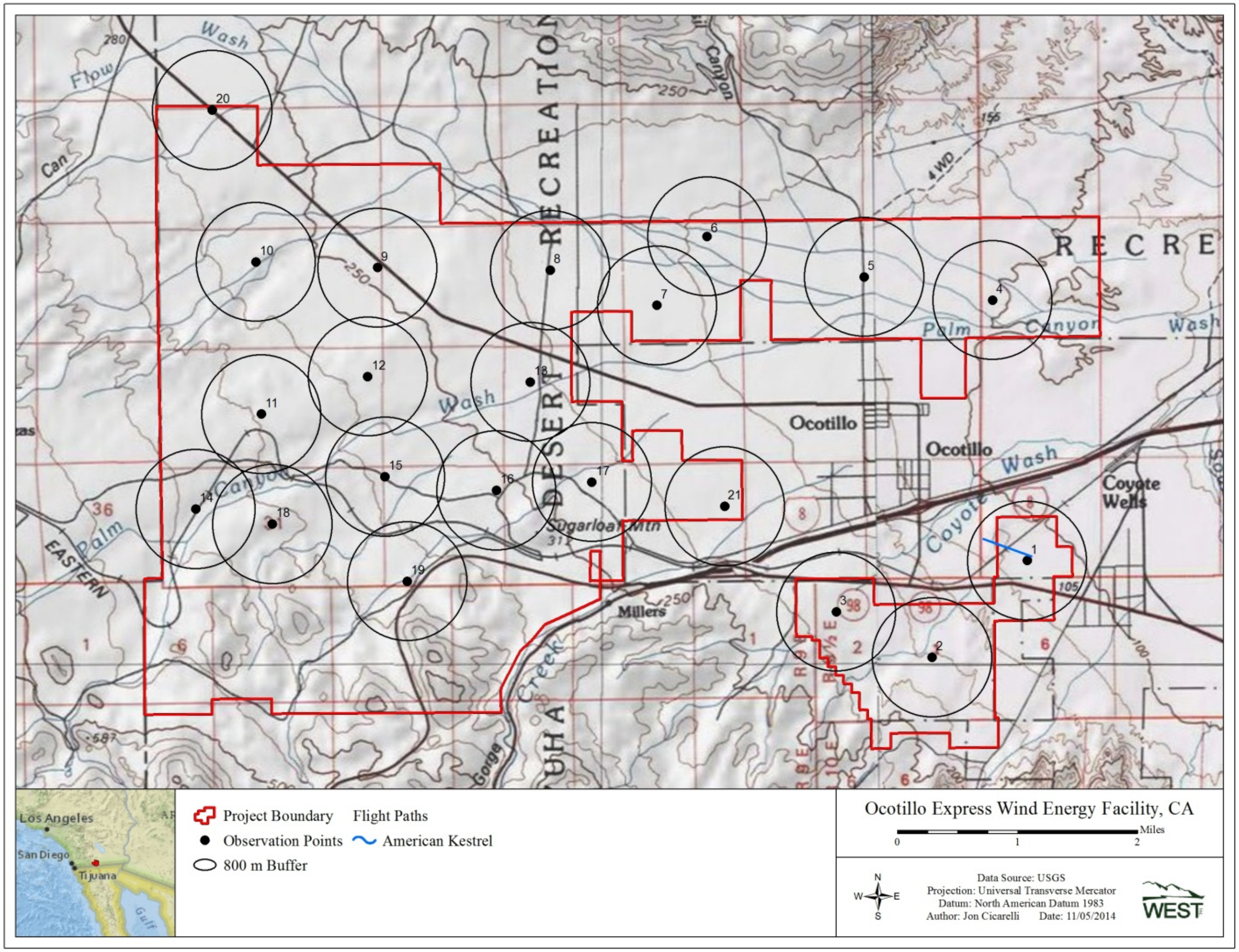
	Survey Point																				
Bird Type	**0**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Diurnal Raptor	0.04	0	0	0.23	0.15	0.12	0.08	0.04	0.04	0.08	0.08	0.08	0.08	0	0.04	0	0.27	0	0.04	0	0
Buteo	*0*	*0*	*0*	*0.23*	*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.

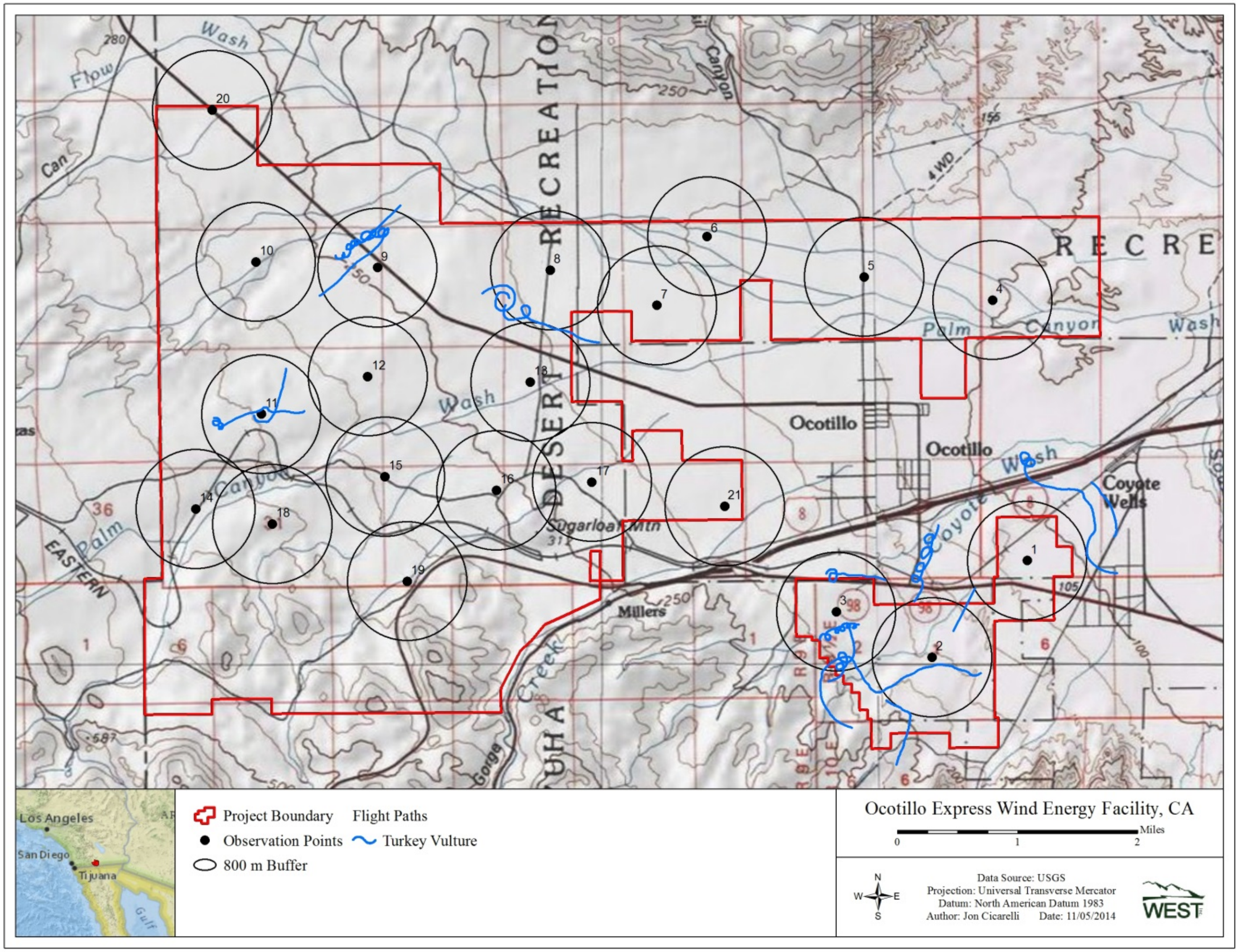
Appendix G. Large Bird Flight Paths Recorded during Fixed-Point Bird Use Surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014



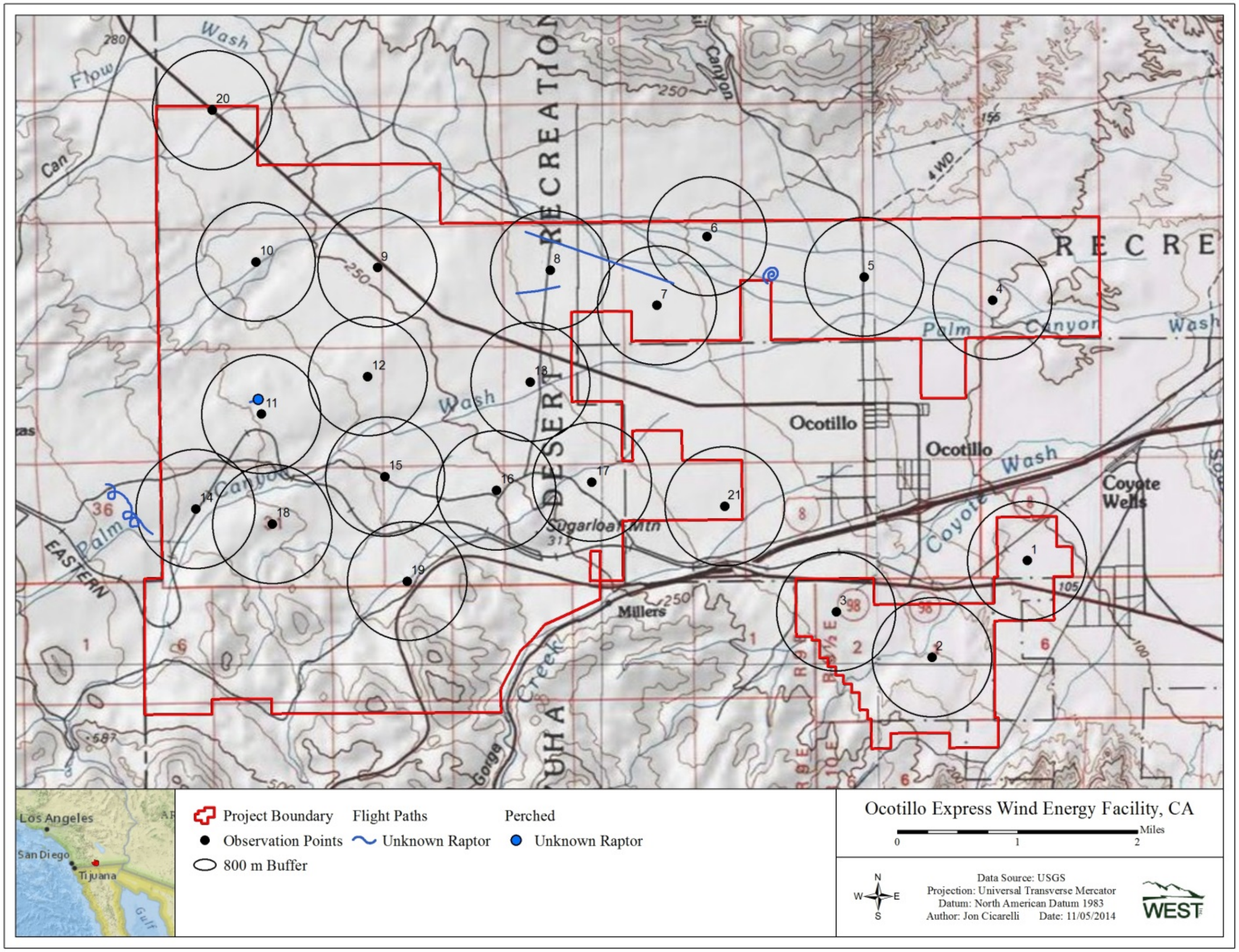
Appendix G. Buteo flight paths recorded at the Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from August 26, 2012 – September 29, 2014.



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

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

October 3, 2014 – September 25, 2015

Final Report

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January 22, 2016

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 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 multi-year, formal year-long mortality monitoring studies, raptor nest surveys, and avian use monitoring surveys. This report includes the results of the second full year of post-construction wildlife monitoring studies for the OWEF, including the second standardized year-long fatality monitoring study and avian use studies as well as comparisons of the second-year fatality rates to both the first-year rates and 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 will also be provided to the Technical Advisory Committee. In addition, additional carcass discoveries that occurred 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 second year of standardized year-long fatality monitoring began at the OWEF in October, 2014. Standardized carcass searches were conducted at 33 of the 112 turbines twice a month for a full year (October 2014 - September 2015). 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, 63 fatalities (37 birds and 26 bats) were documented from October 3, 2014, through September 25, 2015, during the second standardized year-long mortality monitoring study or incidentally during the study period. By comparison, 40 fatalities (26 birds and 14 bats) were documented during the first year of the study. Townsend's warbler was the most commonly identified bird fatality (four fatalities), while no more than three fatalities were documented for other identified bird species. Two red-tailed hawks (one discovered incidentally, one discovered during scheduled searches) were the only raptor fatalities identified during the study. Two Birds of Conservation Concern in Bird Conservation Region 33 (yellow warbler and Costa's hummingbird) were 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 only a few fatalities identified during the summer period.

A total of 26 bat fatalities were found during the second year of standardized year-long fatality monitoring studies, with 21 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). By comparison, 14 bat fatalities (five of which were incidental discoveries) were found during the first year. Mexican free-tailed bat was the most commonly documented fatality (10 fatalities); followed by western mastiff bat (three fatalities), pocketed free-tailed bat (three fatalities), western yellow bat (two fatalities), big free-tailed bat (one fatality), and long-legged bat (one fatality) were the other bat species identified as fatalities during the study. There were no federally listed bat species identified during the second standardized year-long mortality monitoring study or incidentally during the study period. One species (western mastiff bat) is listed as a BLM sensitive species and as a California Department of Fish and Wildlife species of special conservation. No more than three 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 (March and April), late summer (early to mid-July) and in early fall (mid-August into early October).

Searcher efficiency trials included 119 small bird and 49 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 79.8%, while the efficiency rate for large birds was 95.8%. Carcass removal trials included 90 large bird and 90 small bird carcasses. Removal rates differed among seasons for small birds and large birds, thus four rates were applied to estimate annual small bird/bat and large bird fatalities. Average removal times for small birds/bats were 11.95 days in winter, 9.18 days in spring, 6.90 days in summer, and 2.47 days in fall, while the average removal times for large birds were 19.13 days in winter, 19.41 days in spring, 17.32 days in summer, and 16.23 days in fall.

Fatality estimates and 90% confidence intervals were calculated for birds and bats. For small birds and bats, the probability that a carcass would remain in a search plot and be found by a searcher was 0.48 in winter, 0.41 in spring, 0.33 in summer, and 0.13 in fall. For large birds, the probability was 0.68 in winter and spring, 0.65 in summer, and 0.63 in fall. Annual fatality rates for all birds, adjusted for searcher efficiency and carcass removal, was 1.37 fatalities/MW/year, and the annual adjusted fatality rate for bats was 1.45 fatalities/MW/year.

The estimated overall bird fatality rate of 1.37 birds/MW/year was relatively low compared to other wind energy facilities with publicly available data in North America where rates have ranged from 0.06 to 17.44 birds/MW/year as well as in California and the desert southwest where estimates have ranged from 0.55 to 17.44 birds/MW/year. The overall bird fatality rate at the OWEF ranked sixth lowest compared to 23 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 raptor fatality rate of 0.04 raptors/MW/year was low compared to other wind energy facilities in North America which have ranged from zero to 1.06 raptors/MW/year as well as in California and the desert southwest where estimates have ranged from zero to 1.06 raptors/MW/year. Based upon the small estimate of raptor mortality at the OWEF, it is unlikely that operation of this facility will result in significant impacts to local or regional raptor populations.

The estimated overall bat fatality rate at the OWEF (1.45 bats/MW/year) was considered low relative to other wind energy facilities in North America where rates have ranged from zero to 40.2 bats/MW/year. The overall bat fatality rate is moderate relative to other wind energy facilities in California and the desert southwest with publicly available bat fatality data, where bat fatality rates ranged from zero 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-four rounds of fixed-point avian use surveys were conducted at 21 survey stations from October 3, 2014, through September 25, 2015, resulting in 504 fixed-point surveys. Twenty-seven unique bird species were documented, with house finch, common raven, and rock wren accounting for the majority of all observations. Raptor use was low throughout all seasons, and varied from 0.02 raptors per 800-m (2,625-ft) plot per 30-min survey during the fall to 0.14 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 1.32. birds/100-m plot/30-min survey in the summer to a high of 2.58 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, collectively accounting for between 44% and 62% of passerine use across all seasons.

During the 2014-2015 avian use study, house finch, common raven, rock wren, and black-throated sparrow, and cactus wren were the most abundant bird species. All of these species were also among the most abundant species observed during the 2013-2014 avian use study and the pre-construction studies. Avian abundance was slightly higher during the 2014-2015 study compared to the 2013-2014 study but is still considered low relative to the results of other publicly available studies with similar methodologies.

The results of the second year of standardized studies have provided additional 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. The results of the second year of post-construction monitoring also support this conclusion, suggesting that the first year results (which demonstrated low impacts to birds and bats), were not an anomaly or unusual, but rather representative of the impacts that can be expected at the Project.

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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 (BLM 2012a, 2012b). 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 (BLM 2010), 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 the 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, US 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, as 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 multi-year, formal year-long mortality monitoring studies, raptor nest surveys, and avian use monitoring surveys. This report includes the results of the second full year of post-construction wildlife monitoring studies for the OWEF including the second standardized year-long mortality monitoring study and avian use studies, as well as comparisons of the second-year mortality rates to the first-year mortality rates and reported mortality rates at wind energy facilities for which publicly available data exist. Separate stand-alone raptor and eagle nest monitoring reports have been prepared and have been or will be provided to the TAC. Additional carcass discoveries that occurred during the separate interim/large bird searches are not presented herein, but a comprehensive list of all carcass discoveries at the facility have been provided to the agencies on a monthly basis.

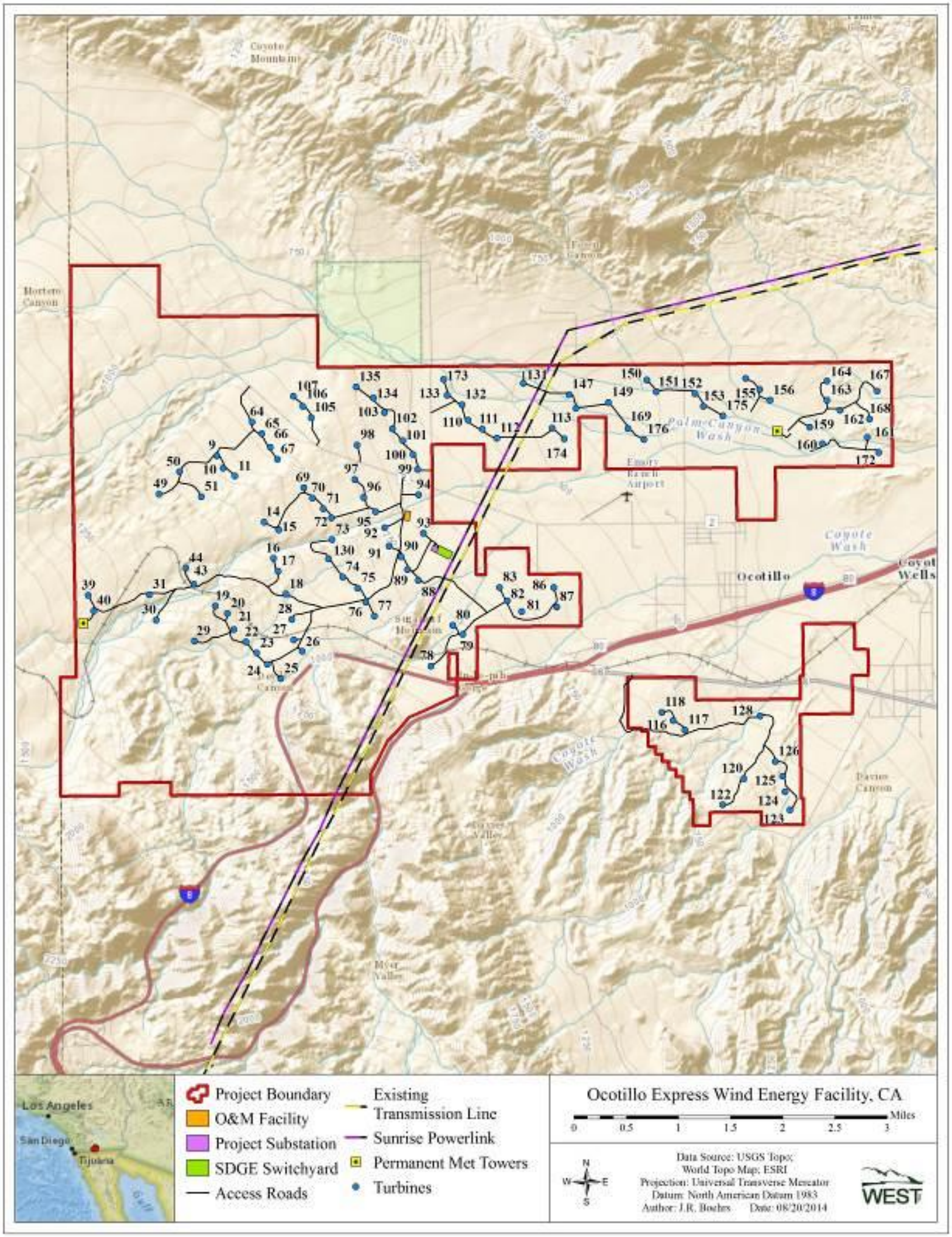

Figure 1. Location of the Ocotillo Express Wind Energy Facility in Imperial County, California.

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 US 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 (an 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 considerably smaller than the northern area and the majority of the southern area 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 also cut through the site.

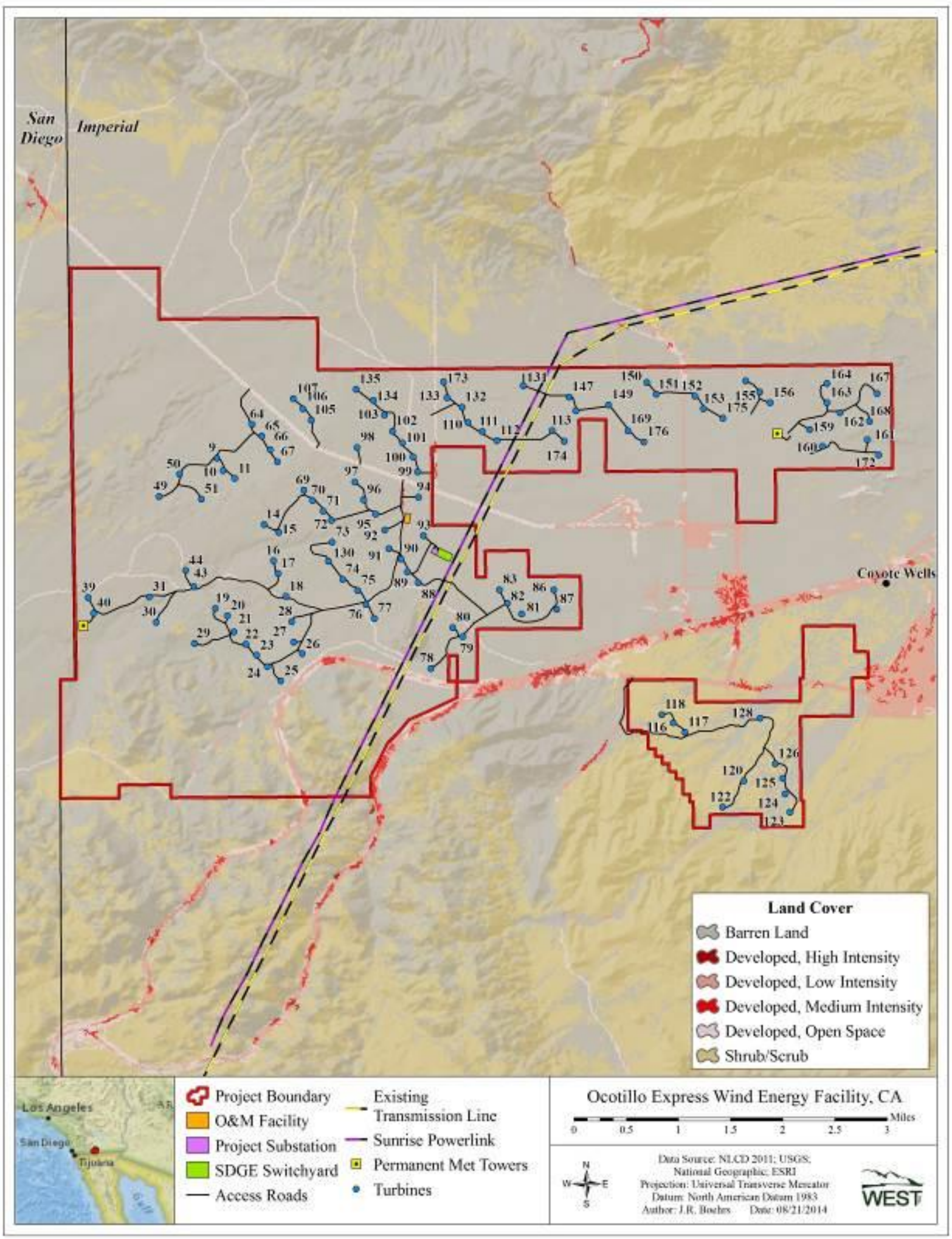

Figure 2. Landuse/landcover information for the Ocotillo Express Wind Energy Facility (USGS NLCD 2001).

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 2 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	173
76	130	174
82	133	176

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 mortality 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 mortality estimates.

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.

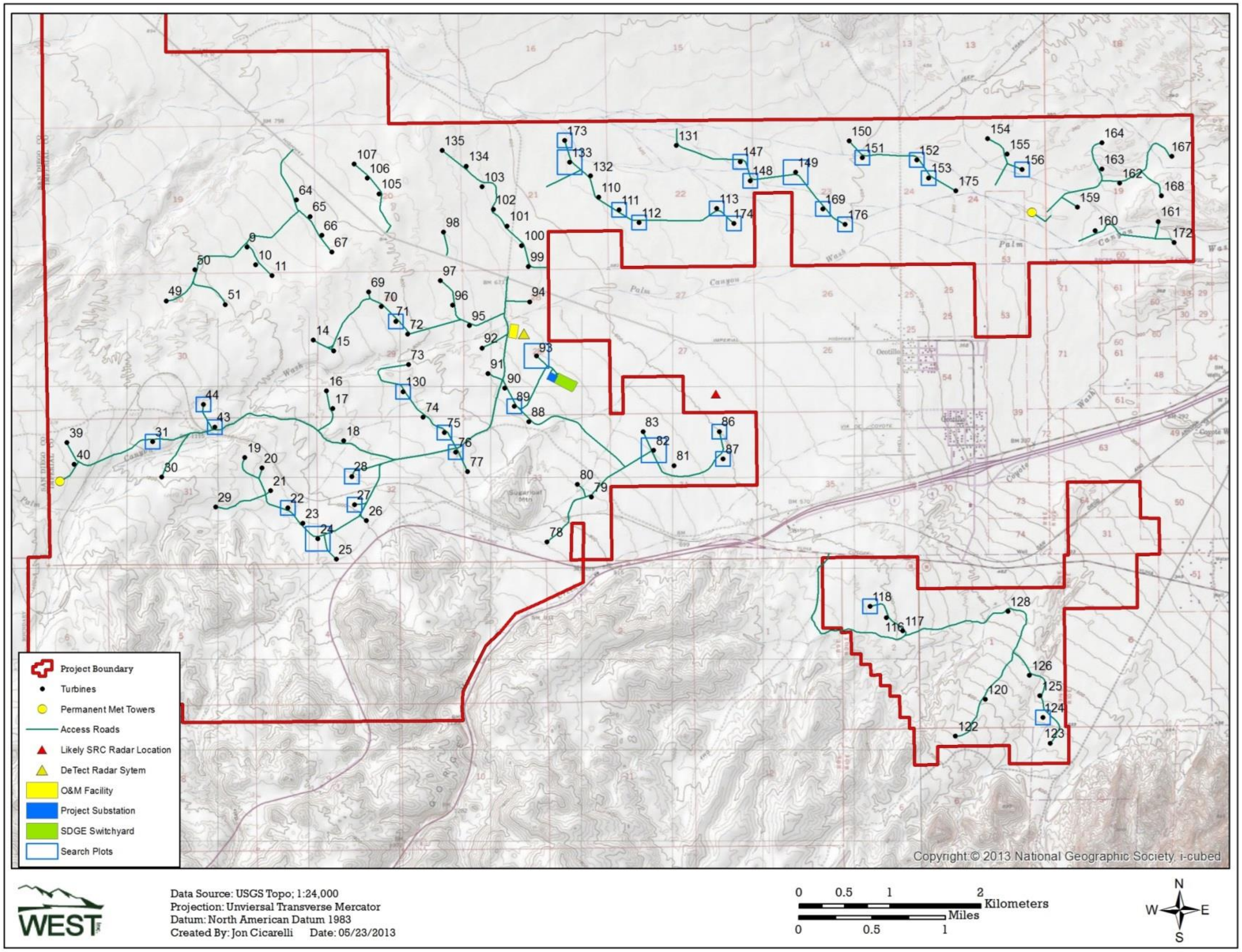

Figure 3. Turbines selected for the Year 2 mortality monitoring study at the Ocotillo Express Wind Energy Facility.

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 mortality. 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.

Mortality 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 mortalities attributable to operation of the facility, based on the number of avian and bat mortalities found at the facility, were reported. All carcasses located within areas surveyed or incidentally, regardless of species, were recorded. 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 Mortality Rates

The estimated per turbine annual mortality 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.

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).

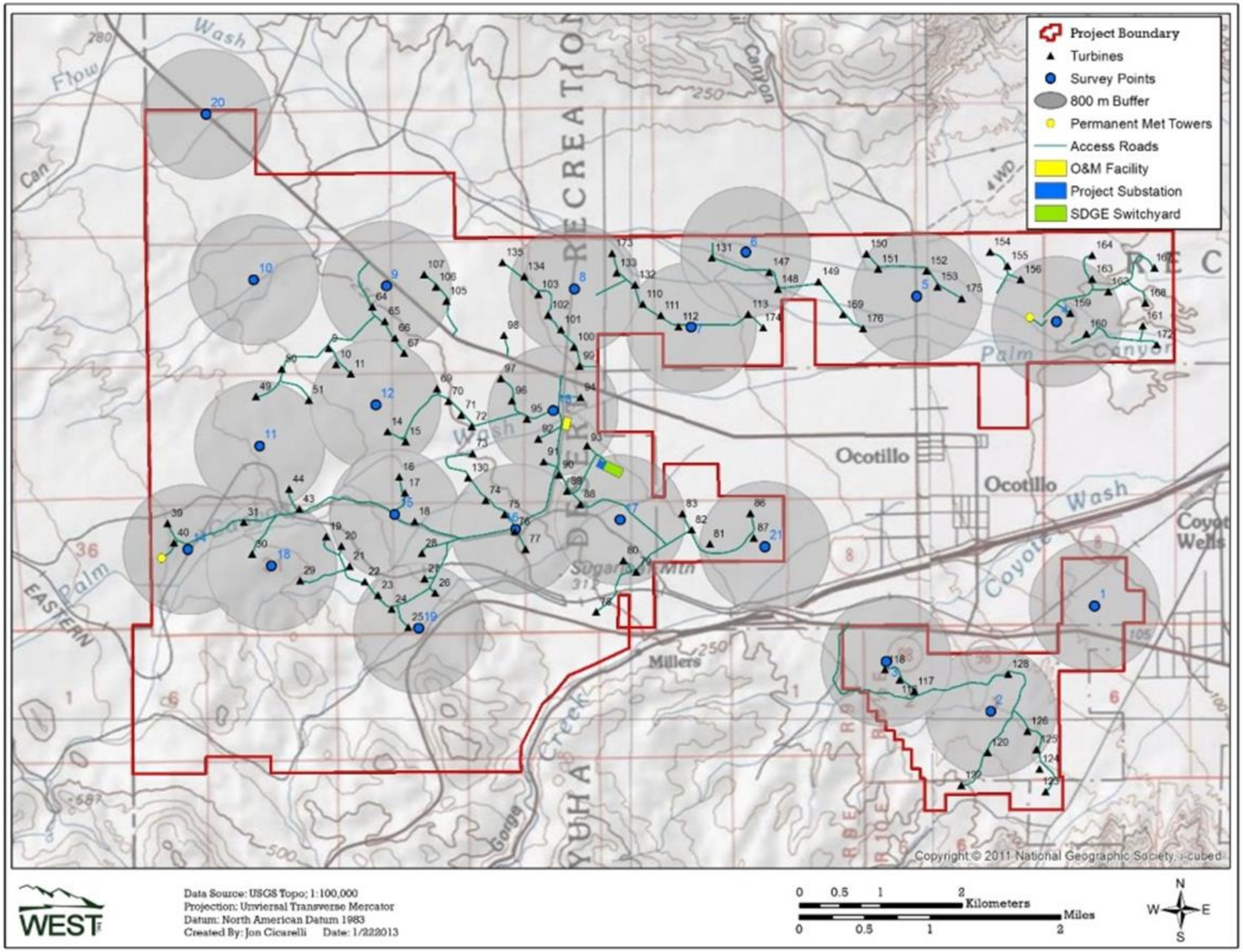

Figure 4. Fixed point locations for avian use surveys at the Ocotillo Express Wind Energy Facility.

Each observation point was surveyed for 30 minutes (min) twice a month. The survey view-sheds 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. To make comparisons to other studies, the use value was further standardized by only including those observations that occurred during the first 20 minutes of the survey, since most of the studies available for comparison used 20-minute survey durations.

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 3, 2014, and continued through September 25, 2015. 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, 63 fatalities (37 birds and 26 bats) were documented during the second year mortality monitoring studies from October 3, 2014, through September 25, 2015 (Table 2). A complete listing of all carcasses identified during the second standardized year-long fatality study or incidentally during the study period is provided in Appendix A. Fifty-four of the carcasses were documented during scheduled searches, while nine carcasses were documented incidentally (Table 2). Two of the incidental bat carcass discoveries and four of the incidental bird carcass discoveries were located on search plots; therefore, these carcasses were included in analyses used to estimate annual mortality rates. All other incidental discoveries were located off search plots and were not included in the analyses used to estimate annual mortality rates.

Table 2. Numbers and composition of bird and bat carcasses discovered at the Ocotillo Express Wind Energy Facility during the year-long standardized searches and incidentally from October 3, 2014 – September 25, 2015.

	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 bird (small)[2]	10	30.3	0	0	0	0	10	27.0
Townsend's warbler	3	9.1	1	25.0	0	0	4	10.8
black-throated gray warbler	3	9.1	0	0	0	0	3	8.1
unidentified sparrow	3	9.1	0	0	0	0	3	8.1
mourning dove	2	6.1	1	25.0	0	0	3	8.1
white-throated swift	2	6.1	0	0	0	0	2	5.4
red-tailed hawk	1	3.0	1	25.0	0	0	2	5.4
common poorwill	1	3.0	0	0	0	0	1	2.7
Costa's hummingbird	1	3.0	0	0	0	0	1	2.7
Eurasian collared-dove	1	3.0	0	0	0	0	1	2.7
horned lark	1	3.0	0	0	0	0	1	2.7
house finch	1	3.0	0	0	0	0	1	2.7
unidentified large bird	1	3.0	0	0	0	0	1	2.7
unidentified warbler	1	3.0	0	0	0	0	1	2.7
Wilson's warbler	1	3.0	0	0	0	0	1	2.7
yellow warbler	1	3.0	0	0	0	0	1	2.7
western tanager	0	0	1	25.0	0	0	1	2.7
Overall Birds	**33**	**100**	**4**	**100**	**0**	**0**	**37**	**100**
Bats								
Mexican free-tailed bat	10	47.6	0	0	0	0	10	38.5
unidentified free-tailed bat[1]	2	9.5	1	50.0	1	33.3	4	15.4
western mastiff bat	2	9.5	1	50.0	0	0	3	11.5
pocketed free-tailed bat[1]	2	9.5	0	0	1	33.3	3	11.5
unidentified bat	2	9.5	0	0	0	0	2	7.7
western yellow bat[1]	1	4.8	0	0	1	33.3	2	7.7
big free-tailed bat	1	4.8	0	0	0	0	1	3.8
long-legged bat	1	4.8	0	0	0	0	1	3.8
Overall Bats	**21**	**100**	**2**	**100**	**3**	**100**	**26**	**100**

[1] Incidental discoveries found off search plots were excluded from the annual mortality estimates.

[2] One unidentified small bird was found outside of the 160 X 160-m plot, but was within the larger 270 X 270-m plot.

Bird Mortalities

During the study, 33 birds comprising 14 identifiable species were found during scheduled searches or incidentally (Table 2). Fifteen of the bird carcasses were not identifiable to species as they consisted primarily of bones, bone fragments, or non-distinct feathers. The bird species most commonly found during the study, either during scheduled searches or incidentally was Townsend's warbler (*Setophaga townsendi*; four carcasses). Mortalities of all other species consisted of either one, two or three individuals (Table 2). One raptor species (red-tailed hawk; *Buteo jamaicensis*) was discovered during the study (two carcasses). None of the avian species identified during the second standardized year-long fatality or incidentally during the study period are federal or state listed species. One Costa's hummingbird (*Calypte costae*) and one yellow warbler (*S. petechia*), both listed as Birds of Conservation Concern (BCC) in Bird

Conservation Region (BCR) 33 [see USFWS 2008]) were the only sensitive avian species carcasses identified during the second year-long mortality monitoring study.

The greatest number of bird mortalities found at any one search plot was three mortalities found at five turbines (Turbines T124, T133, T152, T156, and T76); two bird mortalities were found at six of the turbines, and single mortalities were found at 10 other search turbines (Figure 5 and Figure 6a). The lack of strong patterns in the spatial distribution of bird mortalities suggests no large differences in bird mortality by location within the Project. Of the bird fatalities, about half (54%) were found within 60 m (197 ft) of the turbine and nine were found beyond 90 m (295 ft) from a turbine (Table 3). One of the 19 bird carcasses discovered during scheduled searches was located outside of the 160 X 160-m plot, but was within the larger 270 X 270-m plot. Bird mortalities occurred throughout the year, peaking between March and May (Figure 6b).

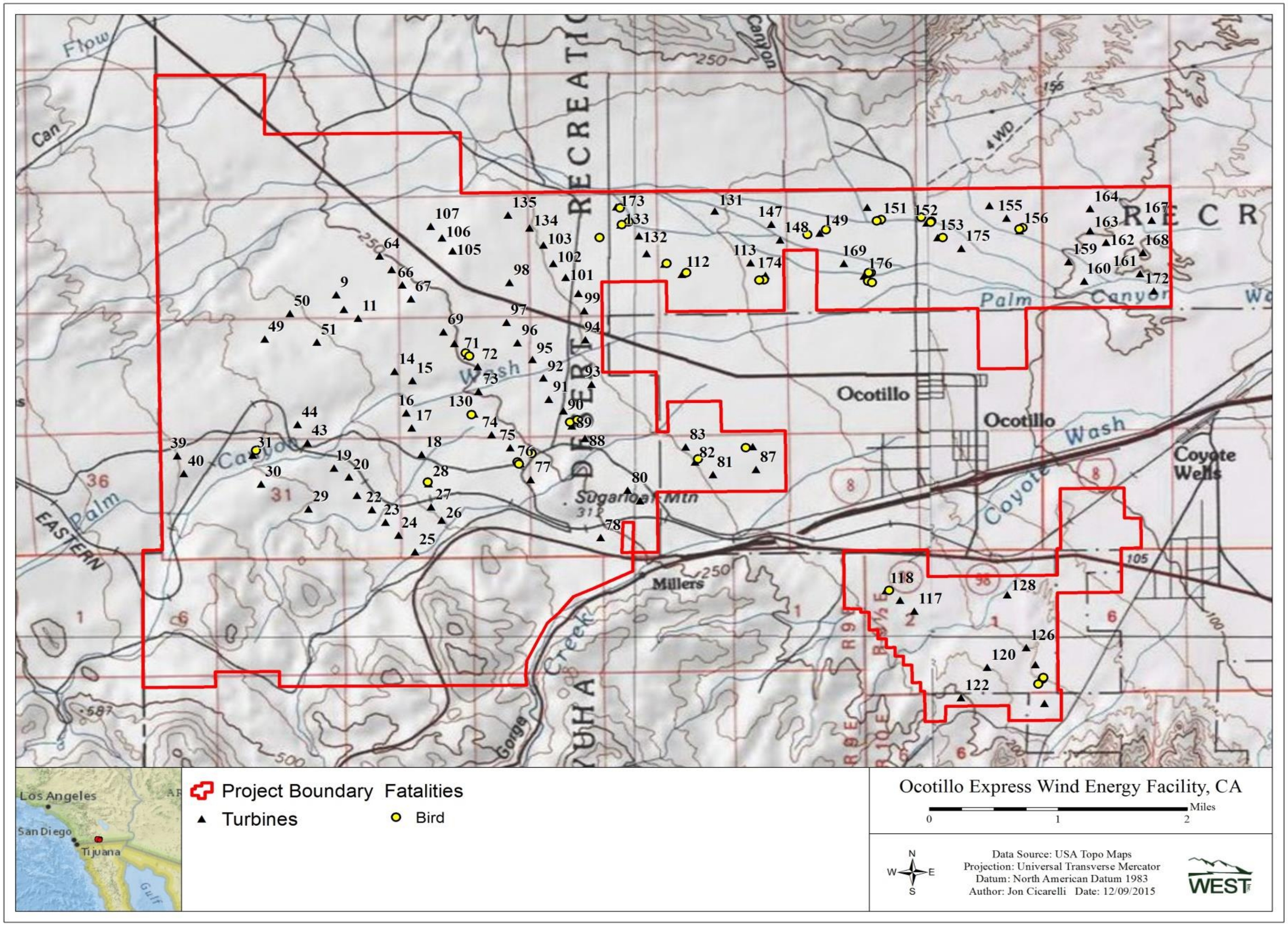

Figure 5. Location of all bird carcasses found during the second standardized year-long mortality study or incidentally during the study period at the Ocotillo Express Wind Energy Facility.

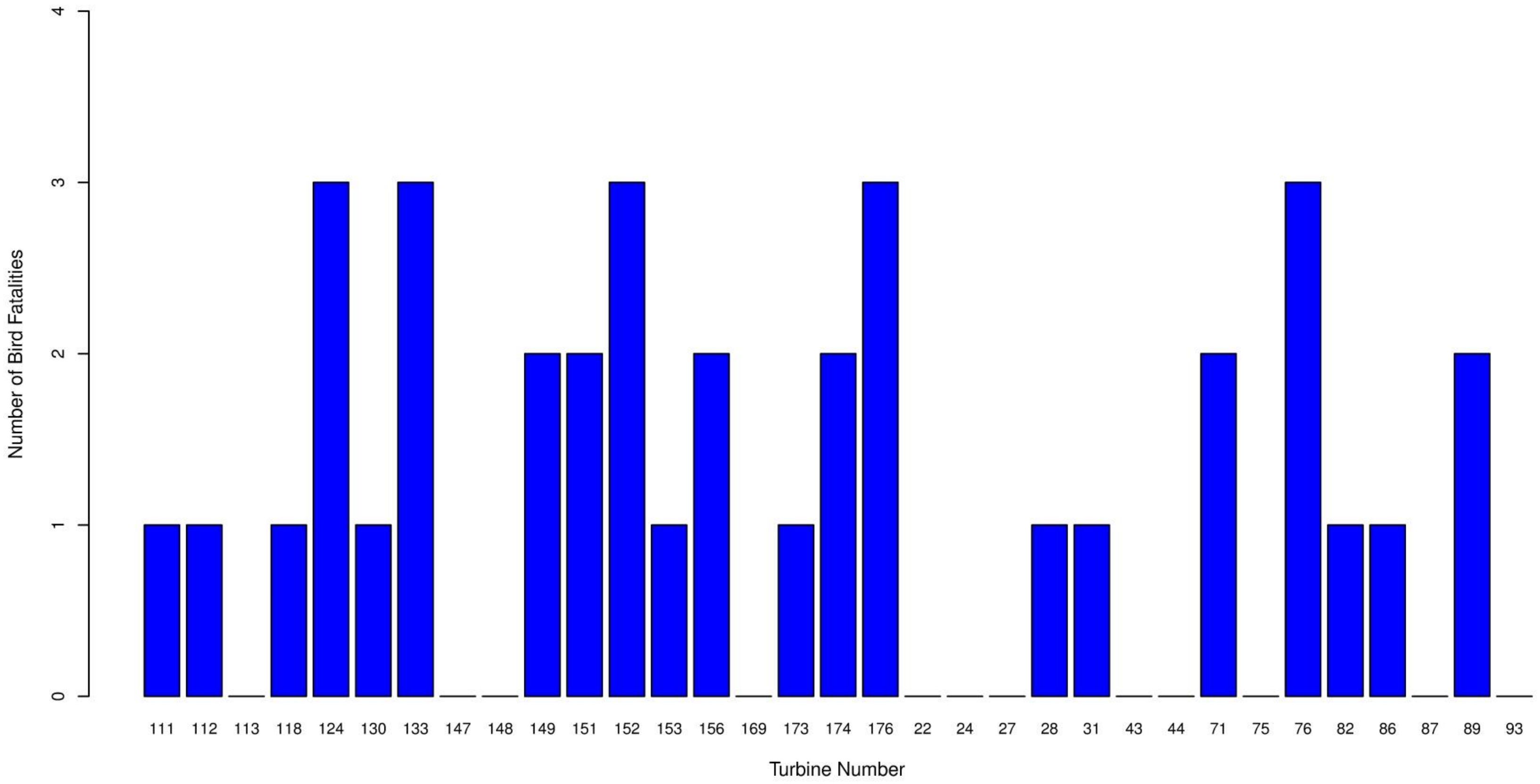

Figure 6a. Number of bird carcasses by turbine found during year-long standardized searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

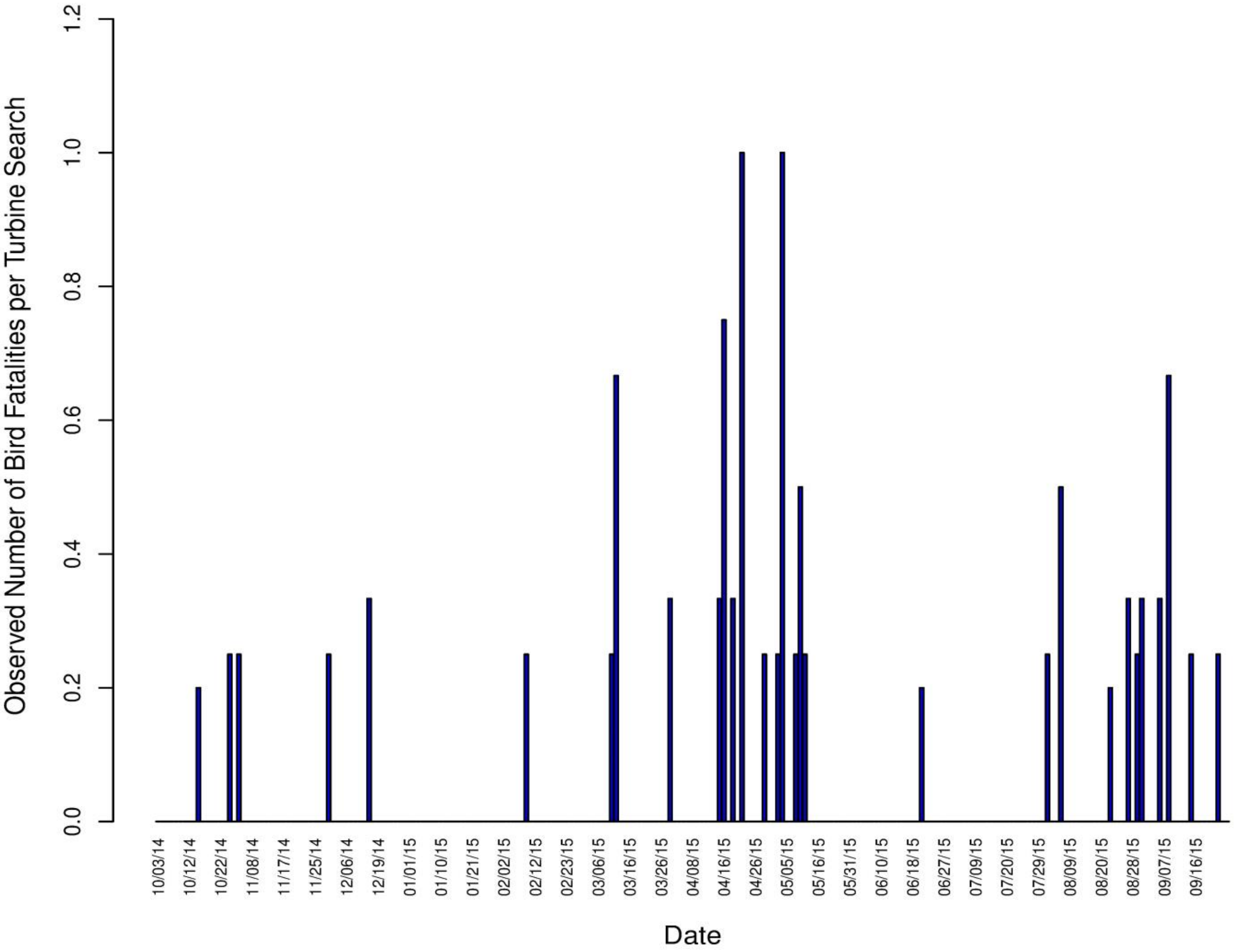

Figure 6b. Timing of bird mortalities found during scheduled searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

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)	Number of Bird Casualties	% Bird Casualties	Number of Bat Casualties	% Bat Casualties
0 to 10	0	0	4	17.4
10 to 20	2	5.4	3	13.0
20 to 30	5	13.5	6	26.1
30 to 40	3	8.1	2	8.7
40 to 50	5	13.5	2	8.7
50 to 60	5	13.5	3	13.0
60 to 70	2	5.4	2	8.7
70 to 80	3	8.1	1	4.3
80 to 90	3	8.1	0	0
>90	9	24.3	0	0

Bat Mortalities

A total of 26 bat mortalities were found during the second standardized year-long mortality monitoring study or incidentally during the study period, with twenty-one 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*; 10 carcasses). Western mastiff bat (*Eumops perotis*; three carcasses), pocketed free-tailed bat (*Nyctinomops femorosaccus*; three carcasses), western yellow bat (*Lasiurus xanthinus*; two carcasses), big free-tailed bat (*N. macrotis*; one carcass), and long-legged bat (*Macrophyllum macrophyllum*; one carcass) were the other bat species identified. The remaining six bat carcasses could not be identified to species. None of the bat species identified during the second standardized year-long fatality or incidentally during the study period are federal or state listed species. The western mastiff bat (*Eumops perotis californicus*) is listed as a species of special concern by CDFW and is also listed as a BLM sensitive species.

Three bat carcasses were found at turbine 149; two bat carcasses were found at each of five turbines (Turbine T148, T173, T174, T31, and T93), and single carcasses were found at 10 other search turbines (Figure 7 and Figure 8a). The lack of strong patterns in the spatial distribution of bat carcasses suggests no large differences in bat mortality by location within the Project. Of the bat mortalities, 73.9% were found within 50 m (164 ft) of the turbine, and no bat mortalities were found greater than 75 m (230 ft) from a turbine (Table 3). Temporally, bat fatalities were concentrated in the late spring (March and April), late summer (early to mid-July), and in early fall (mid-August into early October; Figure 8b).

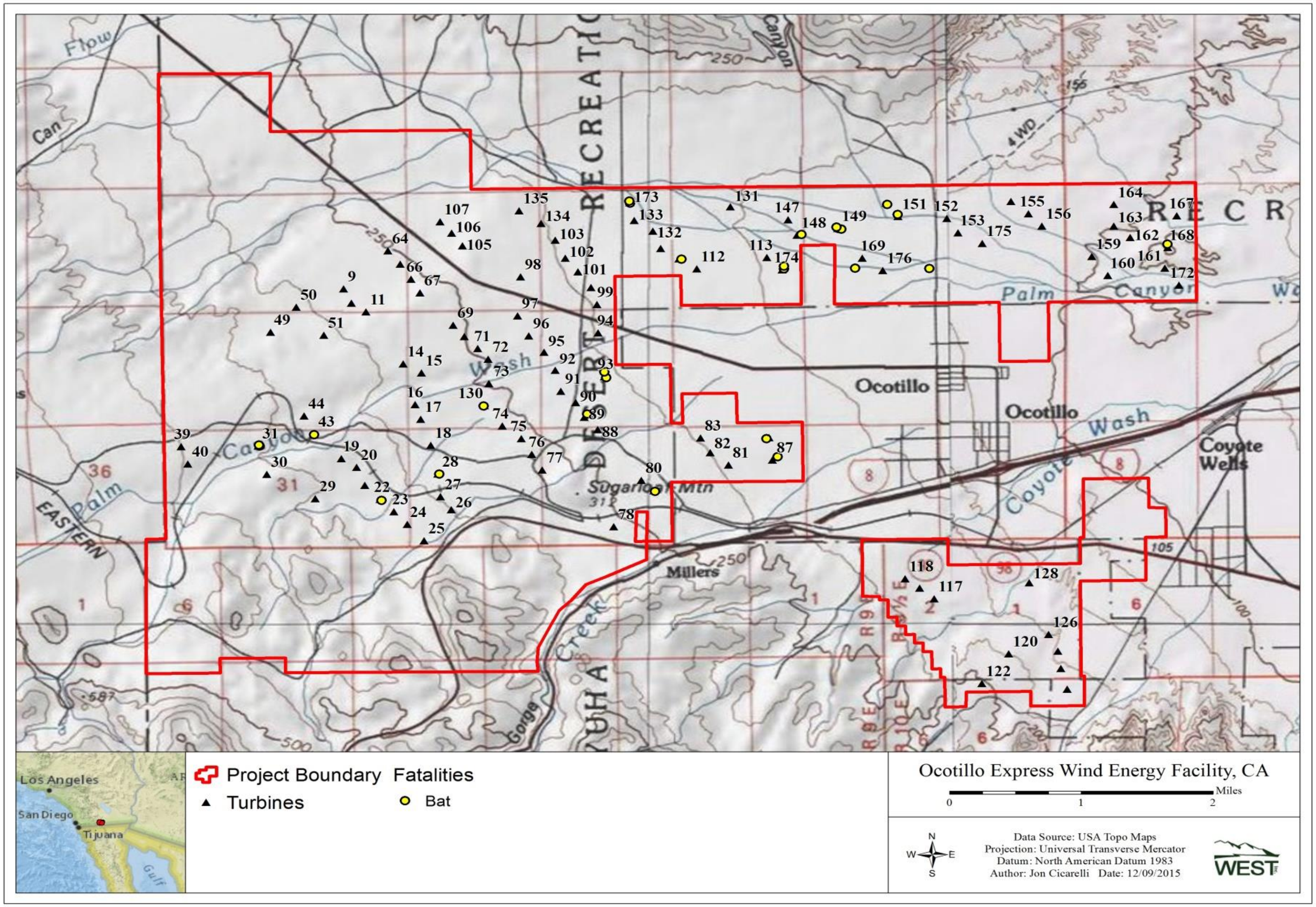

Figure 7. Location of all bat carcasses found during the second standardized year-long fatality study or incidentally during the study period at the Ocotillo Express Wind Energy Facility.

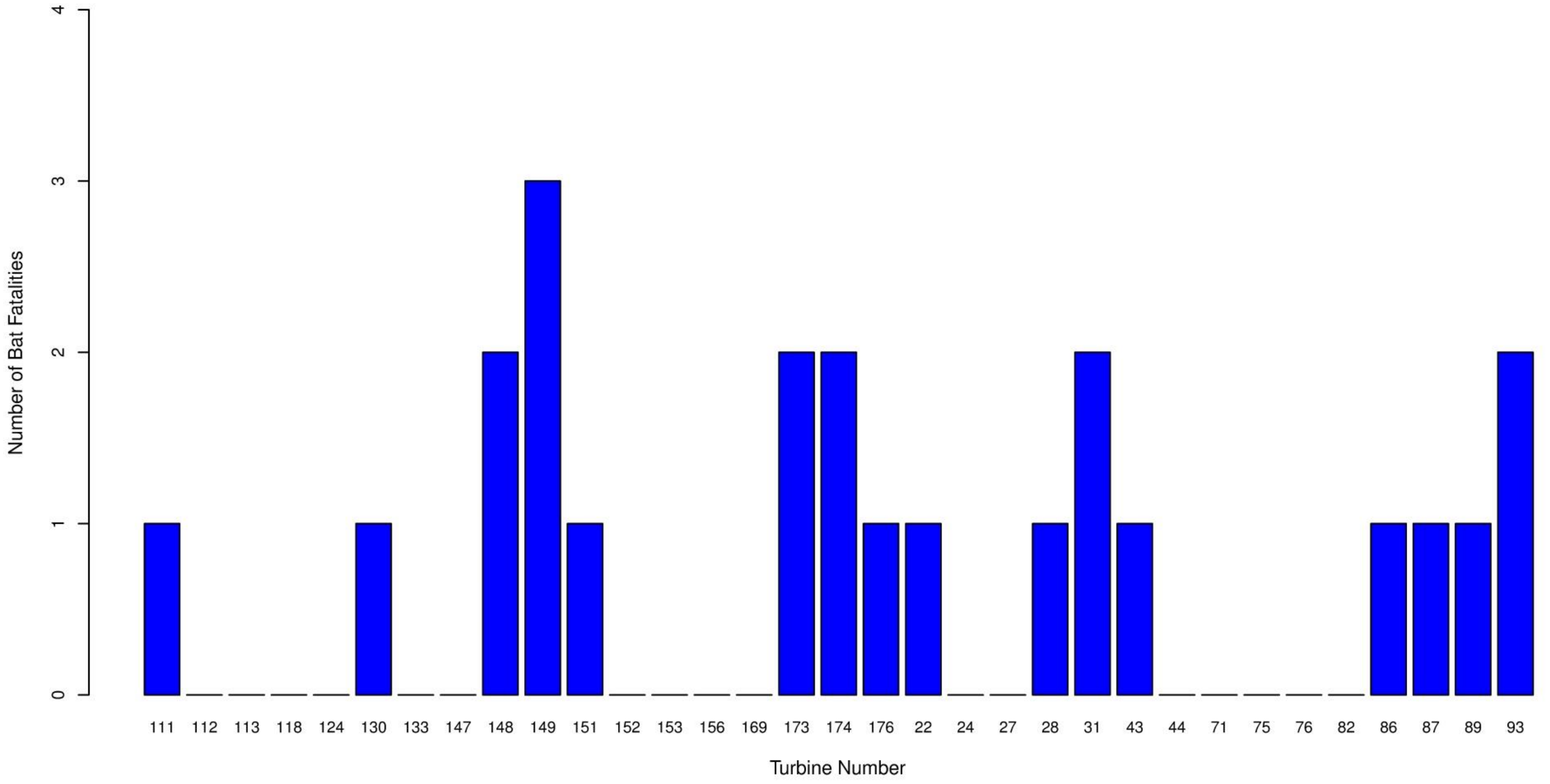

Figure 8a. Number of bat mortalities by turbine found during year-long scheduled searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

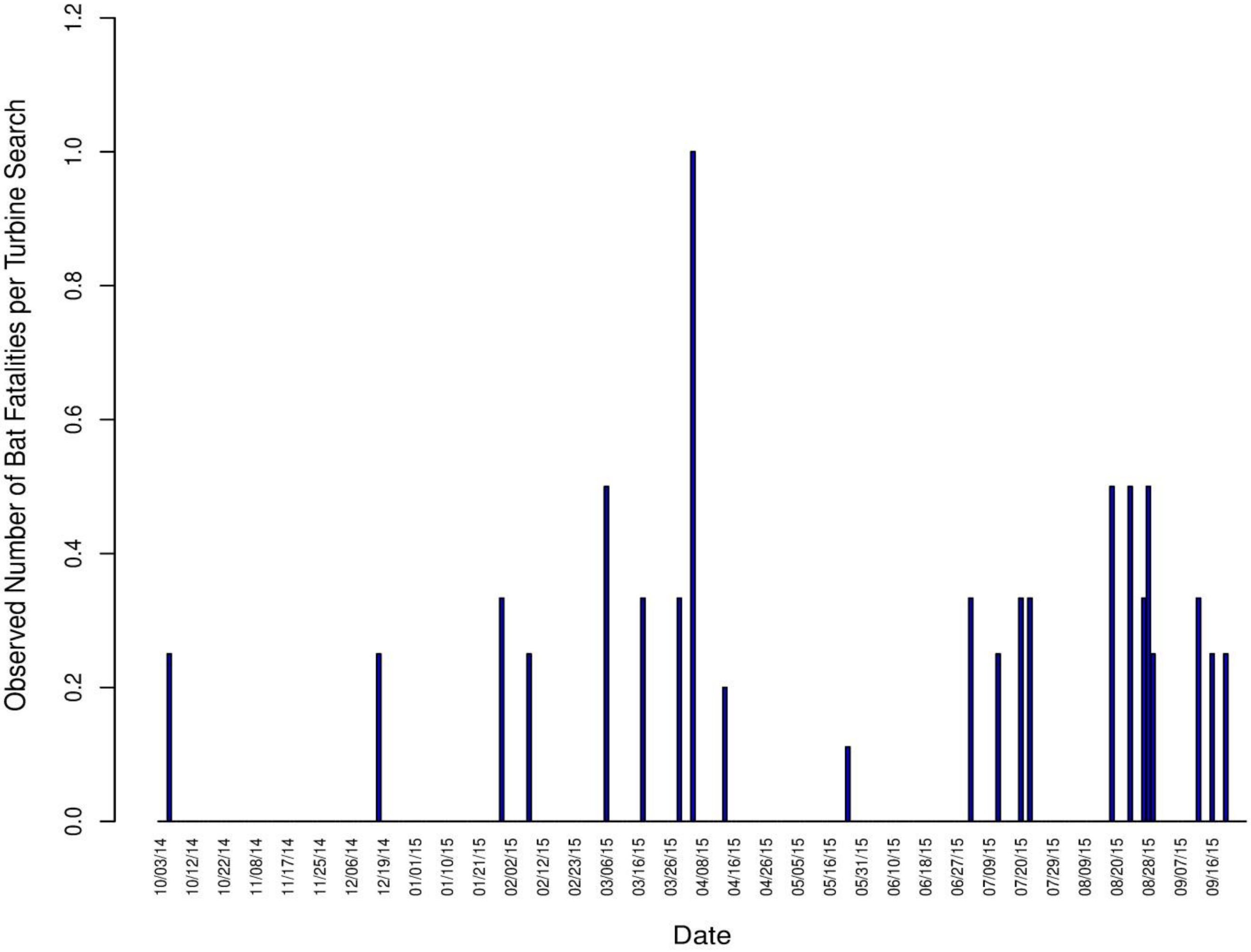

Figure 8b. Timing of bat mortalities found during scheduled searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

Searcher Efficiency Trials

Searcher efficiency trials were conducted throughout the year-long study period and included 119 small bird and 49 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 79.8%, while the efficiency rate for large birds was 95.8%, which is similar to the rates observed during the first year of study (73.4% for small birds and 94.3% for large birds). 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	9/27/2014	15	15	13	86.7
	11/8/2014	19	19	15	78.9
	12/13/2014	15	15	10	66.7
	1/31/2015	14	13	13	100
	4/25/2015	17	13	8	61.5
	5/28/2015	19	19	19	100
	6/18/2015	10	10	7	70.0
	7/27/2015	10	10	6	60.0
Total		**119**	**114**	**91**	**79.8**
Large Birds	9/27/2014	4	4	4	100
	11/8/2014	5	5	5	100
	12/13/2014	4	4	4	100
	1/31/2015	5	5	5	100
	4/25/2015	6	5	4	80.0
	5/28/2015	5	5	4	80.0
	6/18/2015	10	10	10	100
	7/27/2015	10	10	10	100
Total		**49**	**48**	**46**	**95.8**

Carcass Removal Trials

Nine carcass removal trials were conducted throughout the study period. In total, 90 large bird and 90 small bird carcasses were placed (Table 5). No bat carcasses were used during removal trials. Trials were distributed throughout the seasons. Removal rates differed among the four seasons for small birds and large birds, thus four rates were applied to estimate annual small bird/bat and large bird mortality rates. Average removal times for small birds/bats were 11.95 days in winter, 9.18 days in spring, 6.90 days in summer, and 2.47 days in fall, while the average removal time for large birds were 19.13 days in winter, 19.41 days in spring, 17.32 days in summer, and 16.23 days in fall (Figure 9 and Appendix B).

Table 5. Carcass removal trials conducted at the Ocotillo Express Wind Energy Facility, August 19, 2014 – August 17, 2015.

Start Date	# Large Birds Placed	# Small Birds Placed	# Bats Placed
8/19/2014	10	10	0
9/18/2014	10	10	0
11/13/2014	10	10	0
1/14/2015	10	10	0
3/30/2015	10	10	0
4/20/2015	10	10	0
6/8/2015	10	10	0
7/6/2015	10	10	0
8/17/2015	10	10	0
	90	**90**	**0**

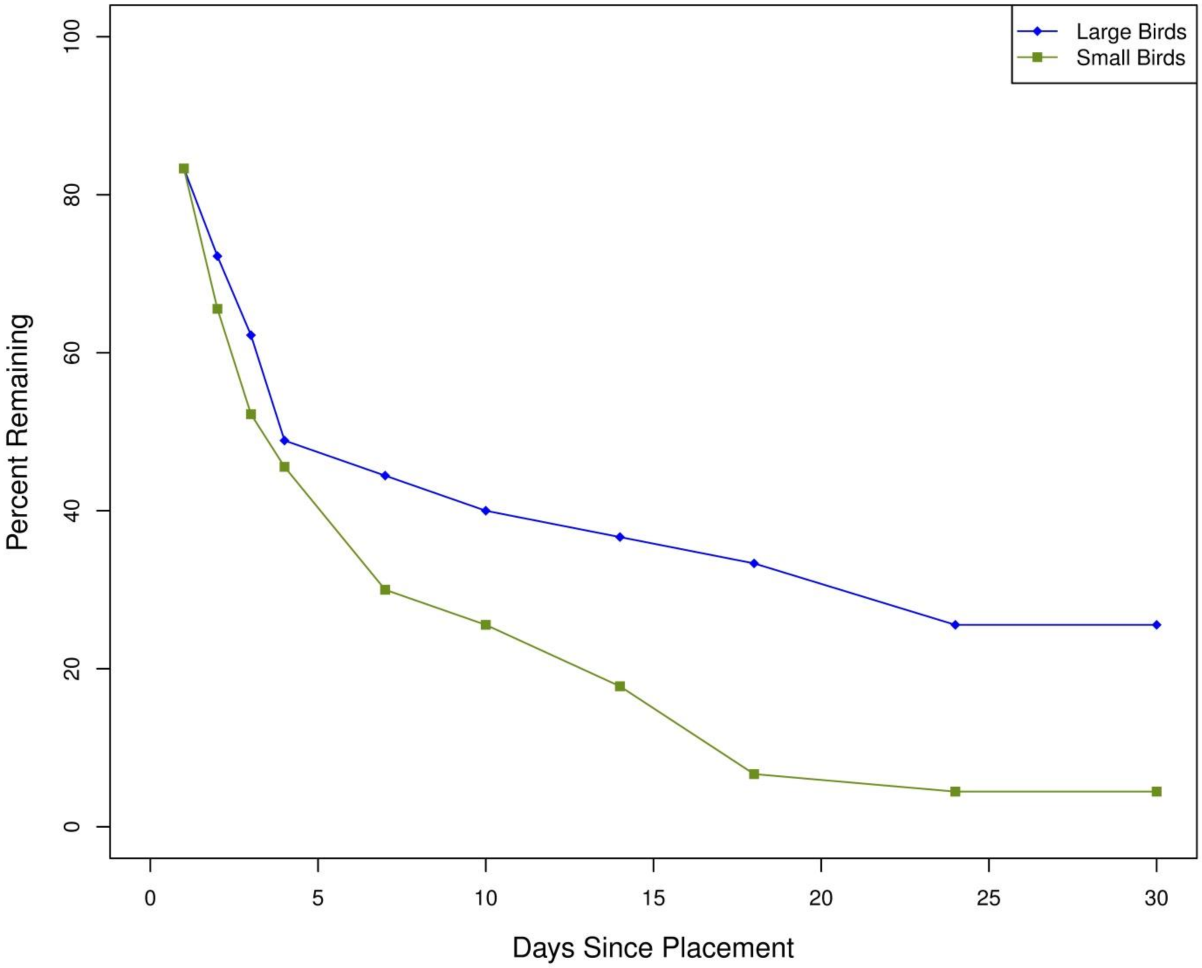

Figure 9. Carcass removal rates at the Ocotillo Express Wind Energy Facility.

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 among seasons for small birds and large birds, four rates were applied to estimate annual small bird/bat and large bird mortalities. For small birds and bats, the probability that a carcass would remain in a search plot and be found by a searcher was 0.48 in winter, 0.41 in spring, 0.33 in summer, and 0.13 in fall. For large birds, the probability was 0.68 in winter and spring, 0.65 in summer, and 0.63 in fall (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 close to, and in some cases 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 mortality estimates for the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015.

Corrected Mortality Estimates[1]		
Species Category	**# mortalities/turbine/study period**	**90% Confidence Intervals**
Small birds	2.87	(1.97, 4.18)
Large birds	0.28	(0.11, 0.51)
Raptors	0.09	-[2]
All birds	3.15	(2.02, 4.23)
Bats	3.33	(2.06, 4.97)
Species Category	**# mortalities/MW/study period**	**90% Confidence Intervals**
Small birds	1.25	(0.85, 1.82)
Large birds	0.12	(0.05, 0.22)
Raptors	0.04	-[2]
All birds	1.37	(0.88, 1.84)
Bats	1.45	(0.90, 2.16)

[1] For details concerning correction factors and confidence intervals for both bird and bat mortality estimates, refer to Appendix B.

[2] Confidence intervals are not reported for categories with five or fewer mortalities

Small Birds

The estimated annual mortality rate for small birds was 2.87 mortalities/turbine/year or 1.25 mortalities/MW/year (Table 6). A detailed breakdown of mortality rates and the associated correction factors is presented in Appendix B.

Large Birds

The estimated annual mortality rate for large birds was 0.28 mortalities/turbine/year or 0.12 mortalities/MW/year (Table 6). A detailed breakdown of mortality rates and the associated correction factors is presented in Appendix B.

All Birds

The estimated annual mortality rate for all birds was 3.15 mortalities/turbine/year or 1.37 mortalities/MW/year (Table 6). A detailed breakdown of mortality rates and the associated correction factors is presented in Appendix B.

Raptors

Two red-tailed hawks were discovered (one incidentally; one during scheduled searches) during the study period. The estimated annual mortality rate for raptors was 0.09 mortalities/turbine/year or 0.04 mortalities/MW/year (Table 6). A detailed breakdown of mortality rates for raptors and the associated correction factors is presented in Appendix B.

Bats

The estimated annual mortality rate for all bats was 3.33 mortalities/turbine/year or 1.45 mortalities/MW/year (Table 6). A detailed breakdown of bat mortality rates and the associated correction factors is presented in Appendix B.

Avian Monitoring

Fixed-Point Avian Use Surveys

Twenty-four rounds of fixed-point avian use surveys were conducted at 21 survey stations from October 3, 2014, through September 25, 2015, resulting in 504 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 October 3, 2014 – September 25, 2015.

Season	Number of Visits	# Surveys Conducted	# Unique Species	Species Richness	
				Large Birds	Small Birds
Fall	5	105	16	0.22	1.26
Winter	7	147	18	0.26	1.69
Spring	6	126	19	0.42	1.87
Summer	6	126	19	0.38	1.05
Overall	**24**	**504**	**27**	**0.32**	**1.49**

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

Bird Diversity and Species Richness

Twenty-seven unique bird species were observed during fixed-point surveys (Table 7). The most abundant species observed were house finch (*Haemorhous mexicanus*; 301 observations; 18.1% of all observations), common raven (*Corvus corax*; 177 observations; 10.7% of all observations), and rock wren (*Salpinctes obsoletus*; 152 observations; 9.2% of all observations;

Appendix C). Species richness (i.e., the number of species observed per plot per survey) was lowest in the summer for small birds, and lowest in the fall for large birds, whereas species richness was highest in the spring for both large and small bird types (Table 7).

Bird Use

Diurnal raptor use varied from 0.02 raptors/800-m plot/30-min survey during the fall to 0.14 raptors/800-m plot/30-min survey during the spring (Appendix D1). Diurnal raptor use was greatest during the spring, with red-tailed hawk accounting for all of the raptor use observed during the spring season. Red-tailed hawk accounted for 100% of raptor use during fall, winter, and spring (Appendix D1), and almost 100% of raptor use during summer (Appendix D1). American kestrel (*Falco sparverius*) and unidentified raptors accounted for the remainder of raptor use in the summer season (Appendix D1).

Passerine use ranged from 1.32 birds/100-m plot/30-min survey in the summer to 2.58 birds/100-m plot/30-min survey in the spring (Appendix D2). Passerine use was dominated by black-throated sparrows (*Amphispiza bilineata*), cactus wrens (*Campylorhynchus brunneicapillus*), house finches, and rock wrens. House finch accounted for 27.1% of passerine use in fall, 28.0% in spring, and 28.3% in summer (Appendix D2). Black-throated sparrow accounted for 18.4% of passerine use in fall and 21.3% in summer. Cactus wren accounted for 19.0% of passerine use in summer, and rock wren accounted for 21.3% of passerine use in fall and 16.9% in winter (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. For example, although common raven had the highest exposure index of any species (0.11; Appendix E1) during the study, no common ravens were found as mortalities. Red-tailed hawk, turkey vulture (*Cathartes aura*), and great-tailed grackle (*Quiscalus mexicanus*) were the only other identified large bird species with exposure indices greater than zero (ranging from 0.01 for great-tailed grackle to 0.03 for red-tailed hawk and turkey vulture; Appendix E1). Small birds with an exposure index greater than zero included house finch (0.04) and yellow-rumped warbler (less than 0.01; Appendix E2).

Spatial Use

For all large bird species combined, use was highest at Point 18 (3.04 birds/plot/30-min survey); Appendix F). Large bird use at other points ranged from 0.08 to 1.46 birds/30-min survey (Appendix F). The mean use estimate for Point 18 was largely due to relatively high dove/pigeon use (2.71 birds/plot/30-min survey; Appendix F). Similar to the 2013-2014 avian use study, diurnal raptor use was highest at Point 17 (0.54 birds/plot/30-min survey; Appendix F). Point 17 was located in close proximity to transmission towers with an active red-tailed hawk nest and it is likely that the relatively higher use was due to the proximity to the active nest. Point 7, with corvid use of 1.21 birds/plot/30-min survey (Appendix F), was 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 (4.79 birds/plot/30-min survey) compared to other points, where it ranged from 0.62 to 4.29 birds/plot/30-min survey (Appendix F).

Flight paths of diurnal raptors and vultures 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 mortality 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 mortalities. It is possible that some of the bird mortalities were caused by predators and that some of the mortalities included in the data were potentially due to natural causes (background mortality), however, to be conservative, all mortalities 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 mortalities possibly occurring outside of the plot boundaries. While this could potentially lead to an underestimate of mortality, 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 mortality using the data from the larger plots were comparable or lower than the estimates from the smaller plot sizes (2.00 small birds/turbine/year compared to 2.87 small birds/turbine/year, 0.32 large birds/turbine/year compared to 0.28 large birds/turbine year, 2.31 all birds/turbine year compared to 3.15 all birds/turbine/year, and 3.65 bats/turbine/year compared to 3.33 bats/turbine/year).

Regardless of plot size, a total of 60 carcasses were found within standardized search plots (37 bird and 23 bats). During the first study year, 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 10 carcasses were found (five birds and five bats) and of those, one bird carcass was found in the portion of the plot that did not overlap with the smaller 160 X 160-m plot. During the first year of the study, nine carcasses (seven birds and two bats) were found at the five turbines for which larger plots were searched and of those carcasses, 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 75 m from a turbine during the study. 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 six additional bird carcasses during the second year of study if we would have searched all 33 turbines at 270 X 270-m plots. However, estimates from 270 X 270-m plots 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 mortality and taking into account mortalities 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 mortality rates at the OWEF are considered low relative to other comparable studies (see the discussion of comparisons to other mortality 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 mortalities or more or less cryptic in color than the actual mortalities. Rock pigeons, mallards, Coturnix quail (*Coturnix japonica*), and house sparrows were used to represent the range of bird mortalities expected. It is believed that this variety of species approximates the range of sizes and other characteristics of actual mortalities and should be a reasonable representation of scavenging rates for birds as a group. For the study, we are assuming that small birds are representative of bats, which may or may not be correct; however, small birds are used as surrogates for bats in many of the other mortality studies at wind energy projects.

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 10 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 37 bird mortalities were found during the second standardized year-long mortality monitoring study, with 33 of those found during scheduled searches (the remaining four were found incidentally, but were within search plots, and as such, were included in the mortality estimates). With the exception of Townsend's warbler (four individuals found), a maximum of three individuals were found for each of the other 12 species identified. No state- or federal-listed threatened or endangered bird species were documented as mortalities. Two BCC species in BCR 33 (yellow warbler and Costa's hummingbird) were documented as mortalities during the study.

The estimated overall bird mortality rate of 1.37 birds/MW/year was relatively low compared to other wind energy facilities in North America (where estimates have ranged from 0.06 to 17.44 birds/MW/year and the California and the desert southwest where estimates have ranged from 0.55 to 17.44 birds/MW/year (Figures 10 and 11, Appendix H1). The overall bird mortality rate at the OWEF ranked sixth lowest compared to 23 other studies at facilities in California and the desert southwest (Figure 10). Based on the relatively low 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.

Raptor Mortalities

Two raptor mortalities (red-tailed hawk) were documented within the OWEF, one incidentally and one during scheduled searches. During the first standardized year-long mortality monitoring study, one raptor mortality (red-tailed hawk) was documented incidentally within the OWEF. 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 raptor mortality rate of 0.04 raptors/MW/year was relatively low compared to other wind energy facilities in North America (where estimates have ranged from zero to 1.06 raptors/MW/year) as well as in California and the desert southwest where estimates have ranged from zero to 1.06 raptors/MW/year (Figures 12 and 13, Appendix H2). The overall raptor mortality rate at the OWEF ranked fifth lowest compared to 19 other studies at facilities in California and the desert southwest (Figure 11). Based on the relatively small estimate of raptor mortality at the OWEF, it is unlikely that operation of this facility will result in significant impacts to local or regional raptor populations.

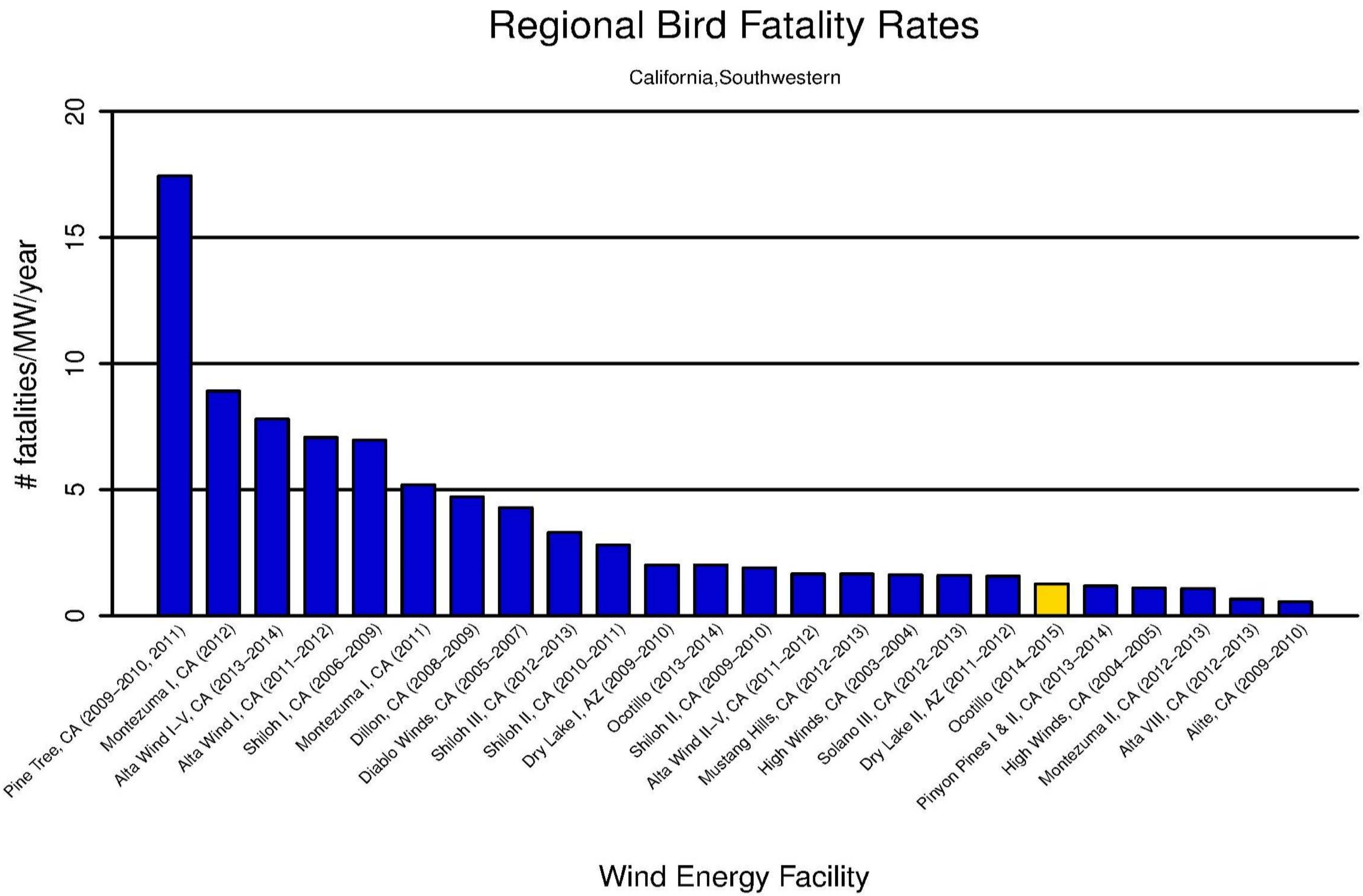

Figure 10. Fatality rates for all birds (number of birds per MW per year) from publicly-available studies of wind energy facilities In California and the desert southwest.

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, 11)	Bioresource Consultants 2012	Shiloh III, CA (12-13)	Kerlinger Et Al. 2013b	Solano III, CA (12-13)	AECOM 2013
Montezuma I, CA (12)	ICF International 2012	Shiloh II, CA (10-11)	Kerlinger Et Al. 2013a	Dry Lake II, AZ (11-12)	Thompson And Bay 2012
Alta Wind I-V, CA (13-14)	Chatfield Et Al. 2014	Dry Lake I, AZ (09-10)	Thompson Et Al. 2011	Pinyon Pines I & II, CA (13-14)	Chatfield And Russo 2014
Alta Wind I, CA (11-12)	Chatfield Et Al. 2012	Ocotillo, CA (12-13)	WEST 2015	High Winds, CA (04-05)	Kerlinger Et Al. 2006
Shiloh I, CA (06-09)	Kerlinger Et Al. 2009	Shiloh II, CA (09-10)	Kerlinger Et Al. 2010b	Montezuma II, CA (12-13)	Harvey & Associates 2013
Montezuma I, CA (11)	ICF International 2012	Alta Wind II-V, CA (11-12)	Chatfield Et Al. 2012	Alta VIII, CA (12-13)	Chatfield And Bay 2014
Dillon, CA (08-09)	Chatfield Et Al. 2009	Mustang Hills, CA (12-13)	Chatfield And Bay 2014	Alite, CA (09-10)	Chatfield Et Al. 2010b
Diablo Winds, CA (05-07)	WEST 2006, 2008	High Winds, CA (03-04)	Kerlinger Et Al. 2006		

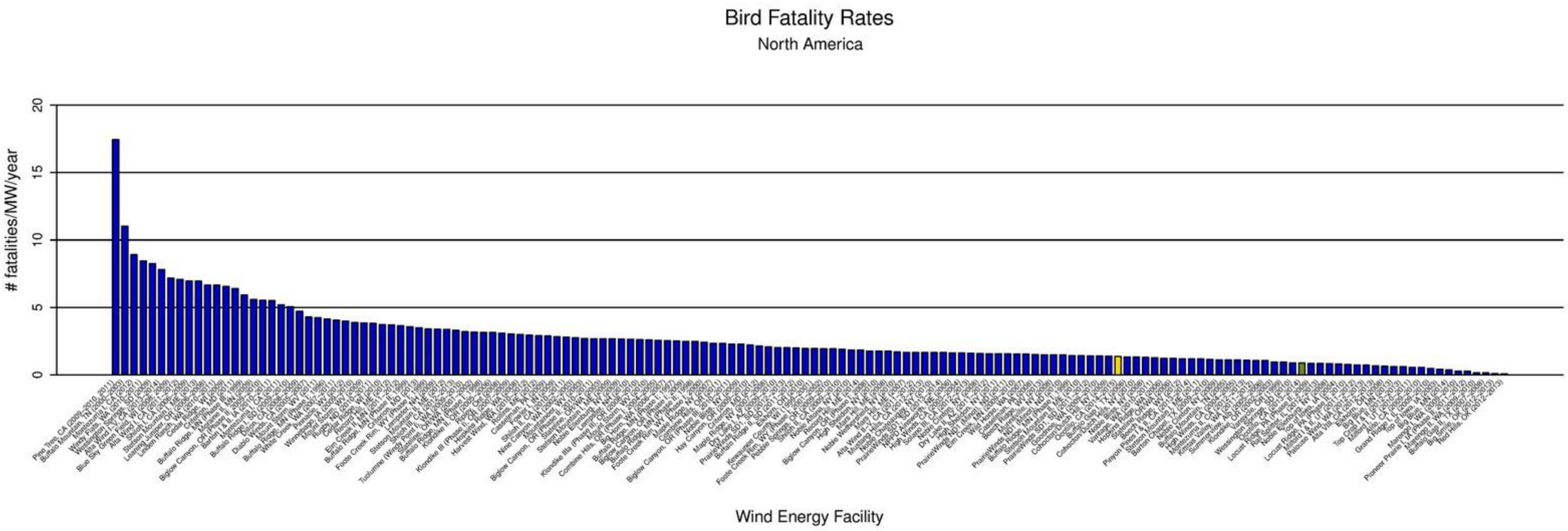

Figure 11. Fatality rates for all birds (number of birds per MW per year) from publicly-available studies in North America. Ocotillo Express Wind Energy Facility Year 1 data is in olive green, Ocotillo Year 2 data is in yellow. Data sources may be found in Appendix H.

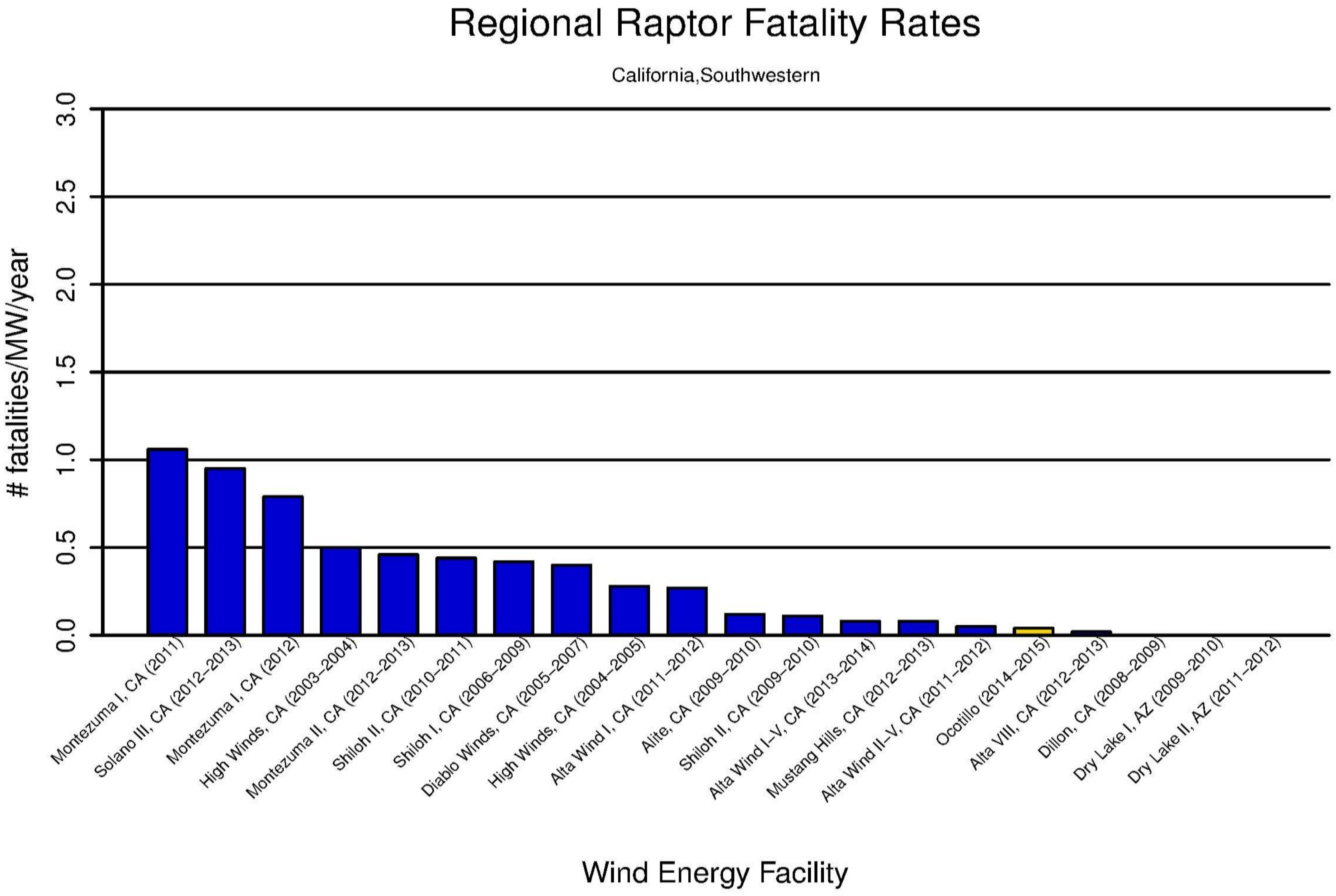

Figure 12. Fatality rates for raptors (number of raptors per MW per year) from publicly-available studies at wind energy facilities in California and the desert southwest.

Figure 12 (*continued*). Fatality rates for raptors (number of raptors 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 (14-15)	This study.				
Montezuma I, CA (11)	ICF International 2012	Diablo Winds, CA (05-07)	WEST 2006, 2008	Alta Wind II-V, CA (11-12)	Chatfield et al. 2012
Solano III, CA (12-13)	AECOM 2013	High Winds, CA (04-05)	Kerlinger et al. 2006	Alta VIII, CA (12-13)	Chatfield and Bay 2014
Montezuma I, CA (12)	ICF International 2012	Alta Wind I, CA (11-12)	Chatfield et al. 2012	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	Dry Lake I, AZ (09-10)	Thompson et al. 2011
Montezuma II, CA (12-13)	Harvey & Associates 2013	Shiloh II, CA (09-10)	Kerlinger et al. 2010b	Dry Lake II, AZ (11-12)	Thompson and Bay 2012
Shiloh II, CA (10-11)	Kerlinger et al. 2013a	Alta Wind I-V, CA (13-14)	Chatfield et al. 2014		
Shiloh I, CA (06-09)	Kerlinger et al. 2009	Mustang Hills, CA (12-13)	Chatfield and Bay 2014		

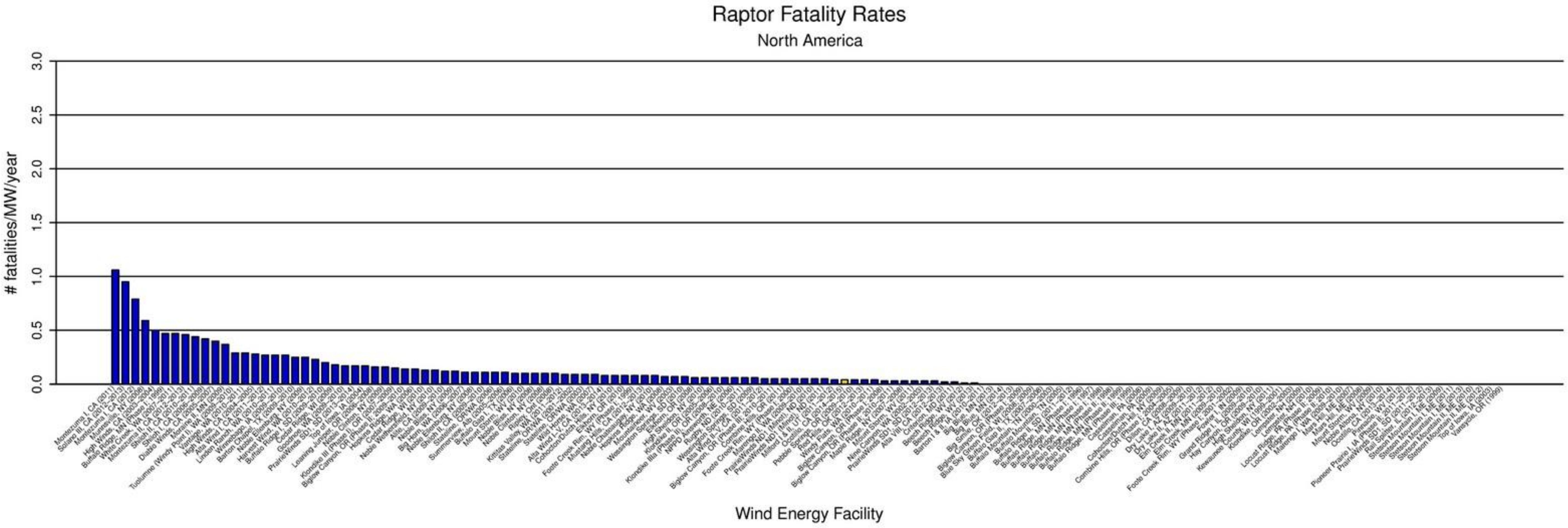

Figure 13. Fatality rates for raptors (number of raptors per MW per year) from publicly-available studies in North America. Ocotillo Express Wind Energy Facility Year 2 data is in yellow. Data sources may be found in Appendix H.

Bat Mortalities

A total of 26 bats (including 21 found during standardized searches, two incidentals on search plots, and three incidentals off plots) were discovered during the second year-long mortality monitoring study. Mexican free-tailed bats accounted for 38.5% of all documented bat mortalities, while unidentified free-tailed bats accounted for 15.4%, western mastiff bat and pocketed free-tailed bats each accounted for 11.5%, western yellow and unidentified bats each accounted for 7.7%, and big free-tailed and long-legged bats each accounted for 3.9%. None of the bat species identified during the first year-long fatality study are federally listed species, although one species (western mastiff) is designated as a species of special concern by the CDFW and is also listed as a BLM sensitive species. The estimated overall bat mortality rate at the OWEF (1.45 bats/MW/year) was considered moderate relative to other wind energy facilities in California and the desert southwest with publicly available bat fatality data (Figure 14, Appendix H3). Bat mortality rates at these other facilities in California and the desert southwest ranged from zero to 3.92 bats/MW/year (Appendix H3). However, the estimated mortality rate at the OWEF, is considered low relative to publicly available bat mortality rates across North America where reported bat mortality rates have ranged from zero to 40.2 bats/MW year and averaged approximately 5 bats/MW/year (Figure 15; Appendix H4). Based on the 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.

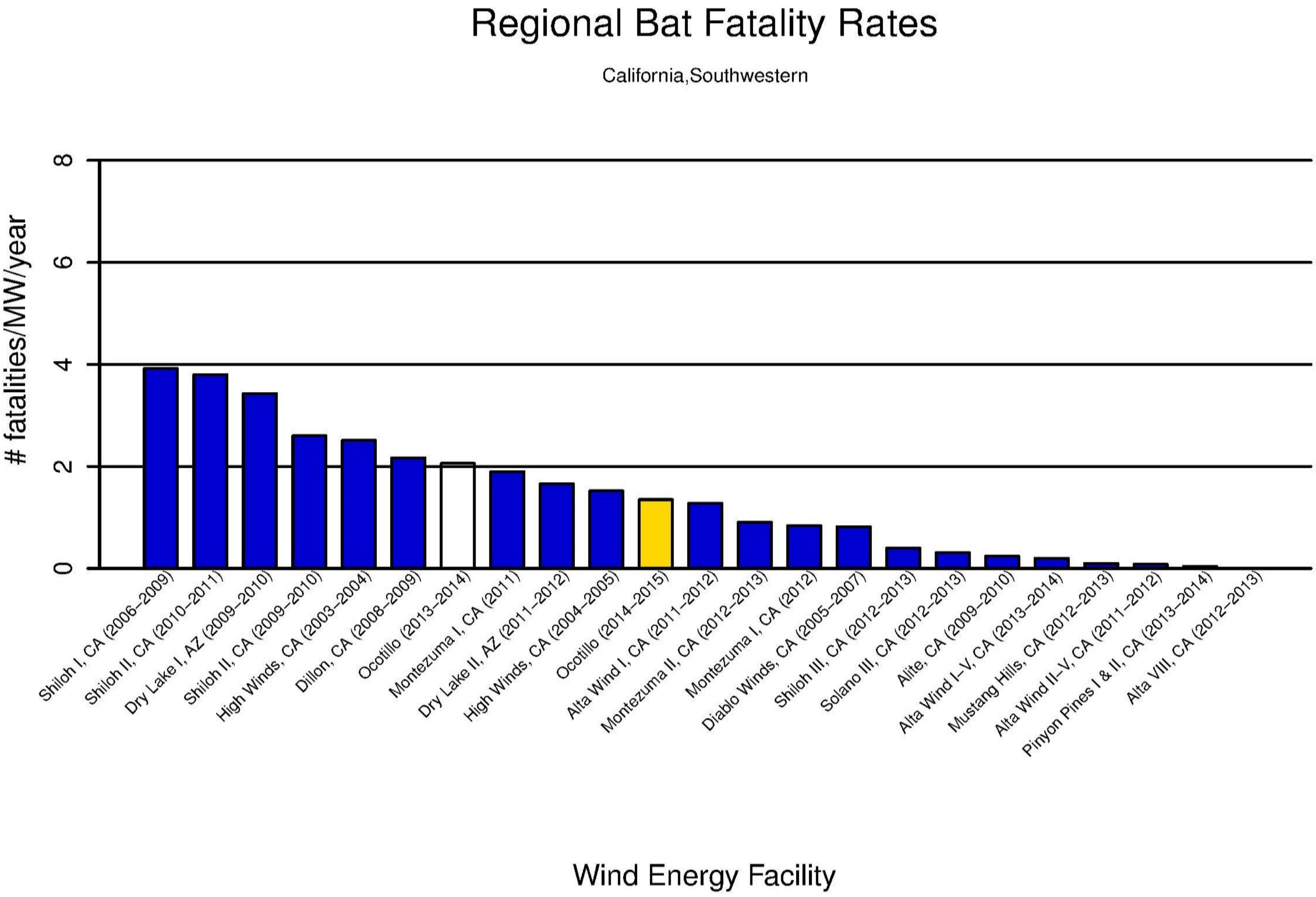

Figure 14. Fatality rates for bats (number of bats per MW per year) from publicly-available studies at wind energy facilities in California and the desert southwest.

Figure 14 (*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	Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Alite, CA (09-10)	Chatfield et al. 2010b
Shiloh II, CA (10-11)	Kerlinger et al. 2013a	High Winds, CA (04-05)	Kerlinger et al. 2006	Alta Wind I-V, CA (13-14)	Chatfield et al. 2014
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Alta Wind I, CA (11-12)	Chatfield et al. 2012	Mustang Hills, CA (12-13)	Chatfield and Bay 2014
Shiloh II, CA (09-10)	Kerlinger et al. 2010b	Montezuma II, CA (12-13)	Harvey & Associates 2013	Alta Wind II-V, CA (11-12)	Chatfield et al. 2012
High Winds, CA (03-04)	Kerlinger et al. 2006	Montezuma I, CA (12)	ICF International 2013	Pinyon Pines I&II, CA (13-14)	Chatfield and Bay 2014
Dillon, CA (08-09)	Chatfield et al. 2009	Diablo Winds, CA (05-07)	WEST 2006, 2008	Alta VIII, CA (12-13)	Chatfield and Bay 2014
Ocotillo, CA (12-13)	WEST 2015	Shiloh III, CA (12-13)	Kerlinger et al. 2013b		
Montezuma I, CA (11)	ICF International 2012	Solano III, CA (12-13)	AECOM 2013		

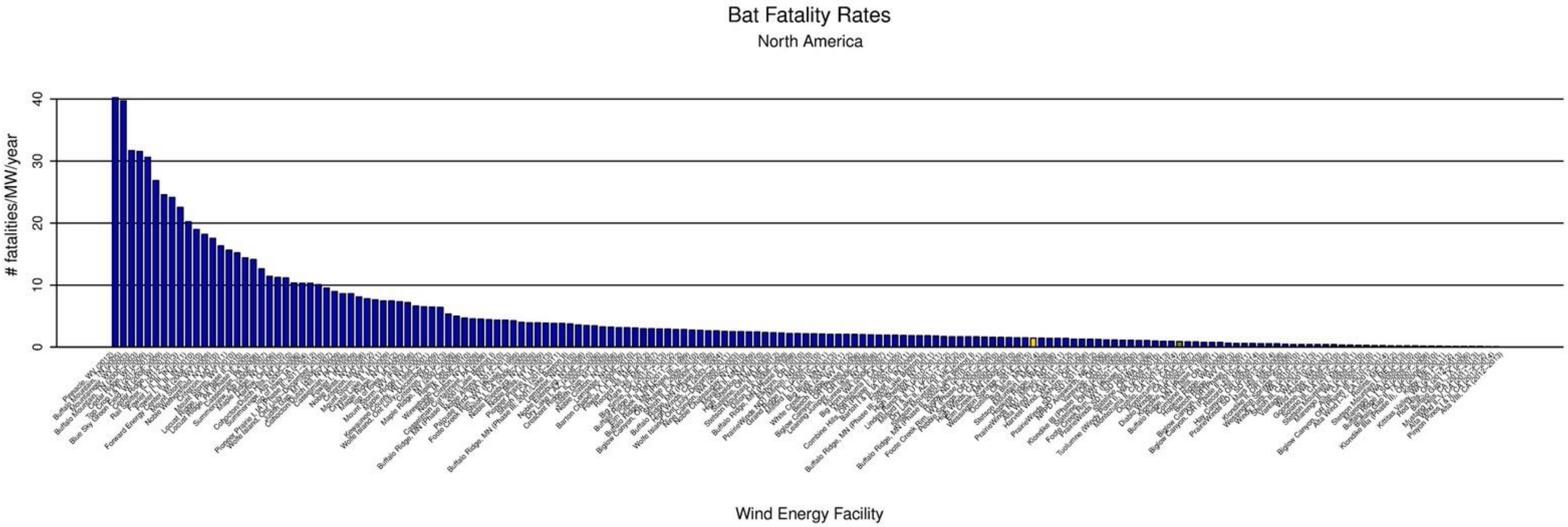

Figure 15. Fatality rates for bats (number of bats per MW per year) from publicly-available studies in North America. Ocotillo Express Wind Energy Facility Year 1 data is in olive green, Ocotillo Year 2 data is in yellow. Data sources may be found in Appendix H.

Avian Monitoring

Fixed-Point Avian Use Surveys

Based on the 2014-2015 avian use data, raptor use was highest in the spring (0.14 raptors/800-m plot/30-min survey) relative to the remaining seasons. Raptor use was highest in the spring (0.09 raptors/800-m plot/30-min survey) during the 2013-2014 study as well. The relatively higher raptor use measured in spring was primarily due to use by red-tailed hawk in both years. Red-tailed hawk had the highest exposure index of any raptor species. The only other raptors observed during the 2014-2015 avian use study were American kestrel and unidentified raptor. Overall, raptor use was relatively low compared to other projects where similar data have been collected (Figure 16). The relatively low raptor use observed at the Project is consistent with the low overall raptor mortality that has been observed during the first and second year of the standardized mortality monitoring study.

Similar to the first year of study, small bird use was greatest in the spring (2.89 birds/100-m plot/30-min survey) and winter (2.53 birds/100-m plot/30-min survey), and lower in the fall (1.79) and summer (1.38). This pattern of use by small birds is generally consistent with the observed bird mortalities, with more carcasses discovered in the spring, winter, and fall seasons, and fewer carcasses discovered during the summer.

During both the first and second year of the 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. Avian abundance was slightly higher during the 2014-2015 study compared to the 2013-2014 study but is still considered low relative to the results of other publicly available studies with similar methodologies.

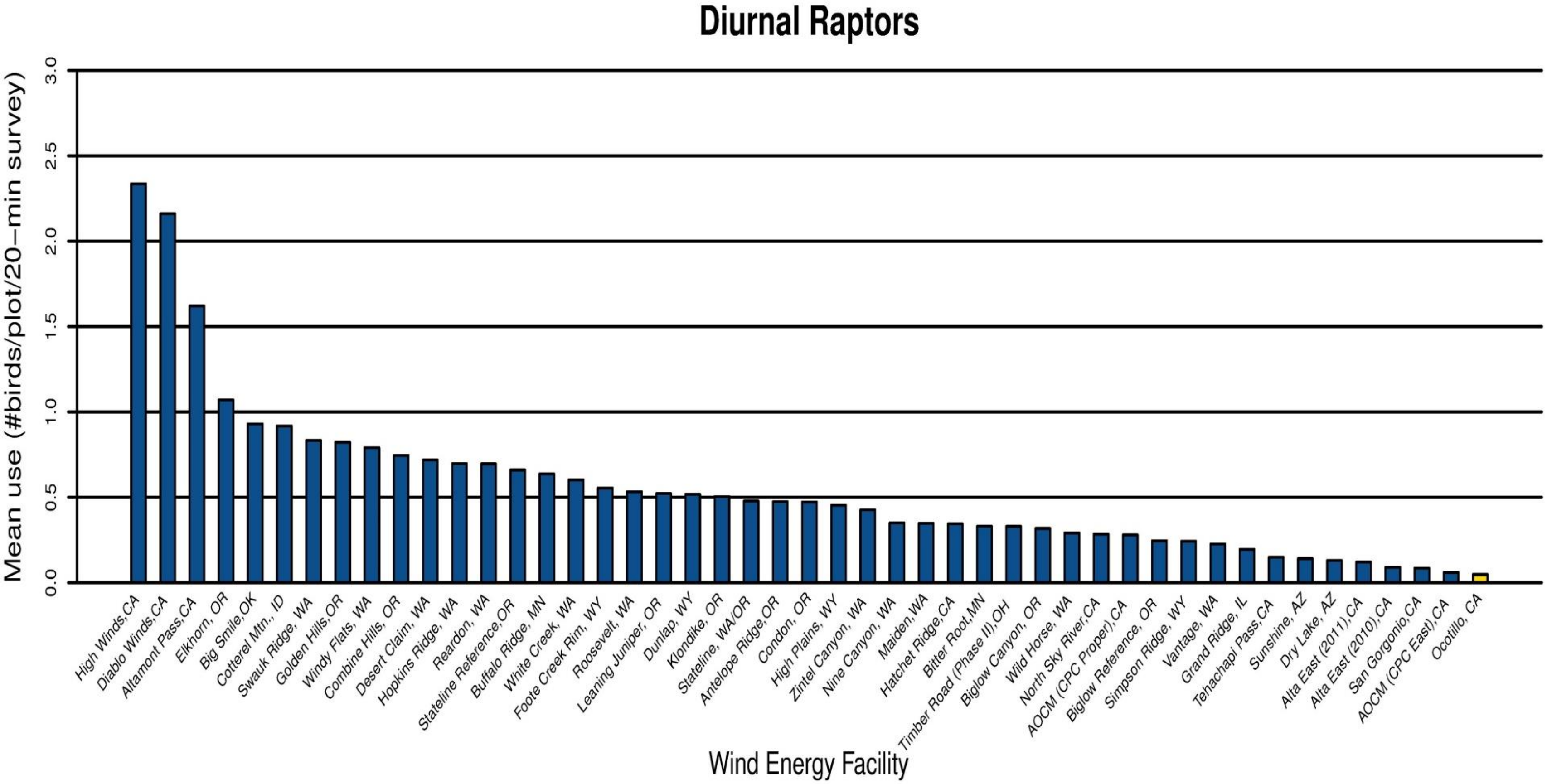

Figure 16. Comparison of estimated annual diurnal raptor use (raptors/800-m plot/20-min survey) during fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015, and diurnal raptor use at other wind resource areas with three or four other seasons of raptor use data.

Figure 16 (*continued*). 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 October 3, 2014 – September 25, 2015, and diurnal raptor use at other 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	Foote Creek Rim, WY	Johnson et al. 2000b	Wild Horse, WA	Erickson et al. 2003d
Diablo Winds, CA	WEST 2006	Roosevelt, WA	NWC and WEST 2004	North Sky River, CA	Erickson et al. 2011
Altamont Pass, CA	Orloff and Flannery 1992	Leaning Juniper, OR	Kronner et al. 2005	AOCM (CPC Proper), CA	Chatfield et al. 2010a
Elkhorn, OR	WEST 2005a	Dunlap, WY	Johnson et al. 2009a	Biglow Reference, OR	WEST 2005c
Big Smile (Dempsey), OK	Derby et al. 2010a	Klondike, OR	Johnson et al. 2002	Simpson Ridge, WY	Johnson et al. 2000b
Cotterel Mtn., ID	BLM 2006	Stateline, WA/OR	Erickson et al. 2003a	Vantage, WA	Jeffrey et al. 2007
Swauk Ridge, WA	Erickson et al. 2003b	Antelope Ridge, OR	WEST 2009	Grand Ridge, IL	Derby et al. 2009
Golden Hills, OR	Jeffrey et al. 2008	Condon, OR	Erickson et al. 2002b	Tehachapi Pass, CA	Anderson et al. 2000, Erickson et al. 2002b
Windy Flats, WA	Johnson et al. 2007	High Plains, WY	Johnson et al. 2009b	Sunshine, AZ	WEST and the CPRS 2006
Combine Hills, OR	Young et al. 2003d	Zintel Canyon, WA	Erickson et al. 2002a, 2003c	Dry Lake, AZ	Young et al. 2007c
Desert Claim, WA	Young et al. 2003b	Nine Canyon, WA	Erickson et al. 2001	Alta East (2011), CA	Chatfield et al. 2011
Hopkins Ridge, WA	Young et al. 2003a	Maiden, WA	Young et al. 2002	Alta East (2010), CA	Chatfield et al. 2011
Reardon, WA	WEST 2005b	Hatchet Ridge, CA	Young et al. 2007b	San Gorgonio, CA	Anderson et al. 2000, Erickson et al. 2002b
Stateline Reference, OR	URS et al. 2001	Bitter Root. MN	Derby and Dahl 2009	AOCM (CPC East), CA	Chatfield et al. 2010a
Buffalo Ridge, MN	Johnson et al. 2000a	Timber Road (Phase II), OH	Good et al. 2010		
White Creek, WA	NWC and WEST 2005	Biglow Canyon, OR	WEST 2005c		

CONCLUSIONS

The second standardized year-long mortality monitoring study and avian use study at the OWEF were completed in the fall of 2015, with the conclusion of the 12 months of mortality surveys. This report presents the results of the second full year of standardized mortality surveys and avian use surveys. Additional carcass discoveries that occurred 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 second year of standardized studies have provided additional 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 North America. The second year of the study also supported this conclusion, suggesting that the first year results, (which demonstrate low impacts to birds and bats), were not an anomaly or unusual, but rather representative of the impacts that can be expected at the OWEF. No federal- or state-listed species were identified during the first or second year-long standardized mortality monitoring studies. Two BCC species in BCR 33 (yellow warbler and Costa's hummingbird) and one CDFW species of special concern and BLM sensitive species (western mastiff bat) were discovered during the second year-long mortality monitoring 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 Mortality Listing for Carcasses Discovered during the Second Year of Standardized Year-Long Fatality Monitoring and Incidentally at the Ocotillo Express Wind Energy Facility, October 3, 2014 – September 25, 2015

Appendix A. Complete mortality listing for the Ocotillo Wind Energy Facility.

Date	Common Name	Location	Distance from Turbine	Type of Find	Survey Type	Condition
9/1/2015	mourning dove	133	313	incidental find	Twice Monthly	Intact
8/23/2015	mourning dove	112	58	carcass search	Twice Monthly	Feather Spot
8/17/2015	western mastiff bat	151	27	incidental find	Twice Monthly	Intact
9/8/2015	Eurasian collared-dove	82	58	carcass search	Twice Monthly	Dismembered
9/8/2015	unidentified bird (small)	86	87	carcass search	Twice Monthly	Feather Spot
8/27/2015	long-legged bat	130	7	carcass search	Twice Monthly	Intact
8/28/2015	Mexican free-tailed bat	86	37	carcass search	Twice Monthly	Intact
8/27/2015	unidentified bird (small)	130	31	carcass search	Twice Monthly	Feather Spot
8/24/2015	Mexican free-tailed bat	174	54	carcass search	Twice Monthly	Intact
10/16/2014	unidentified bird (small)	174	62	carcass search	Twice Monthly	Feather Spot
8/31/2015	mourning dove	76	41	carcass search	Twice Monthly	Intact
9/20/2015	Mexican free-tailed bat	22	22	carcass search	Twice Monthly	Intact
9/22/2015	white-throated swift	76	17	carcass search	Twice Monthly	Feather Spot
9/15/2015	unidentified warbler	152	47	carcass search	Twice Monthly	Feather Spot
10/5/2014	Mexican free-tailed bat	174	25	carcass search	Twice Monthly	Intact
9/16/2015	Mexican free-tailed bat	148	57	carcass search	Twice Monthly	Intact
8/30/2015	unidentified large bird	31	74	carcass search	Twice Monthly	Feather Spot
9/13/2015	Mexican free-tailed bat	31	15	carcass search	Twice Monthly	Intact
8/28/2015	unidentified bat	87	75	carcass search	Twice Monthly	Intact
8/30/2015	unidentified free-tailed bat	93	64	carcass search	Twice Monthly	Intact
4/3/2015	big free-tailed bat	176	46	carcass search	Twice Monthly	Intact
4/23/2015	black-throated gray warbler	111	31	carcass search	Twice Monthly	Intact
4/15/2015	black-throated gray warbler	124	91	carcass search	Twice Monthly	Intact
4/16/2015	black-throated gray warbler	153	68	carcass search	Twice Monthly	Intact
4/14/2015	Mexican free-tailed bat	43	10	carcass search	Twice Monthly	Scavenged
4/28/2015	common poorwill	71	23	carcass search	Twice Monthly	Feather Spot
3/29/2015	pocketed free-tailed bat	93	29	carcass search	Twice Monthly	Intact
3/19/2015	unidentified free-tailed bat	79	17	incidental find	Twice Monthly	Intact
3/17/2015	unidentified free-tailed bat	148	60	carcass search	Twice Monthly	Intact
4/29/2015	western yellow bat	150	25	incidental find	Twice Monthly	Intact
5/6/2015	western tanager	76	197	incidental find	Twice Monthly	Intact
4/21/2015	Townsend's warbler	176	100	carcass search	Twice Monthly	Intact
3/23/2015	pocketed free-tailed bat	168	35	incidental find	Twice Monthly	Intact
4/23/2015	red-tailed hawk	156	25	incidental find	Twice Monthly	Dismembered
5/7/2015	Townsend's warbler	89	107	carcass search	Twice Monthly	Intact
4/16/2015	unidentified sparrow	156	56	carcass search	Twice Monthly	Dismembered
4/26/2015	Townsend's warbler	176	79	incidental find	Twice Monthly	Scavenged
4/16/2015	Townsend's warbler	152	60	carcass search	Twice Monthly	Intact

Appendix A. Complete mortality listing for the Ocotillo Wind Energy Facility.

Date	Common Name	Location	Distance from Turbine	Type of Find	Survey Type	Condition
3/29/2015	unidentified sparrow	118	44	carcass search	Twice Monthly	Intact
5/4/2015	Wilson's warbler	149	90	carcass search	Twice Monthly	Scavenged
5/4/2015	unidentified bird (small)	176	85	carcass search	Twice Monthly	Feather Spot
5/8/2015	yellow warbler	133	108	carcass search	Twice Monthly	Intact
6/20/2015	horned lark	28	23	carcass search	Twice Monthly	Intact
7/22/2015	Mexican free-tailed bat	173	20	carcass search	Twice Monthly	Intact
5/28/2015	Mexican free-tailed bat	173	9	carcass search	Twice Monthly	Intact
8/7/2015	unidentified bird (small)	173	49	carcass search	Twice Monthly	Feather Spot
7/20/2015	western mastiff bat	149	25	carcass search	Twice Monthly	Intact
8/7/2015	unidentified bird (small)	133	16	carcass search	Twice Monthly	Feather Spot
7/2/2015	unidentified bat	149	44	carcass search	Twice Monthly	Intact
7/12/2015	western yellow bat	89	61	carcass search	Twice Monthly	Intact
8/1/2015	unidentified bird (small)	151	27	carcass search	Twice Monthly	Feather Spot
12/2/2014	unidentified bird (small)	149	161	carcass search	Twice Monthly	Feather Spot
2/10/2015	house finch	89	57	carcass search	Twice Monthly	Intact
12/15/2014	unidentified free-tailed bat	149	5	incidental find	Twice Monthly	Intact
3/11/2015	white-throated swift	124	21	carcass search	Twice Monthly	Intact
12/15/2014	unidentified bird (small)	151	34	carcass search	Twice Monthly	Feather Spot
1/30/2015	Mexican free-tailed bat	31	14	carcass search	Twice Monthly	Intact
11/1/2014	red-tailed hawk	152	103	carcass search	Twice Monthly	Feather Spot
3/11/2015	unidentified sparrow	124	72	carcass search	Twice Monthly	Scavenged
3/10/2015	Costa's hummingbird	71	41	carcass search	Twice Monthly	Intact
11/3/2014	unidentified bird (small)	174	101	carcass search	Twice Monthly	Feather Spot
2/9/2015	western mastiff bat	28	21	carcass search	Twice Monthly	Intact
3/6/2015	pocketed free-tailed bat	111	31	carcass search	Twice Monthly	Intact

Appendix B. Complete Bird and Bat Fatality Table for the Ocotillo Express Wind Energy Facility for Studies Conducted from October 3, 2014 – September 25, 2015

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 3, 2014 – September 25, 2015.

	Winter (33 turbines searched)		**Spring (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)	0.80	0.74-0.86	0.80	0.74-0.86
p (large birds)	0.96	0.92-1.00	0.96	0.92-1.00
p (bats)	0.80	0.74-0.86	0.80	0.74-0.86
Mean Carcass Removal Time (Days)				
$\bar{t}$ (small birds)	11.95	7.17-17.59	9.18	6.55-12.18
$\bar{t}$ (large birds)	19.13	9.94-34.38	19.41	12.18-28.87
$\bar{t}$ (bats)	11.95	7.17-17.59	9.18	6.55-12.18
Observed Fatality Rates (Fatalities/Turbine/Season(s))				
small birds	0.18	0.09-0.36	0.39	0.21-0.61
large birds	0.03	-	0.03	-
bats	0.12	0.03-0.21	0.12	-
Average Probability of Carcass Availability and Detected				
small birds	0.48	0.34-0.59	0.41	0.31-0.49
large birds	0.68	-	0.68	-
bats	0.48	0.34-0.59	0.41	-
Adjusted Fatality Rates (Fatalities/Turbine/Seasons(s))				
small birds	0.39	0.18-0.83	0.97	0.53-1.60
large birds	0.04	-	0.04	-
bats	0.25	0.06-0.48	0.30	-

*90% confidence levels not provided for categories including five or fewer fatalities

Appendix B (continued). 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 3, 2014 – September 25, 2015.

	Summer (33 turbines searched)		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)	0.80	0.74-0.86	0.80	0.74-0.86
p (large birds)	0.96	0.92-1.00	0.96	0.92-1.00
p (bats)	0.80	0.74-0.86	0.80	0.74-0.86
Mean Carcass Removal Time (Days)				
$\bar{t}$ (small birds)	6.9	4.42-9.57	2.47	1.90-3.00
$\bar{t}$ (large birds)	17.32	16.93-9.37	16.23	8.38-28.23
$\bar{t}$ (bats)	6.9	4.42-9.57	2.47	1.90-3.00
Observed Fatality Rates (Fatalities/Turbine/Season(s))				
small birds	0.12	-	0.15	0.06-0.24
large birds	0	-	0.12	-
bats	0.15	0.03-0.30	0.30	0.15-0.45
Average Probability of Carcass Availability and Detected				
small birds	0.33	-	0.13	0.10-0.16
large birds	0.65	-	0.63	-
bats	0.33	0.23-0.43	0.13	0.10-0.16
Adjusted Fatality Rates (Fatalities/Turbine/Seasons(s))				
small birds	0.37	-	1.16	0.47-2.08
large birds	0	-	0.19	-
bats	0.46	0.08-0.95	2.32	1.20-3.79

Overall Adjusted Fatality Rates (Fatalities/Turbine/Study Period)		
	Mean	**90% CI**
small birds	2.87	(1.97, 4.18)
large birds	0.28	(0.11, 0.51)
all birds	3.15	(2.02, 4.23)
bats	3.33	(2.06, 4.97)

*90% confidence levels not provided for categories including five or fewer fatalities

Appendix C. Summary of Individual and Group Observations by Bird Type and Species for Fixed-Point Bird Use Surveys at the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015

Appendix C. Summary of individual and group observations by bird type and species for fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility[a] from October 3, 2014 – September 25, 2015.

		Fall		Winter		Spring		Summer		Total	
Type / Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Diurnal Raptors		**4**	**5**	**8**	**9**	**20**	**27**	**10**	**12**	**42**	**53**
Buteos		3	4	8	9	16	21	5	5	32	39
red-tailed hawk	*Buteo jamaicensis*	3	4	8	9	16	21	5	5	32	39
Falcons		0	0	0	0	0	0	1	2	1	2
American kestrel	*Falco sparverius*	0	0	0	0	0	0	1	2	1	2
Other Raptors		1	1	0	0	4	6	4	5	9	12
unidentified raptor	*NA*	1	1	0	0	4	6	4	5	9	12
Vultures		**3**	**5**	**1**	**1**	**2**	**2**	**12**	**18**	**18**	**26**
turkey vulture	*Cathartes aura*	3	5	1	1	2	2	12	18	18	26
Doves/Pigeons		**5**	**69**	**1**	**2**	**8**	**8**	**23**	**34**	**37**	**113**
Eurasian collared-dove	*Streptopelia decaocto*	0	0	0	0	5	5	13	19	18	24
mourning dove	*Zenaida macroura*	4	67	1	2	2	2	4	4	11	75
unidentified dove	*NA*	1	2	0	0	1	1	6	11	8	14
Large Corvids		**16**	**17**	**38**	**60**	**50**	**74**	**16**	**26**	**120**	**177**
common raven	*Corvus corax*	16	17	38	60	50	74	16	26	120	177
Cuckoos		**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**
greater roadrunner	*Geococcyx californianus*	0	0	0	0	0	0	1	1	1	1
Passerines		**175**	**221**	**280**	**372**	**248**	**371**	**143**	**177**	**846**	**1,141**
black-tailed gnatcatcher	*Polioptila melanura*	9	10	20	23	12	14	2	3	43	50
black-throated sparrow	*Amphispiza bilineata*	7	11	18	27	40	69	22	37	87	144
black phoebe	*Sayornis nigricans*	0	0	0	0	3	4	0	0	3	4
cactus wren	*Campylorhynchus brunneicapillus*	13	18	40	52	29	35	30	36	112	141
great-tailed grackle	*Quiscalus mexicanus*	0	0	0	0	0	0	1	5	1	5
horned lark	*Eremophila alpestris*	0	0	2	3	14	22	1	1	17	26
house finch	*Haemorhous mexicanus*	47	70	70	107	61	120	4	4	182	301
Le Conte's thrasher	*Toxostoma lecontei*	7	7	1	1	7	8	20	22	35	38
loggerhead shrike	*Lanius ludovicianus*	13	14	18	18	24	26	46	52	101	110
rock wren	*Salpinctes obsoletus*	45	54	51	70	20	25	3	3	119	152
Say's phoebe	*Sayornis saya*	10	10	9	10	4	4	2	2	25	26
Scott's oriole	*Icterus parisorum*	0	0	0	0	1	2	0	0	1	2
unidentified passerine	*NA*	22	25	46	54	33	42	10	10	111	131
unidentified thrasher	*NA*	0	0	0	0	0	0	1	1	1	1
unidentified warbler	*NA*	1	1	0	0	0	0	0	0	1	1
western kingbird	*Tyrannus verticalis*	0	0	0	0	0	0	1	1	1	1
western meadowlark	*Sturnella neglecta*	1	1	0	0	0	0	0	0	1	1
yellow-rumped warbler	*Setophaga coronata*	0	0	5	7	0	0	0	0	5	7

Appendix C. Summary of individual and group observations by bird type and species for fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility[a] from October 3, 2014 – September 25, 2015.

		Fall		**Winter**		**Spring**		**Summer**		**Total**	
Type / Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Swifts/Hummingbirds		**17**	**18**	**36**	**41**	**31**	**31**	**3**	**3**	**87**	**93**
Anna's hummingbird	*Calypte anna*	0	0	5	5	8	8	2	2	15	15
calliope hummingbird	*Selasphorus calliope*	0	0	1	1	0	0	0	0	1	1
Costa's hummingbird	*Calypte costae*	0	0	9	12	9	9	0	0	18	21
unidentified hummingbird	*NA*	17	18	21	23	12	12	1	1	51	54
white-throated swift	*Aeronautes saxatalis*	0	0	0	0	2	2	0	0	2	2
Woodpeckers		**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**2**	**2**
ladder-backed woodpecker	*Picoides scalaris*	1	1	1	1	0	0	0	0	2	2
Unidentified Birds		**6**	**10**	**0**	**0**	**11**	**13**	**7**	**33**	**24**	**56**
unidentified bird (small)	*NA*	6	10	0	0	10	11	6	32	22	53
unidentified large bird	*NA*	0	0	0	0	1	2	1	1	2	3
Overall		**227**	**346**	**365**	**486**	**370**	**526**	**215**	**304**	**1,177**	**1,662**

[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 October 3, 2014 – September 25, 2015

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 October 3, 2014 – September 25, 2015.

	Mean Use				% of Use				% Frequency			
Type / Species	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**
Diurnal Raptors	**0.02**	**0.06**	**0.14**	**0.07**	**2.2**	**14.5**	**19.6**	**11.2**	**1.9**	**4.8**	**8.7**	**5.6**
Buteos	0.02	0.06	0.14	0.04	2.2	14.5	19.6	6.2	1.9	4.8	8.7	4.0
red-tailed hawk	0.02	0.06	0.14	0.04	2.2	14.5	19.6	6.2	1.9	4.8	8.7	4.0
Falcons	0	0	0	0.02	0	0	0	2.5	0	0	0	0.8
American kestrel	0	0	0	0.02	0	0	0	2.5	0	0	0	0.8
Other Raptors	0	0	0	0.02	0	0	0	2.5	0	0	0	1.6
unidentified raptor	0	0	0	0.02	0	0	0	2.5	0	0	0	1.6
Vultures	**0.02**	**<0.01**	**0.02**	**0.09**	**2.2**	**1.6**	**2.2**	**13.8**	**1.9**	**0.7**	**1.6**	**6.3**
turkey vulture	0.02	<0.01	0.02	0.09	2.2	1.6	2.2	13.8	1.9	0.7	1.6	6.3
Doves/Pigeons	**0.66**	**0.01**	**0.06**	**0.27**	**76.7**	**3.2**	**8.7**	**42.5**	**3.8**	**0.7**	**6.3**	**14.3**
Eurasian collared-dove	0	0	0.04	0.15	0	0	5.4	23.8	0.0	0	4.0	7.9
mourning dove	0.64	0.01	0.02	0.03	74.4	3.2	2.2	5.0	2.9	0.7	1.6	3.2
unidentified dove	0.02	0	<0.01	0.09	2.2	0	1.1	13.8	1.0	0	0.8	4.0
Large Corvids	**0.16**	**0.34**	**0.51**	**0.21**	**18.9**	**80.6**	**69.6**	**32.5**	**14.3**	**19.7**	**25.4**	**10.3**
common raven	0.16	0.34	0.51	0.21	18.9	80.6	69.6	32.5	14.3	19.7	25.4	10.3
Overall Large Birds	**0.86**	**0.42**	**0.73**	**0.63**	**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 October 3, 2014 – September 25, 2015.

	Mean Use				% of Use				% Frequency			
Type / Species	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**
Cuckoos	**0**	**0**	**0**	**<0.01**	**0**	**0**	**0**	**0.6**	**0**	**0**	**0**	**0.8**
greater roadrunner	0	0	0	<0.01	0	0	0	0.6	0	0	0	0.8
Passerines	**1.58**	**2.24**	**2.58**	**1.32**	**88.3**	**88.7**	**89.3**	**95.4**	**59.0**	**71.4**	**69.8**	**57.1**
black-tailed gnatcatcher	0.1	0.16	0.11	0.02	5.3	6.2	3.8	1.7	7.6	12.9	8.7	1.6
black-throated sparrow	0.1	0.18	0.53	0.29	5.3	7.0	18.4	21.3	5.7	11.6	27.0	15.1
black phoebe	0	0	0.02	0	0	0	0.5	0	0	0	1.6	0
cactus wren	0.14	0.26	0.17	0.26	8.0	10.2	6.0	19.0	8.6	16.3	14.3	19.0
great-tailed grackle	0	0	0	0.04	0	0	0	2.9	0	0	0	0.8
horned lark	0	0.02	0.17	<0.01	0	0.8	6.0	0.6	0	1.4	10.3	0.8
house finch	0.49	0.71	0.82	0.03	27.1	28.0	28.3	2.3	29.5	38.1	37.3	3.2
Le Conte's thrasher	0.07	<0.01	0.06	0.17	3.7	0.3	2.2	12.6	6.7	0.7	5.6	15.9
loggerhead shrike	0.09	0.09	0.18	0.37	4.8	3.5	6.3	26.4	6.7	7.5	15.9	30.2
rock wren	0.38	0.43	0.19	0.02	21.3	16.9	6.6	1.7	26.7	24.5	13.5	2.4
Say's phoebe	0.05	0.06	0.02	<0.01	2.7	2.4	0.8	0.6	4.8	5.4	1.6	0.8
Scott's oriole	0	0	0.02	0	0	0	0.5	0	0	0	0.8	0
unidentified passerine	0.16	0.29	0.28	0.07	9.0	11.6	9.6	5.2	13.3	23.1	21.4	7.1
unidentified thrasher	0	0	0	<0.01	0	0	0	0.6	0	0	0	0.8
unidentified warbler	<0.01	0	0	0	0.5	0	0	0	1.0	0	0	0
western kingbird	0	0	0	<0.01	0	0	0	0.6	0	0	0	0.8
western meadowlark	<0.01	0	0	0	0.5	0	0	0	1.0	0	0	0
yellow-rumped warbler	0	0.05	0	0	0	1.9	0	0	0	3.4	0	0
Swifts/Hummingbirds	**0.17**	**0.28**	**0.25**	**0.02**	**9.6**	**11.0**	**8.5**	**1.7**	**11.4**	**21.1**	**24.6**	**2.4**
Anna's hummingbird	0	0.03	0.06	0.02	0	1.3	2.2	1.1	0	3.4	6.3	1.6
calliope hummingbird	0	<0.01	0	0	0	0.3	0	0	0	0.7	0	0
Costa's hummingbird	0	0.08	0.07	0	0	3.2	2.5	0	0	6.1	7.1	0
unidentified hummingbird	0.17	0.16	0.1	<0.01	9.6	6.2	3.3	0.6	11.4	13.6	9.5	0.8
white-throated swift	0	0	0.02	0	0	0	0.5	0	0	0	1.6	0
Woodpeckers	**<0.01**	**<0.01**	**0**	**0**	**0.5**	**0.3**	**0**	**0**	**1.0**	**0.7**	**0**	**0**
ladder-backed woodpecker	<0.01	<0.01	0	0	0.5	0.3	0	0	1.0	0.7	0	0
Unidentified Birds	**0.03**	**0**	**0.06**	**0.03**	**1.6**	**0**	**2.2**	**2.3**	**1.9**	**0**	**4.8**	**3.2**
unidentified bird (small)	0.03	0	0.05	0.02	1.6	0	1.6	1.7	1.9	0	4.0	2.4
unidentified large bird	0	0	0.02	<0.01	0	0	0.5	0.6	0	0	0.8	0.8
Overall Small Birds	**1.79**	**2.53**	**2.89**	**1.38**	**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 October 3, 2014 – September 25, 2015

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 October 3, 2014 – September 25, 2015.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH based on initial obs	Exposure Index	% Within RSH at anytime
common raven	74	0.31	72.0	50.4	0.11	79.6
red-tailed hawk	21	0.07	70.6	66.7	0.03	70.8
turkey vulture	14	0.03	100	81.2	0.03	100
unidentified dove	8	0.03	100	14.3	<0.01	28.6
unidentified raptor	2	<0.01	100	50.0	<0.01	50.0
mourning dove	6	0.15	93.3	0	0	92.9
Eurasian collared-dove	15	0.05	87.5	0	0	0.0
American kestrel	1	<0.01	100	0	0	100

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 October 3, 2014 – September 25, 2015.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH based on initial obs	Exposure Index	% Within RSH at anytime
house finch	66	0.52	51.5	14.8	0.04	18.5
great-tailed grackle	1	0.01	100	100	0.01	100
unidentified passerine	25	0.21	31.7	15.2	<0.01	27.3
yellow-rumped warbler	2	0.01	57.1	75.0	<0.01	75.0
black-throated sparrow	48	0.28	63.6	0	0	0
rock wren	9	0.26	11.5	0	0	0
cactus wren	11	0.21	14.8	0	0	0
loggerhead shrike	35	0.18	44.0	0	0	5.0
unidentified hummingbird	40	0.11	79.6	0	0	11.6
black-tailed gnatcatcher	15	0.1	40.0	0	0	0
Le Conte's thrasher	8	0.08	26.3	0	0	0
horned lark	8	0.05	57.7	0	0	0
Costa's hummingbird	9	0.04	57.1	0	0	0
Say's phoebe	5	0.04	27.8	0	0	0
Anna's hummingbird	8	0.03	53.3	0	0	0
unidentified bird (small)	7	0.02	75.0	0	0	0
unidentified large bird	2	<0.01	100	0	0	0
white-throated swift	2	<0.01	100	0	0	0
Scott's oriole	1	<0.01	100	0	0	0
black phoebe	2	<0.01	100	0	0	0
ladder-backed woodpecker	1	<0.01	50.0	0	0	0
western kingbird	1	<0.01	100	0	0	0
unidentified thrasher	0	<0.01	0	0	0	0
greater roadrunner	0	<0.01	0	0	0	0
calliope hummingbird	1	<0.01	100	0	0	0
western meadowlark	0	<0.01	0	0	0	0
unidentified warbler	1	<0.01	100	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).

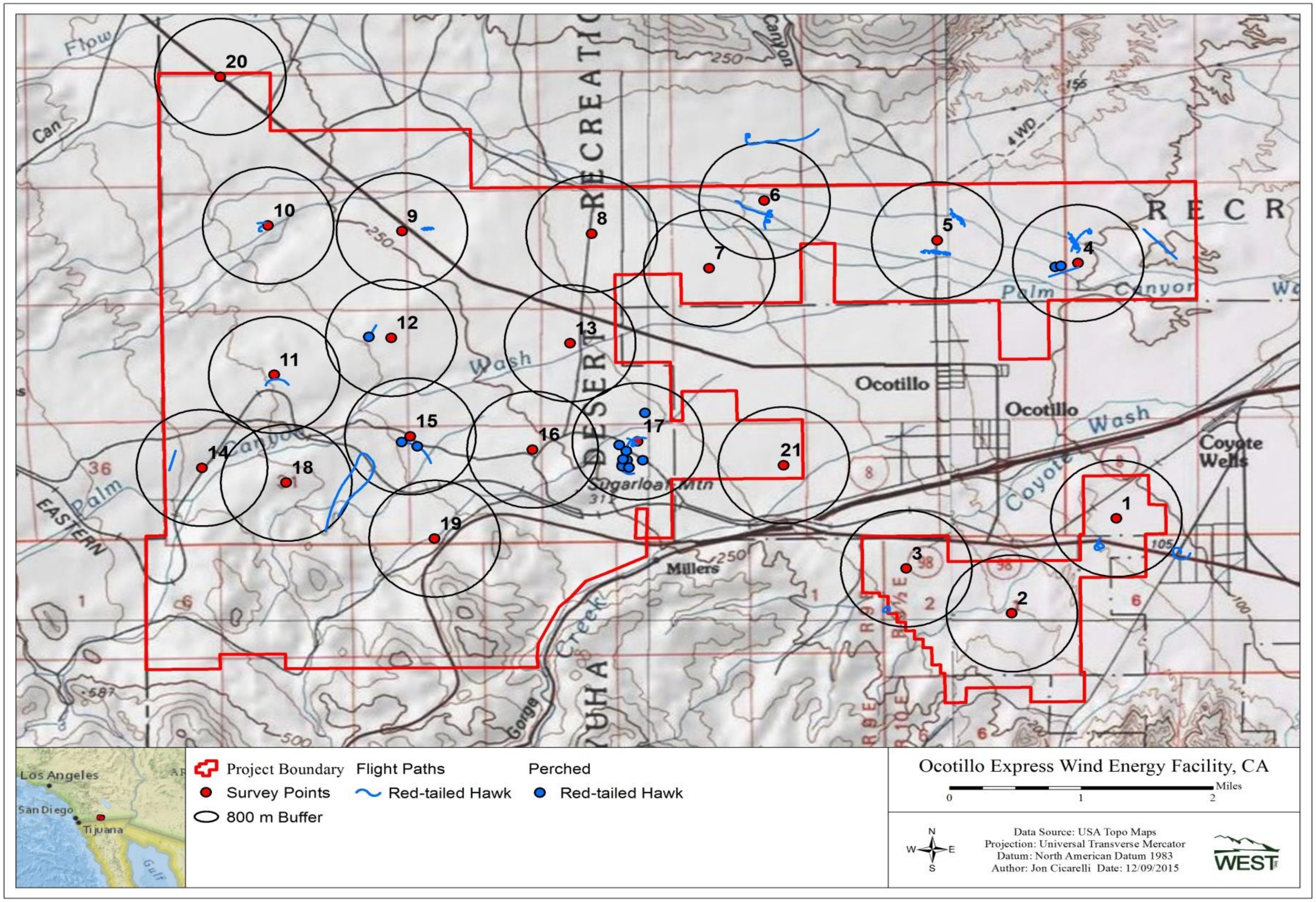
Appendix F. Mean Use by Point for All Birds, Major Bird Types, and Diurnal Raptor Subtypes during Fixed-Point Bird Use Surveys at the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015

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 October 3, 2014 to September 25, 2015.

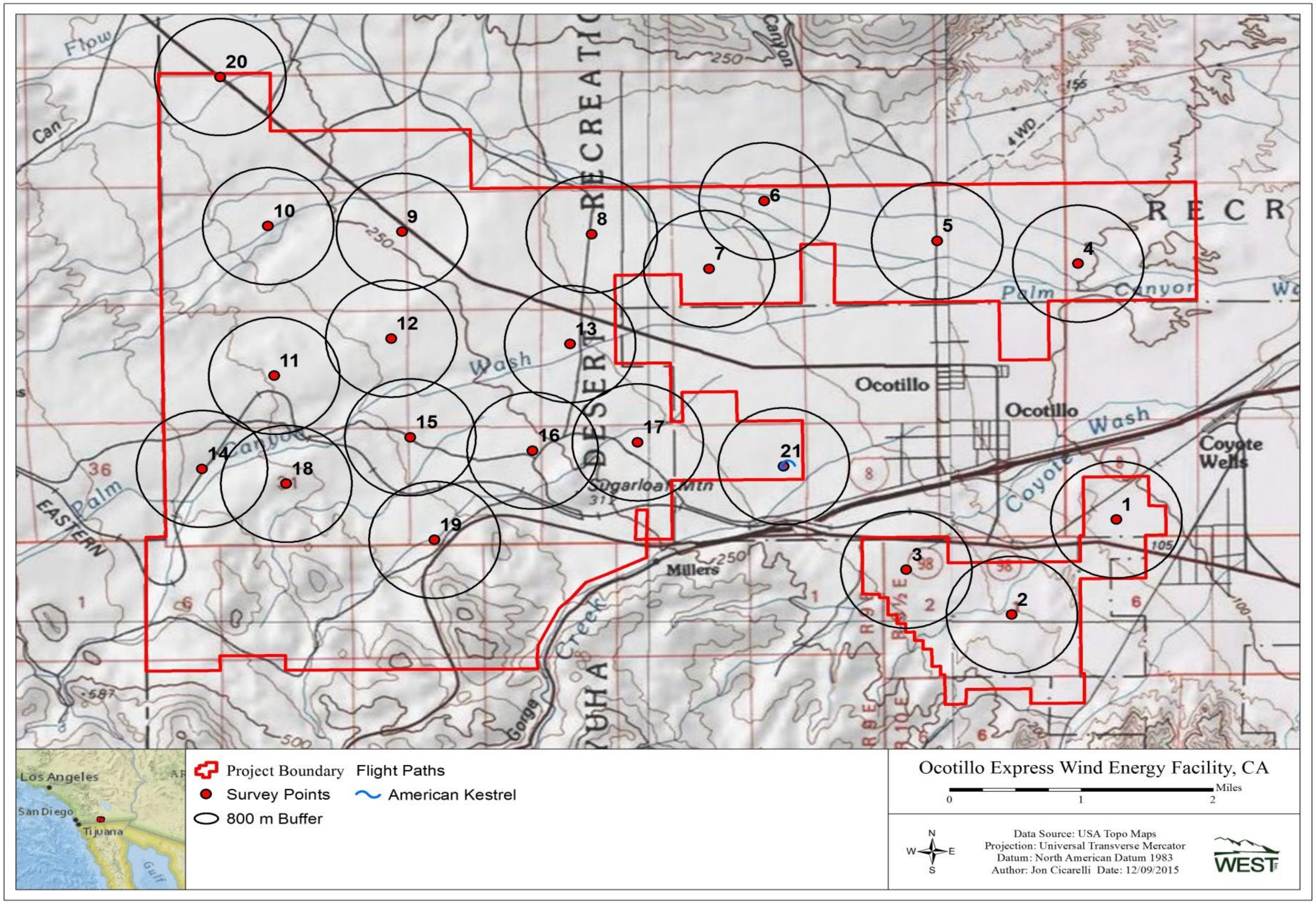
	Survey Point																				
Bird Type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Diurnal Raptors	0.12	0	0.08	0.25	0.08	0.08	0	0	0	0.08	0.04	0.04	0	0.04	0.04	0	0.54	0.04	0	0.04	0.08
Buteos	0.12	0	0.04	0.25	0.08	0.08	0	0	0	0.08	0.04	0.04	0	0.04	0.04	0	0.54	0.04	0	0	0
Falcons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.08
Other Raptors	0	0	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.04	0
Vultures	0.12	0.08	0	0.17	0.08	0	0.04	0	0.08	0	0	0	0	0	0	0	0	0	0	0.08	0
Doves/Pigeons	0.38	0.21	0.04	0	0	0	0.04	0.08	0	0.25	0.04	0.04	0.12	0	0	0	0.12	2.71	0.17	0.04	0.46
Large Corvids	0.29	0.12	0.21	0.12	0.58	0.33	1.21	0.17	0.08	0.25	0.29	0.08	0.21	0.12	0.04	0.25	0.25	0.29	0.58	0.12	0.92
All Large Birds	**0.92**	**0.42**	**0.33**	**0.54**	**0.75**	**0.42**	**1.29**	**0.25**	**0.17**	**0.58**	**0.38**	**0.17**	**0.33**	**0.17**	**0.08**	**0.25**	**0.92**	**3.04**	**0.75**	**0.29**	**1.46**
Passerines	1.42	0.62	0.88	0.62	1	1.04	0.67	1.21	1.46	3.67	3.08	3.92	2	3.12	2.67	1.21	4.33	2.96	1.5	2.04	1.71
Cuckoos	0	0	0	0	0	0	0	0	0	0	0.04	0	0	0	0	0	0	0	0	0	0
Swifts/ Hummingbirds	0.04	0.17	0.04	0	0.08	0.08	0.08	0.17	0.25	0.5	0.29	0.21	0.04	0.33	0.17	0.08	0.46	0.29	0.08	0.38	0.12
Woodpeckers	0	0	0	0	0	0	0	0	0	0	0	0	0	0.04	0	0	0	0	0.04	0	0
Unidentified Birds	0	0	0	0	0	0	0.04	0	0.08	0.12	0.08	0	0.04	0.04	0.04	0	0	0	0.08	0	0.08
All Small Birds	**1.46**	**0.79**	**0.92**	**0.62**	**1.08**	**1.12**	**0.79**	**1.38**	**1.79**	**4.29**	**3.5**	**4.12**	**2.08**	**3.54**	**2.88**	**1.29**	**4.79**	**3.25**	**1.71**	**2.42**	**1.92**

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

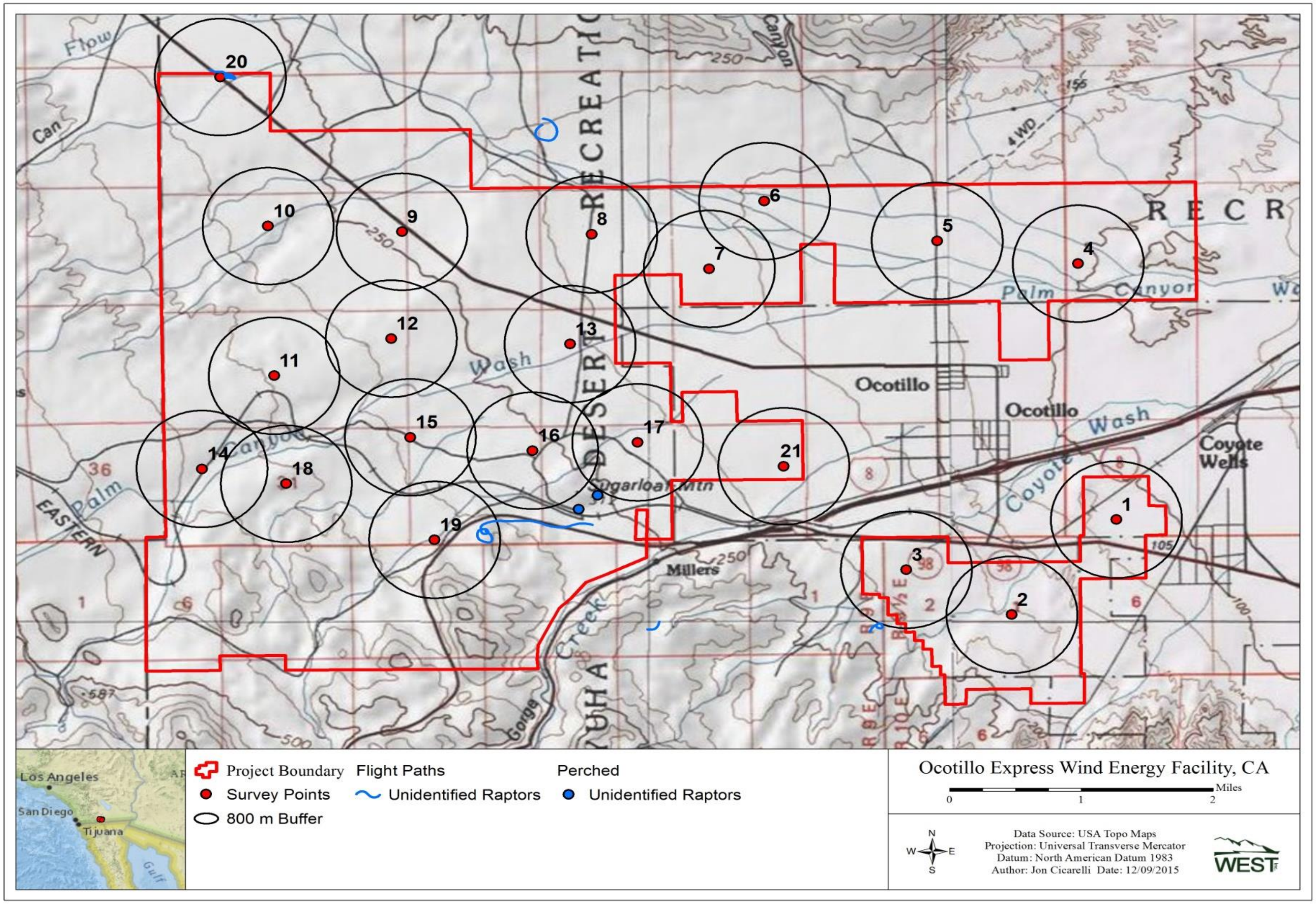
Appendix G. Large Bird Flight Paths Recorded during Fixed-Point Bird Use Surveys at the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015



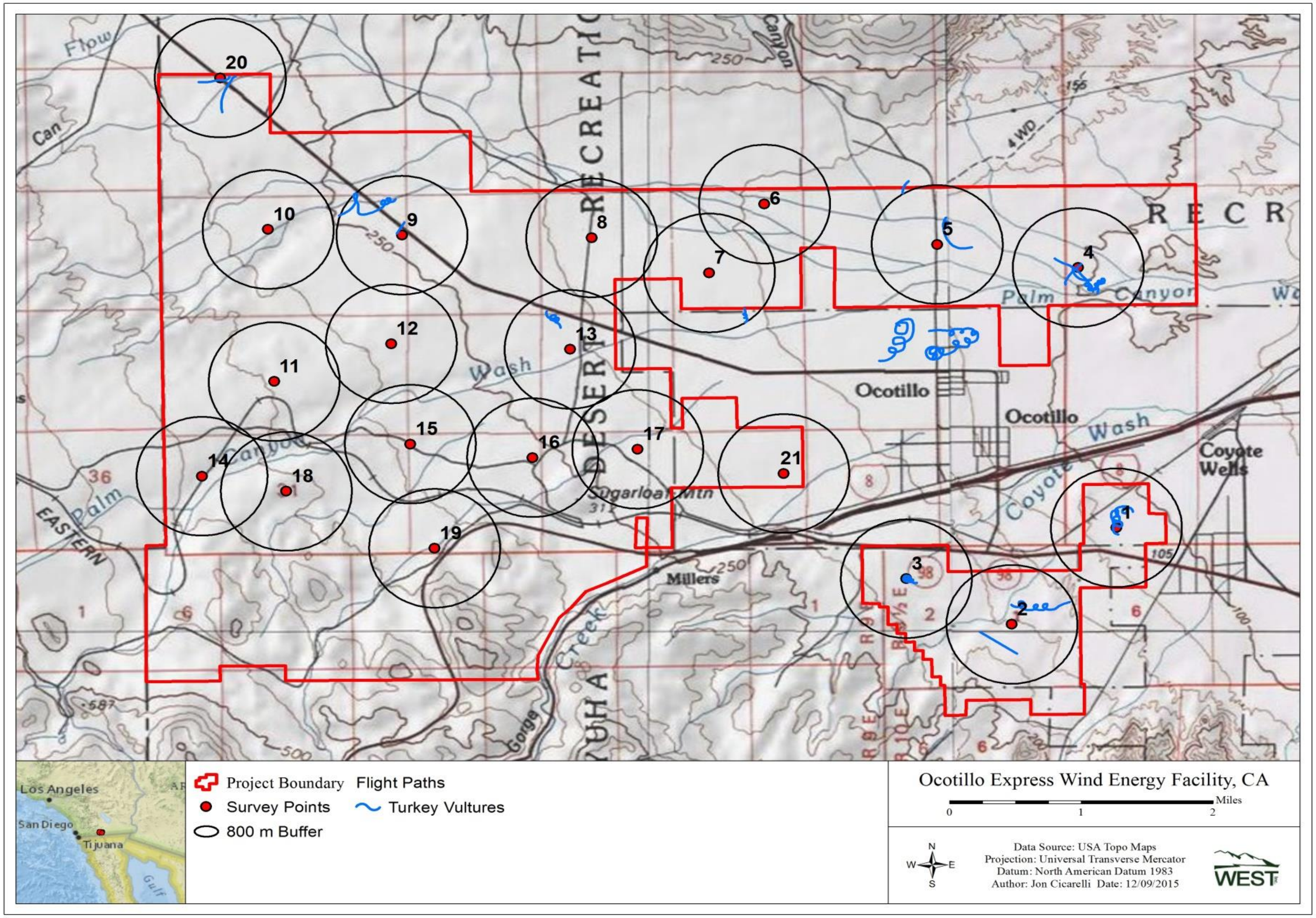
Appendix G. Buteo flight paths recorded at the Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from October 3, 2014 – September 25, 2015.



Appendix G (*continued*). Falcon flight paths recorded at the Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from October 3, 2014 – September 25, 2015.



Appendix G (*continued*). Unidentified raptor flight paths recorded at Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from October 3, 2014 – September 25, 2015.



Appendix G (*continued*). Turkey vulture flight paths recorded at Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from October 3, 2014 – September 25, 2015.

Appendix H. North American Fatality Summary Tables

Appendix H1. Wind energy facilities in California and the Southwest with publicly-available and comparable fatality data for all bird species.

Wind Energy Facility	Fatality Estimate^A	No. of Turbines	Total MW
Ocotillo, CA	**1.37**	**112**	**315**
California			
Pine Tree, CA (2009-2010, 2011)	17.44	90	135
Montezuma I, CA (2012)	8.91	16	36.8
Alta Wind I-V, CA (2013-2014)	7.8	290	720 (150 GE, 570 vestas)
Alta Wind I, CA (2011-2012)	7.07	100	150
Shiloh I, CA (2006-2009)	6.96	100	150
Montezuma I, CA (2011)	5.19	16	36.8
Dillon, CA (2008-2009)	4.71	45	45
Diablo Winds, CA (2005-2007)	4.29	31	20.46
Shiloh III, CA (2012-2013)	3.3	50	102.5
Shiloh II, CA (2010-2011)	2.8	75	150
Shiloh II, CA (2009-2010)	1.9	75	150
Mustang Hills, CA (2012-2013)	1.66	50	150
Alta Wind II-V, CA (2011-2012)	1.66	190	570
High Winds, CA (2003-2004)	1.62	90	162
Solano III, CA (2012-2013)	1.6	55	128
Pinyon Pines I & II, CA (2013-2014)	1.18	100	NA
High Winds, CA (2004-2005)	1.1	90	162
Montezuma II, CA (2012-2013)	1.08	34	78.2
Alta VIII, CA (2012-2013)	0.66	50	150
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

A=number of bird fatalities/MW/year

Data from the following sources:

Wind Energy Facility	Estimate Reference	Wind Energy Facility	Estimate Reference
Ocotillo, CA	This study.		
Alite, CA (09-10)	Chatfield et al. 2010b	Montezuma I, CA (11)	ICF International 2012
Alta Wind I, CA (11-12)	Chatfield et al. 2012	Montezuma I, CA (12)	ICF International 2012
Alta Wind I-V, CA (13-14)	Chatfield et al. 2014	Montezuma II, CA (12-13)	Harvey & Associates 2013
Alta Wind II-V, CA (11-12)	Chatfield et al. 2012	Mustang Hills, CA (12-13)	Chatfield and Bay 2014
Alta VIII, CA (12-13)	Chatfield and Bay 2014	Pine Tree, CA (09-10, 11)	BioResource Consultants 2012
Diablo Winds, CA (05-07)	WEST 2006, 2008	Pinyon Pines I & II, CA (13-14)	Chatfield and Russo 2014
Dillon, CA (08-09)	Chatfield et al. 2009	Shiloh I, CA (06-09)	Kerlinger et al. 2009
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Shiloh II, CA (09-10)	Kerlinger et al. 2010b
Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Shiloh II, CA (10-11)	Kerlinger et al. 2013a
High Winds, CA (03-04)	Kerlinger et al. 2006	Shiloh III, CA (12-13)	Kerlinger et al. 2013b
High Winds, CA (04-05)	Kerlinger et al. 2006	Solano III, CA (12-13)	AECOM 2013

Appendix H2. Wind energy facilities in California and the Southwestwith publicly-available and comparable use and fatality data for raptors.

Wind Energy Facility	Use Estimate[A]	Raptor Fatality Estimate[B]	No. of Turbines	Total MW
Ocotillo, CA	**NA**	**0.04**	112	315
	California			
Montezuma I, CA (2011)	NA	1.06	16	36.8
Solano III, CA (2012-2013)	NA	0.95	55	128
Montezuma I, CA (2012)	NA	0.79	16	36.8
High Winds, CA (2003-2004)	2.337	0.5	90	162
Montezuma II, CA (2012-2013)	NA	0.46	34	78.2
Shiloh II, CA (2010-2011)	NA	0.44	75	150
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
Alite, CA (2009-2010)	NA	0.12	8	24
Shiloh II, CA (2009-2010)	NA	0.11	75	150
Mustang Hills, CA (2012-2013)	NA	0.08	50	150
Alta Wind I-V, CA (2013-2014)	NA	0.08	290	720 (150 GE, 570 vestas)
Alta Wind II-V, CA (2011-2012)	0.04	0.05	190	570
Alta VIII, CA (2012-2013)	NA	0.02	50	150
Dillon, CA (2008-2009)	NA	0	45	45
	Southwest			
Dry Lake I, AZ (2009-2010)	0.13	0	30	63
Dry Lake II, AZ (2011-2012)	NA	0	31	65

A=number of raptors/plot/20-min survey

B=number of fatalities/MW/year

Data from the following sources:

Wind Energy Facility	Estimate Reference	Wind Energy Facility	Estimate Reference
Ocotillo, CA	This study.		
Alite, CA (09-10)	Chatfield et al. 2010b	Montezuma I, CA (11)	ICF International 2012
Alta Wind I, CA (11-12)	Chatfield et al. 2012	Montezuma I, CA (12)	ICF International 2013
Alta Wind I-V, CA (13-14)	Chatfield et al. 2014	Montezuma II, CA (12-13)	Harvey & Associates 2013
Alta Wind II-V, CA (11-12)	Chatfield et al. 2012	Mustang Hills, CA (12-13)	Chatfield and Bay 2014
Alta VIII, CA (12-13)	Chatfield and Bay 2014	Pine Tree, CA (09-10, 11)	BRC 2012
Diablo Winds, CA (05-07)	WEST 2006, 2008	Pinyon Pines I & II, CA (13-14)	Chatfield and Russo 2014
Dillon, CA (08-09)	Chatfield et al. 2009	Shiloh I, CA (06-09)	Kerlinger et al. 2009
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Shiloh II, CA (09-10)	Kerlinger et al. 2010b
Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Shiloh II, CA (10-11)	Kerlinger et al. 2013a
High Winds, CA (03-04)	Kerlinger et al. 2006	Shiloh III, CA (12-13)	Kerlinger et al. 2013b
High Winds, CA (04-05)	Kerlinger et al. 2006	Solano III, CA (12-13)	Kerlinger et al. 2010b

Appendix H3. Wind energy facilities in California and the Southwest with publicly-available comparable activity and fatality data for bats.

Wind Energy Facility	Bat Activity Estimate^A	Bat Activity Dates	Fatality Estimate^B	No. of Turbines	Total MW
Ocotillo, CA	**NA**	**NA**	**1.45**	**112**	**315**
		California			
Shiloh I, CA (2006-2009)	NA	NA	3.92	100	150
Shiloh II, CA (2010-2011)	NA	NA	3.8	75	150
Shiloh II, CA (2009-2010)	NA	NA	2.6	75	150
High Winds, CA (2003-2004)	NA	NA	2.51	90	162
Dillon, CA (2008-2009)	NA	NA	2.17	45	45
Montezuma I, CA (2011)	NA	NA	1.9	16	36.8
High Winds, CA (2004-2005)	NA	NA	1.52	90	162
Alta Wind I, CA (2011-2012)	4.42^C	6/26/09-10/31/09	1.28	100	150
Montezuma II, CA (2012-2013)	NA	NA	0.91	34	78.2
Montezuma I, CA (2012)	NA	NA	0.84	16	36.8
Diablo Winds, CA (2005-2007)	NA	NA	0.82	31	20.46
Shiloh III, CA (2012-2013)	NA	NA	0.4	50	102.5
Solano III, CA (2012-2013)	NA	NA	0.31	55	128
Alite, CA (2009-2010)	NA	NA	0.24	8	24
Alta Wind I-V, CA (2013-2014)	NA	NA	0.2	290	720 (150 GE, 570 vestas)
Mustang Hills, CA (2012-2013)	NA	NA	0.1	50	150
Alta Wind II-V, CA (2011-2012)	0.78	6/26/09-10/31/09	0.08	190	570
Pinyon Pines I & II, CA (2013-2014)	NA	NA	0.04	100	NA
Alta VIII, CA (2012-2013)	NA	NA	0	50	150
		Southwest			
Dry Lake I, AZ (2009-2010)	8.8	4/29/10-11/10/10	3.43	30	63
Dry Lake II, AZ (2011-2012)	11.5	5/11/11-10/26/11	1.66	31	65

A = 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
Data from the following sources:

Facility	Activity Estimate	Fatality Estimate	Facility	Activity Estimate	Fatality Estimate
Ocotillo, CA	**NA**	**This study**			
Alite, CA (09-10)		Chatfield et al. 2010b	Montezuma I, CA (11)		ICF International 2012
Alta Wind I, CA (11-12)	Solick et al. 2010b	Chatfield et al. 2012	Montezuma I, CA (12)		ICF International 2013
Alta Wind I-V, CA (13-14)		Chatfield et al. 2014	Montezuma II, CA (12-13)		Harvey & Associates 2013
Alta Wind II-V, CA (11-12)	Solick et al. 2010b	Chatfield et al. 2012	Mustang Hills, CA (12-13)		Chatfield and Bay 2014
Alta VIII, CA (12-13)		Chatfield and Bay 2014	Pinyon Pines I&II, CA (13-14)		Chatfield and Bay 2014
Diablo Winds, CA (05-07)		WEST 2006, 2008	Shiloh I, CA (06-09)		Kerlinger et al. 2009
Dillon, CA (08-09)		Chatfield et al. 2009	Shiloh II, CA (09-10)		Kerlinger et al. 2010b
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Thompson et al. 2011	Shiloh II, CA (10-11)		Kerlinger et al. 2013a
Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Thompson and Bay 2012	Shiloh III, CA (12-13)		Kerlinger et al. 2013b
High Winds, CA (03-04)		Kerlinger et al. 2006	Solano III, CA (12-13)		AECOM 2013
High Winds, CA (04-05)		Kerlinger et al. 2006			

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 I-V, CA (2013-2014)	7.8	0.08	0.2	Na	Chatfield et al. 2014
Alta Wind II-V, CA (2011-2012)	1.66	0.05	0.08	Desert scrub	Chatfield et al. 2012
Alta VIII, CA (2012-2013)	0.66	0.02	0	Grassland and riparian	Chatfield and Bay 2014
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. 2013b
Beech Ridge, WV (2013)	1.48	0.01	0.58	Forest	Young et al. 2014a
Big Blue, MN (2013)	0.6	0	2.04	Agriculture	Fagen Engineering 2014
Big Blue, MN (2014)	0.37	0	1.43	Agriculture	Fagen Engineering 2015
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
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

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 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. 2010c
Buffalo Ridge II, SD (2011-2012)	1.99	0	2.81	Agriculture, grassland	Derby et al. 2012a
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
Casselman Curtailment, PA (2008)	NA	NA	4.4	Forest	Arnett et al. 2009b
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	Enz et al. 2012
Crescent Ridge, IL (2005-2006)	NA	NA	3.27	Agriculture	Kerlinger et al. 2007
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
Criterion, MD (2013)	3.49	NA	5.32	Forest, agriculture	Young et al. 2014b
Crystal Lake II, IA (2009)	NA	NA	7.42	Agriculture	Derby et al. 2010b
Diablo Winds, CA (2005-2007)	4.29	0.4	0.82		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

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
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. 2010d
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. 2003c
Foote Creek Rim, WY (Phase I; 2000)	2.42	0.05	1.05	Grassland	Young et al. 2003c
Foote Creek Rim, WY (Phase I; 2001-2002)	1.93	0	1.57	Grassland	Young et al. 2003c
Forward Energy Center, WI (2008-2010)	NA	NA	18.17	Agriculture	Grodsky and Drake 2011
Fowler I, IN (2009)	2.83	0	8.09	Agriculture	Johnson et al. 2010a
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. 2013c
Fowler III, IN (2009)	NA	NA	1.84	Agriculture	Johnson et al. 2010b
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. 2010h
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

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
Kittitas Valley, WA (2011-2012)	1.06	0.09	0.12	Sagebrush-steppe, grassland	Stantec Consulting Services 2012a
Klondike, OR (2002-2003)	0.95	0	0.77	Agriculture/grassland	Johnson et al. 2003
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
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)	2.34	NA	6.49	Agriculture/forested	Jain et al. 2009a
Maple Ridge, NY (2007-2008)	2.07	0.03	4.96	Agriculture/forested	Jain et al. 2009d
Maple Ridge, NY (2012)	NA	NA	7.3	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 Corporation 2010c
Mars Hill, ME (2007)	1.67	0	2.91	Forest	Stantec 2008
Mars Hill, ME (2008)	1.76	0	0.45	Forest	Stantec 2009a
Milford I, UT (2010-2011)	0.56	NA	2.05	Desert shrub	Stantec 2011
Milford I & II, UT (2011-2012)	0.73	0.04	1.67	Desert shrub	Stantec 2012b
Montezuma I, CA (2011)	5.19	1.06	1.9	Agriculture and grasslands	ICF International 2012
Montezuma I, CA (2012)	8.91	0.79	0.84	Agriculture and grasslands	ICF International 2013
Montezuma II, CA (2012-2013)	1.08	0.46	0.91	Agriculture	Harvey & Associates 2013
Moraine II, MN (2009)	5.59	0.37	2.42	Agriculture/grassland	Derby et al. 2010e
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

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
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
Mustang Hills, CA (2012-2013)	1.66	0.08	0.1	Grasslands and riparian	Chatfield and Bay 2014
Nine Canyon, WA (2002-2003)	2.76	0.03	2.47	Agriculture/grassland	Erickson et al. 2003c
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
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
Ocotillo (2014-2015)	1.27	0.04	1.35	NA	This study
Palouse Wind, WA (2012-2013)	0.72	NA	4.23	Agriculture and grasslands	Stantec 2013a
Pebble Springs, OR (2009-2010)	1.93	0.04	1.55	Grassland	Gritski and Kronner 2010b
Pine Tree, CA (2009-2010, 2011)	17.44	NA	NA	Grassland	BioResource Consultants 2012
Pinnacle, WV (2012)	3.99	0	40.2	Forest	Hein et al. 2013a
Pinyon Pines I & II, CA (2013-2014)	1.18	NA	0.04	Na	Chatfield and Russo 2014
Pioneer Prairie I, IA (Phase II; 2011-2012)	0.27	0	10.06	Agriculture, grassland	Chodachek et al. 2012
Pioneer Prairie II, IA (2013)	NA	NA	3.83	Agriculture	Chodachek et al. 2014
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
PrairieWinds SD1, SD (2013-2014)	1.66	0.17	0.52	Grassland	Derby et al. 2014
Rail Splitter, IL (2012-2013)	0.84	0	22.53	Agriculture	Good et al. 2013b
Record Hill, ME (2012)	3.7	NA	2.96	Forest	Stantec 2013b
Record Hill, ME (2014)	1.84	NA	0.55	Forest	Stantec 2015
Red Hills, OK (2012-2013)	0.08	0.04	0.11	Grassland	Derby et al. 2013c

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
Ripley, Ont (2008)	3.09	0.1	4.67	Agriculture	Jacques Whitford 2009
Rollins, ME (2012)	2.9	NA	0.18	Forest	Stantec 2013c
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)	1.9	0.11	2.6	Agriculture	Kerlinger et al. 2010a, 2013a
Shiloh II, CA (2010-2011)	2.8	0.44	3.8	Agriculture	Kerlinger et al. 2013a
Shiloh III, CA (2012-2013)	3.3	NA	0.4	Na	Kerlinger et al. 2013b
Solano III, CA (2012-2013)	1.6	0.95	0.31	Na	AECOM 2013
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	Forest	Normandeau Associates 2011
Stetson Mountain I, ME (2013)	6.95	0	0.18	Forest	Stantec 2014
Stetson Mountain II, ME (2010)	1.42	0	1.65	Forest	Normandeau Associates 2010
Stetson Mountain II, ME (2012)	3.37	0	2.27	Forest	Stantec 2013e
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 Crop I & II (2012-2013)	0.6	NA	26.85	Agriculture	Good et al. 2013a
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
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. 2000
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. 2010g
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

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
Winnebago, IA (2009-2010)	3.88	0.27	4.54	Agriculture/grassland	Derby et al. 2010f
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 I-V, CA (2013-2014)	290	720 (150 GE, 570 vestas)	80	55 (25 at Alta I, 30 at Alta II-V)	120 m radius circles	NA	Monthly or bi-weekly
Alta Wind II-V, CA (2011-2012)	190	570	80	41	120-m radius circle	14.5 months	Every two weeks
Alta VIII, CA (2012-2013)	50	150	90	12 plots (equivalent to 15 turbines)	240 x 240 m	1 year	Bi-weekly
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)
Barton Chapel, TX (2009-2010)	60	120	78	30	200 m x 200 m	1 year	10 turbines weekly, 20 monthly
Beech Ridge, WV (2012)	67	100.5	80	67	40 m radius	7 months	Every two days
Beech Ridge, WV (2013)	67	100.5	80	67	40 m radius	7.5 months	Every two days
Big Blue, MN (2013)	18	36	78 or 90 (according to Gamesa website)	18	200m diameter	NA	Weekly, monthly (Nov and Dec)
Big Blue, MN (2014)	18	36	78 or 90 (according to Gamesa website)	18	200m diameter	NA	Weekly, monthly (Nov and Dec)

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

Appendix 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 (1994-1995)	73	25	37	1994:10 plots (3 turbines/plot), 20 addition plots in Sept & Oct 1994, 1995: 30 turbines search every other week (Jan-Mar), 60 searched weekly (Apr, July, Aug) 73 searched weekly (May-June and Sept-Oct), 30 searched weekly (Nov-Dec)	100 x 100m	20 months	Varies. See number turbines searched or page 44 of report
Buffalo Ridge, MN (Phase I; 1996)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase I; 1997)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase I; 1998)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase I; 1999)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 1998)	143	107.25	50	40	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 1999)	143	107.25	50	40	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	143	107.25	50	83	60 m x 60 m	Summer, fall	Bi-monthly
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	143	107.25	50	103	60 m x 60 m	Summer, fall	Bi-monthly
Buffalo Ridge, MN (Phase III; 1999)	138	103.5	50	30	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	138	103.5	50	83	60 m x 60 m	Summer, fall	Bi-monthly
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	138	103.5	50	103	60 m x 60 m	Summer, fall	Bi-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
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)	60	39.6	50	60	50-m radius	2 years	Weekly, bi-weekly
Castle River, Alb (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	n/a	n/a	n/a	n/a	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

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
Criterion, MD (2012)	28	70	80	14	40-50m radius	7.5 months	Weekly
Criterion, MD (2013)	28	70	80	14	40-50m radius	7.5 months	Weekly
Crystal Lake II, IA (2009)	80	200	80	16 turbines through week 6, and then 15 for duration of study	100 m x 100 m	Spring, summer, fall	3 times per week for 26 weeks
Diablo Winds, CA (2005-2007)	31	20.46	50 and 55	31	75 m x 75 m	2 years	Monthly
Dillon, CA (2008-2009)	45	45	69	15	200 m x 200 m	1 year	Weekly, bi-monthly in winter
Dry Lake I, AZ (2009-2010)	30	63	78	15	160 m x 160 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Dry Lake II, AZ (2011-2012)	31	65	78	31: 5 (full plot), 26 (road & pad)	160 m x 160 m	1 year	Twice weekly (spring, summer, fall), weekly (winter)
Elkhorn, OR (2008)	61	101	80	61	220 m x 220 m	1 year	Monthly
Elkhorn, OR (2010)	61	101	80	31	220 m x 220 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
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
Hay Canyon, OR (2009-2010)	48	100.8	79	20	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Heritage Garden I, MI (2012-2014)	14	28	90	14	120 x 120 m except one plot that was 280 x 280 m	2 years	Weekly (spring, summer, and fall) and bi-weekly (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
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
Klondike II, OR (2005-2006)	50	75	80	25	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (summer, winter)
Klondike III (Phase I), OR (2007-2009)	125	223.6	GE = 80; Siemens= 80, Mitsubishi = 80	46	240 m x 240 m (1.5MW) 252 m x 252 m (2.3MW)	2 year	Bi-monthly (spring, fall migration), monthly (summer, winter)

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

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
Mars Hill, ME (2008)	28	42	80.5	28	76-m diameter, extended plot 238-m diameter	Spring, summer, fall	Weekly: extended plot searched once per season
McBride, Alb (2004)	114	75	50	114	4 parallel transects 120-m wide	1 year	Weekly, bi-weekly
Melancthon, Ont (Phase I; 2007)	45	NA	NA	45	35m radius	5 months	Weekly, twice weekly
Meyersdale, PA (2004)	20	30	80	20	130 m x 120 m	6 weeks	Daily (half turbines), weekly (half turbines)
Milford I, UT (2010-2011)	58	145	80	24	120x120	NA	Weekly
Milford I & II, UT (2011-2012)	107	160.5 (58.5 I, 102 II)	80	43	120x120	NA	Every 10.5 days
Montezuma I, CA (2011)	16	36.8	80	16	105 m radius	1 year	Weekly and bi-Weekly
Montezuma I, CA (2012)	16	36.8	80	16	105 m radius	1 year	Weekly and bi-Weekly
Montezuma II, CA (2012-2013)	34	78.2	80	17	105 m radius	1 year	Weekly
Moraine II, MN (2009)	33	49.5	82.5	30	200 m x 200 m	1 year	Weekly (migratory), monthly (non-migratory)
Mount Storm, WV (Fall 2008)	82	164	78	27	varied	3 months	Weekly (18 turbines), daily (9 turbines)
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
Mountaineer, WV (2003)	44	66	80	44	60-m radius	7 months	Weekly, monthly
Mountaineer, WV (2004)	44	66	80	44	130 m x 120 m	6 weeks	Daily, weekly
Munnsville, NY (2008)	23	34.5	69.5	12	120 m x 120 m	Spring, summer, fall	Weekly

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
Mustang Hills, CA (2012-2013)	50	150	90	13 plots (equivalent to 15 turbines)	240 x 240 m	1 year	Bi-weekly
Nine Canyon, WA (2002-2003)	37	48.1	60	37	90-m radius	1 year	Bi-monthly (spring, summer, fall), monthly (winter)
Nine Canyon II, WA (2004)	12	15.6	60	12	90 m x 90 m	3 months	Once every two weeks
Noble Altona, NY (2010)	65	97.5	80	22	120 m x 120 m	Spring, summer, fall	Daily, weekly
Noble Altona, NY (2011)	65	97.5	80	22	120m x 120m	2 months	Daily
Noble Bliss, NY (2008)	67	100	80	23	120 m x 120 m	Spring, summer, fall	Daily (8 turbines), 3-day (8 turbines), weekly (7 turbines)
Noble Bliss, NY (2009)	67	100	80	23	120 m x 120 m	Spring, summer, fall	Weekly, 8 turbines searched daily from July 1 to August 15
Noble Bliss/Wethersfield, NY (2011)	151	226	80	48 (24 from each site:12 ag, 12 forest)	road & pad 70 m out from turbine	2 months	Daily
Noble Chateaugay, NY (2010)	71	106.5	80	24	120 m x 120 m	Spring, summer, fall	Weekly
Noble Clinton, NY (2008)	67	100	80	23	120 m x 120 m	Spring, summer, fall	Daily (8 turbines), 3-day (8 turbines), weekly (7 turbines)
Noble Clinton, NY (2009)	67	100	80	23	120 m x 120 m	Spring, summer, fall	Daily (8 turbines), weekly (15 turbines), all turbines weekly from July 1 to August 15
Noble Ellenburg, NY (2008)	54	80	80	18	120 m x 120 m	Spring, summer, fall	Daily (6 turbines), 3-day (6 turbines), weekly (6 turbines)
Noble Ellenburg, NY (2009)	54	80	80	18	120 m x 120 m	Spring, summer, fall	Daily (6 turbines), weekly (12 turbines), all turbines weekly from July 1 to August 15
Noble Wethersfield, NY (2010)	84	126	80	28	120 m x 120 m	Spring, summer, fall	Weekly

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
NPPD Ainsworth, NE (2006)	36	20.5	70	36	220 m x 220 m	Spring, summer, fall	Bi-monthly
Oklahoma Wind Energy Center, OK (2004; 2005)	68	102	70	68	20m radius	3 months (2 years)	Bi-monthly
Pacific, CA (2012-2013)	70	140	78.5	20	126 m radius	NA	Twice weekly (fall), and biweekly
Palouse Wind, WA (2012-2013)	58	104.4	80, 90, or 105 M (according to the Vestas website)	19	120m x 120m	1 year	Monthly (Winter) and Weekly (Spring-Fall)
Pebble Springs, OR (2009-2010)	47	98.7	79	20	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Pine Tree, CA (2009-2010, 2011)	90	135	65	40	100 m radius	1.5 year	Bi-weekly, weekly
Pinnacle, WV (2012)	23	55.2	80	11	126 m x 120m	9 months	Weekly
Pinnacle Operational Mitigation Study (2012)	23	55.2	80	12	126m x 120m	2.5 months	Daily
Pinyon Pines I & II, CA (2013-2014)	100	NA	90	25 plots (aprox 31 turbines)	240x240 m	NA	Bi-weekly
Pioneer Prairie I, IA (Phase II; 2011-2012)	62	102.3	80	62 (57 road/pad) 5 full search plots	80 x 80m	1 year	Weekly (spring and fall), every two weeks (summer), monthly (winter)
Pioneer Prairie II, IA (2013)	62	102.3	80	62	80x80 m (5 turbines), road and pad within 100 m of turbine (57 turbines)	NA	Weekly
Pioneer Trail, IL (2012-2013)	94	150.5	NA	50	80x80m	Fall, spring	Weekly
Prairie Rose, MN (2014)	119	200	80	10	100x100m	6 months	Weekly
PrairieWinds ND1 (Minot), ND (2010)	80	115.5	89	35	minimum of 100 m x 100 m	3 seasons	Bi-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
PrairieWinds ND1 (Minot), ND (2011)	80	115.5	80	35	minimum 100 x 100m	3 season	Twice monthly
PrairieWinds SD1, SD (2012-2013)	108	162	80	50	200 x 200m	1 year	Bi-weekly
PrairieWinds SD1, SD (2013-2014)	108	162	80	45	200 x 200m	1 year	Twice monthly (spring, summer, fall), monthly (winter)
PrairieWinds SD1, SD (2011-2012)	108	162	80	50	200 x 200m	1 year	Twice monthly (spring, summer, fall), monthly (winter)
Rail Splitter, IL (2012-2013)	67	100.5	80	34	60 m radius	1 year	Weekly (spring, summer, and fall) and bi-weekly (winter)
Record Hill, ME (2012)	22	50.6	80	22	126.5 x1 26.5 m	5 months	Three times every two weeks
Record Hill, ME (2014)	22	50.6	80	10	varied due to steep terrain and heavily vegetated areas	4.5 months	Daily for 5 days a week
Red Canyon, TX (2006-2007)	56	84	70	28	200 m x 200 m in fall and winter; 160 m x 160 m in spring and summer	1 year	Every 14 days in fall and winter; 7 days in spring, 3 days in summer
Red Hills, OK (2012-2013)	82	123	80	20 (plus one met tower)	100 x 100	1 year	Weekly (spring, summer, fall), monthly (winter)
Ripley, Ont (2008)	38	76	64	38	80 m x 80 m	Spring, fall	Twice weekly for odd turbines; weekly for even turbines.
Ripley, Ont (2008-2009)	38	76	64	38	80 m x 80 m	6 weeks	Twice weekly for odd turbines; weekly for even turbines.
Rollins, ME (2012)	40	60	80	20	varied; turbine laydown area and gravel access roads out to 60m	6 months	Weekly

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
Rugby, ND (2010-2011)	71	149	78	32	200 m x 200 m	1 year	Weekly (spring, fall; migratory turbines), monthly (non-migratory turbines)
San Gorgonio, CA (1997-1998; 1999-2000)	3000	n/a	24.4-42.7		50-m radius	2 years	Quarterly
Searsburg, VT (1997)	11	7	65	11	20- to 55-m radius	Spring, fall	Weekly (fall migration)
Sheffield, VT (2012)	16	40	80	8	126m x 120m	3 months	Daily
Sheffield Operational Mitigation Study (2012)	16	40	80	16	126m x 120m	4 months	Daily
Shiloh I, CA (2006-2009)	100	150	65	100	105-m radius	3 years	Weekly
Shiloh II, CA (2009-2010)	75	150	80	25	100m radius	1 year	Weekly
Shiloh II, CA (2010-2011)	75	150	80	25	100 m radius	1 year	Weekly
Shiloh III, CA (2012-2013)	50	102.5	78.5	25	100 m radius	NA	Weekly
SMUD Solano, CA (2004-2005)	22	15	65	22	60-m radius	1 year	Bi-monthly
Solano III, CA (2012-2013)	55	128	80	19	100 m radius	NA	Bi-Weekly
Spruce Mountain, ME (2012)	10	20	78	10	100 m x 100 m	7 months	Weekly
Stateline, OR/WA (2001-2002)	454	299	50	124	minimum 126 m x 126 m	17 months	Bi-weekly, monthly
Stateline, OR/WA (2003)	454	299	50	153	minimum 126 m x 126 m	1 year	Bi-weekly, monthly
Stateline, OR/WA (2006)	454	299	50	39	variable turbine strings	1 year	Bi-weekly
Steel Winds I & II, NY (2012)	14	35	80	8 (1 was just gravel pad)	120m x 120m	6 months	Weekly, bi-weekly (November only)
Steel Winds I, NY (2007)	8	20	80	8	176m x 176m	6.5 months	Every 10 days (spring, fall) every 21 days (summer)
Stetson Mountain I, ME (2009)	38	57	80	19	76-m diameter	27 weeks (spring, summer, fall)	Weekly
Stetson Mountain I, ME (2011)	38	57	80	19	79.45x79.45m	6 months	Weekly

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
Stetson Mountain I, ME (2013)	38	57	80	19	76 m diameter	6 months	Weekly
Stetson Mountain II, ME (2010)	17	25.5	80	17	74.5x74.5m	6 months	Weekly (3 turbines twice a week)
Stetson Mountain II, ME (2012)	17	25.5	80	17	laydown area and road up to 60m	6 months	Weekly
Summerview, Alb (2005-2006)	39	70.2	67	39	140 m x 140 m	1 year	Weekly, bi-weekly (May to July, September)
Summerview, Alb (2006; 2007)	39	70.2	65	39	52-m radius; 2 spiral transects 7 m apart	Summer, fall (2 years)	Daily (10 turbines), weekly (29 turbines)
Tehachapi, CA (1996-1998)	3300	n/a	14.7 to 57.6	201	50-m radius	20 months	Quarterly
Top Crop I & II (2012-2013)	68 (phase I) 132 (phase (II)	300 (102 (phase I) 198 (phase II))	65 (phase I) 80 (phase II)	100	61 m radius	1 year	Weekly (spring, summer, and fall) and bi-weekly (winter)
Top of Iowa, IA (2003)	89	80	71.6	26	76 m x 76 m	Spring, summer, fall	Once every 2 to 3 days
Top of Iowa, IA (2004)	89	80	71.6	26	76 m x 76 m	Spring, summer, fall	Once every 2 to 3 days
Tuolumne (Windy Point I), WA (2009-2010)	62	136.6	80	21	180 m x 180 m	1 year	Monthly throughout the year, a sub-set of 10 turbines were also searched weekly during the spring, summer, and fall
Vansycle, OR (1999)	38	24.9	50	38	126 m x 126 m	1 year	Monthly
Vantage, WA (2010-2011)	60	90	80	30	240 m x 240 m	1 year	Monthly, a subset of 10 searched weekly during migration
Vasco, CA (2012-2013)	34	78.2	80	34	105 m radius	1 year	Weekly, monthly

Appendix 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
Wessington Springs, SD (2009)	34	51	80	20	200 m x 200 m	Spring, summer, fall	Bi-monthly
Wessington Springs, SD (2010)	34	51	80	20	200 m x 200 m	8 months	Bi-weekly (spring, summer, fall)
White Creek, WA (2007-2011)	89	204.7	80	89	180 m x 180 m & 240 m x 240 m	4 years	Twice a week, weekly and monthly
Wild Horse, WA (2007)	127	229	67	64	110 m from two turbines in plot	1 year	Monthly, weekly (fall, spring migration at 16 turbines)
Windy Flats, WA (2010-2011)	114	262.2	80	36 (plus 1 MET tower)	180 m x 180 m (120m at MET tower)	1 year	Monthly (spring, summer, fall, and winter), weekly (spring and fall migration)
Winnebago, IA (2009-2010)	10	20	78	10	200 m x 200 m	1 year	Weekly (migratory), monthly (non-migratory)
Wolfe Island, Ont (May-June 2009)	86	197.8	80	86	60-m radius	Spring	43 twice weekly, 43 weekly
Wolfe Island, Ont (July-December 2009)	86	197.8	80	86	60-m radius	Summer, fall	43 twice weekly, 43 weekly
Wolfe Island, Ont (January-June 2010)	86	197.8	80	86	60-m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (July-December 2010)	86	197.8	80	86	50-m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (January-June 2011)	86	197.8	80	86	50-m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (July-December 2011)	86	197.8	80	86	50-m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (January-June 2012)	86	197.8	NA	86	50-m radius	NA	1/2 searched twice weekly, 1/2 searched weekly

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

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
Erie Shores, Ont. (06)	James 2008	Searsburg, VT (97)	Kerlinger 2002a
Foote Creek Rim, WY (Phase I; 99)	Young et al. 2003c	Sheffield, VT (12)	Martin et al. 2013
Foote Creek Rim, WY (Phase I; 00)	Young et al. 2003c	Sheffield Operational Mitigation Study (12)	Martin et al. 2013
Foote Creek Rim, WY (Phase I; 01-02)	Young et al. 2003c	Shiloh I, CA (06-09)	Kerlinger et al. 2009
Forward Energy Center, WI (08-10)	Grodsky and Drake 2011	Shiloh II, CA (09-10)	Kerlinger et al. 2010b
Fowler I, IN (09)	Johnson et al. 2010a	Shiloh II, CA (10-11)	Kerlinger et al. 2013a
Fowler I, II, III, IN (10)	Good et al. 2011	Shiloh III, CA (12-13)	Kerlinger et al. 2013b
Fowler I, II, III, IN (11)	Good et al. 2012	SMUD Solano, CA (04-05)	Erickson and Sharp 2005
Fowler I, II, III, IN (12)	Good et al. 2013c	Solano III, CA (12-13)	AECOM 2013
Fowler III, IN (09)	Johnson et al. 2010b	Spruce Mountain, ME (12)	Tetra Tech 2013
Goodnoe, WA (09-10)	URS Corporation 2010a	Stateline, OR/WA (01-02)	Erickson et al. 2004
Grand Ridge I, IL (09-10)	Derby et al. 2010h	Stateline, OR/WA (03)	Erickson et al. 2004
Harrow, Ont (10)	Natural Resource Solutions 2011	Stateline, OR/WA (06)	Erickson et al. 2007
Harvest Wind, WA (10-12)	Downes and Gritski 2012a	Steel Winds I, NY (07)	Grehan 2008
Hay Canyon, OR (09-10)	Gritski and Kronner 2010a	Steel Winds I & II, NY (12)	Stantec 2013d
Heritage Garden I, MI (12-14)	Heritage Garden I, MI (12-14)	Stetson Mountain I, ME (09)	Stantec 2009c
High Sheldon, NY (10)	Tidhar et al. 2012a	Stetson Mountain I, ME (11)	Normandeau Associates 2011
High Sheldon, NY (11)	Tidhar et al. 2012b	Stetson Mountain I, ME (13)	Stantec 2014
High Winds, CA (03-04)	Kerlinger et al. 2006	Stetson Mountain II, ME (10)	Normandeau Associates 2010
High Winds, CA (04-05)	Kerlinger et al. 2006	Stetson Mountain II, ME (12)	Stantec 2013e
Hopkins Ridge, WA (06)	Young et al. 2007a	Summerview, Alb (05-06)	Brown and Hamilton 2006b
Hopkins Ridge, WA (08)	Young et al. 2009c	Summerview, Alb (06; 07)	Baerwald 2008
Jersey Atlantic, NJ (08)	NJAS 2008a, 2008b, 2009	Tehachapi, CA (96-98)	Anderson et al. 2004
Judith Gap, MT (06-07)	TRC 2008	Top Crop I & II, IL (12-13)	Good et al. 2013a
Judith Gap, MT (09)	Poulton and Erickson 2010	Top of Iowa, IA (03)	Jain 2005
Kewaunee County, WI (99-01)	Howe et al. 2002	Top of Iowa, IA (04)	Jain 2005
Kibby, ME (11)	Stantec 2012	Tuolumne (Windy Point I), WA (09-10)	Enz and Bay 2010
Kittitas Valley, WA (11-12)	Stantec Consulting 2012a	Vansycle, OR (99)	Erickson et al. 2000
Klondike, OR (02-03)	Johnson et al. 2003	Vantage, WA (10-11)	Ventus Environmental Solutions 2012
Klondike II, OR (05-06)	NWC and WEST 2007	Vasco, CA (12-13)	Brown et al. 2013
Klondike III (Phase I), OR (07-09)	Gritski et al. 2010	Wessington Springs, SD (09)	Derby et al. 2010g
Klondike IIIa (Phase II), OR (08-10)	Gritski et al. 2011	Wessington Springs, SD (10)	Derby et al. 2011d
Lakefield Wind, MN (12)	MPUC 2012	White Creek, WA (07-11)	Downes and Gritski 2012b
Leaning Juniper, OR (06-08)	Gritski et al. 2008	Wild Horse, WA (07)	Erickson et al. 2008
Milford I, UT (10-11)	Stantec 2011	Windy Flats, WA (10-11)	Enz et al. 2011
Milford I & II, UT (11-12)	Stantec 2012b	Winnebago, IA (09-10)	Derby et al. 2010f
Montezuma I, CA (11)	ICF International 2012	Wolfe Island, Ont (May-June 09)	Stantec Ltd. 2010a
Montezuma I, CA (12)	ICF International 2013	Wolfe Island, Ont (July-December 09)	Stantec Ltd. 2010b
Montezuma II, CA (12-13)	Harvey & Associates 2013	Wolfe Island, Ont (January-June 10)	Stantec Ltd. 2011a
Lempster, NH (09)	Tidhar et al. 2010	Wolfe Island, Ont (July-December 10)	Stantec Ltd. 2011b
Lempster, NH (10)	Tidhar et al. 2011	Wolfe Island, Ont (January-June 11)	Stantec Ltd. 2011c
Linden Ranch, WA (10-11)	Enz and Bay 2011	Wolfe Island, Ont (July-December 11)	Stantec Ltd. 2012
Locust Ridge, PA (Phase II; 09)	Arnett et al. 2011	Wolfe Island, Ont (January-June 12)	Stantec Ltd. 2014

Appendix D: US Fish and Wildlife Service Risk Assessment for the Ocotillo Wind Energy Facility

Appendix D Service Analysis of Golden Eagle Fatality Predictions from the Ocotillo ECP

D.1 Background

The Service uses explicit models in a Bayesian statistical inference framework to estimate eagle fatalities at a wind facility while accounting for uncertainty. The analysis presented below follows the Service's Eagle Conservation Plan Guidance version 2 (ECP Guidance, USFWS 2013); a more detailed background on the Service's model and modeling framework are presented in Appendix D of the Technical Appendices of the ECP Guidance. The basic Service fatality prediction model is based on the assumption that there is a predictable relationship between pre-construction eagle exposure (λ) and subsequent annual fatalities resulting from collisions with wind turbines (F), such that:

$$F = \varepsilon\lambda C$$

Where C is the probability of a collision given a minute of eagle flight within the hazardous area (see Service definition in ECP Guidance Technical Appendices), and ε is the expansion factor, a constant that describes the total area and time within a project footprint that is potentially hazardous to eagles; this is used to expand the estimated fatality rate into the annual number of predicted fatalities. One advantage of using a Bayesian modeling framework is the ability to incorporate known information directly into the model fitting by defining an appropriate prior probability distribution (or simply "prior"). The Service has defined prior distributions for both eagle exposure and collision probability based on the best available data. The exposure prior is updated with the pre-construction eagle use data collected at the site (which will overwhelm any influence of the prior with adequate sampling) and the collision probability will be updated with post-construction fatality if the project becomes operational. The expansion term represents the hazardous area (dependent on turbine number and size).

All of the model scenarios have the same inputs except for the number of hours of observation. We modeled different scenarios based on different hours of observations because there was concern that the all bird avian point counts were not an effective survey method for raptors. Consequently, we calculated eagle risk at Ocotillo Express under two modeling scenarios. This only affected the observation time because no eagles were observed during the all bird avian point counts. It should be noted that all scenarios assume that the observers detected 100% of eagle flight minutes below 200-m within an 800-m radius plot for each count.

- Model Scenario 1 was calculated using 2745.6 hours of observation. This scenario includes raptor migration data and no avian point count data.

- Model Scenario 2 was calculated using 3270.1 hours of observation. This scenario includes both raptor migration survey and avian point count data.

Avian point count surveys are described in Helix 2010a and based on CEC 2007. Raptor migration surveys are described in Helix 2010b.

D.1.2 EXPOSURE

The Service defines a prior for eagle exposure (Gamma (0.97, 2.76)) based on the exposure rates across a range of sites (USFWS 2012). The prior is then updated with the eagle flight minutes observed and the total area and time covered by observation surveys to get the posterior distribution for exposure that is then used in the fatality model (USFWS 2013). In this case,

$$\textbf{\textit{Posterior } } \boldsymbol{\lambda} \sim \textbf{\textit{Gamma}}\mathbf{(0.97 + 0.3056, 2.76 + 0.1588),}$$

therefore

$$\textbf{\textit{Posterior } } \boldsymbol{\lambda} \sim \textbf{\textit{Gamma}}\mathbf{(1.2756, 2.9188)}$$

Eagle minutes were calculated from eagle tracks recorded during observation surveys (see Figures 6, 7, 8, and 9 in ECP). Eagle minutes were calculated for each observation by multiplying the number of eagles observed by the total time of the observation by the fraction of the total distance that occurred within 800 m of an observation point, rounded up to the nearest minute (see Tables 2, 4 and 5 in ECP). This resulted in a total of 47 eagle minutes over either 2745.6 and 3270.1 hours of observations (this value varied depending on which survey effort was included). No eagles were observed below 200-m and within 800-m of an observation point during avian point counts, so the eagle minutes are the same for both scenarios. Note, unless strata are specified, exposure rate is assumed to be uniform across the space and time of the project footprint. In this case the observation data were not collected in such a way that allow for spatial or temporal stratification, therefore the model is assuming the data represent the range of exposure throughout a typical year.

D.1.3 COLLISION

The Service defines the collision probability as *Beta* (2.31, 396.69) based on information from projects presented in Whitfield (2009).

$$\textbf{\textit{Prior C}} \sim \textbf{\textit{Beta}}\mathbf{(2.31, 396.69)}$$

D.1.4 EXPANSION

This is the product of the total hazardous area ($A = \pi r^2$), where r is the turbine rotor radius and A is summed across all turbines) and daylight hours.

For the Ocotillo Express modeling scenarios, ε is

$$\varepsilon = (51 \times (\pi \times 0.0515^2)) \times 4448.48 = 1890.37$$

The units for ε are hr·km2.

D.1.5 ESTIMATING FATALITIES

Table D-1. Site Data for all model scenarios*

Input		
Location	Latitude	Longitude
	32.750182	-116.054643
	Value	Notes
Number of Turbines*	112	2.3 MW
Turbine Rotor Radius (km)	0.054	108-m diameter
Eagle Minutes	47	
Survey Effort (hours)	2745.6 (Scenario 1) 3270.1 (Scenario 2)	
Count Area (km2)	8.05 (Helix 2010b)	800-m circular plot

*All inputs were the same for all model scenarios except for the number of observation minutes; 2745.6, and 3270.1 for Model Scenarios 1 and 2, respectively. FatalityCMR software was used to estimate prior updates (Peron and Hines 2014).

D.1.6 UPDATING BAYESIAN PRIORS

The Bayesian risk model developed by USFWS (2013) and New et al. (2015) utilize a Bayesian prior based off the post-construction golden eagle mortality data of four wind projects. We were able to utilize this Bayesian risk model to assess how including post-construction mortality monitoring to update the prior can influence the eagle risk estimate. We used the Fatality Capture Mark Recapture (FCMR) approach as provided by Peron and Hines (2014) and divided by the number of years of post-construction mortality monitoring. We provide take estimates with and without updating the risk priors.

Table D-2. Site Data for updating of Bayesian risk model prior

Input		
Sample Sizes	Used	Not Included
Carcass Persistence (CP)	159 mallard, 2 years	6 rock pigeons and 1 RTHA not included due to species difference
Searcher Efficiency (SE)	66 mallards placed, 63 found, 2 years	39 chukar and rock pigeons not included due to species difference
Estimates	Mean	SD
CP	0.6148	0.0289
SE	0.9504	0.0215

	Mean	SD
Exposure Prior - 2 years of study	0.3056	0.159
Exposure Prior - divided by 2 years of study	0.1528	0.159
Exposure Posterior	0.200	0.130

So the fatality estimate is a product of

$$\mathit{Fatalities} = \mathit{Posterior}\ \lambda \times \mathit{Prior}\ C \times \varepsilon$$

We calculate predicted fatalities using simulation runs that draw from the exposure and collision distributions and insert the drawn values into the model. This results in a distribution of predicted fatalities:

Model Scenario 1a: Analysis with preconstruction use data only - 2745.6 observation hours

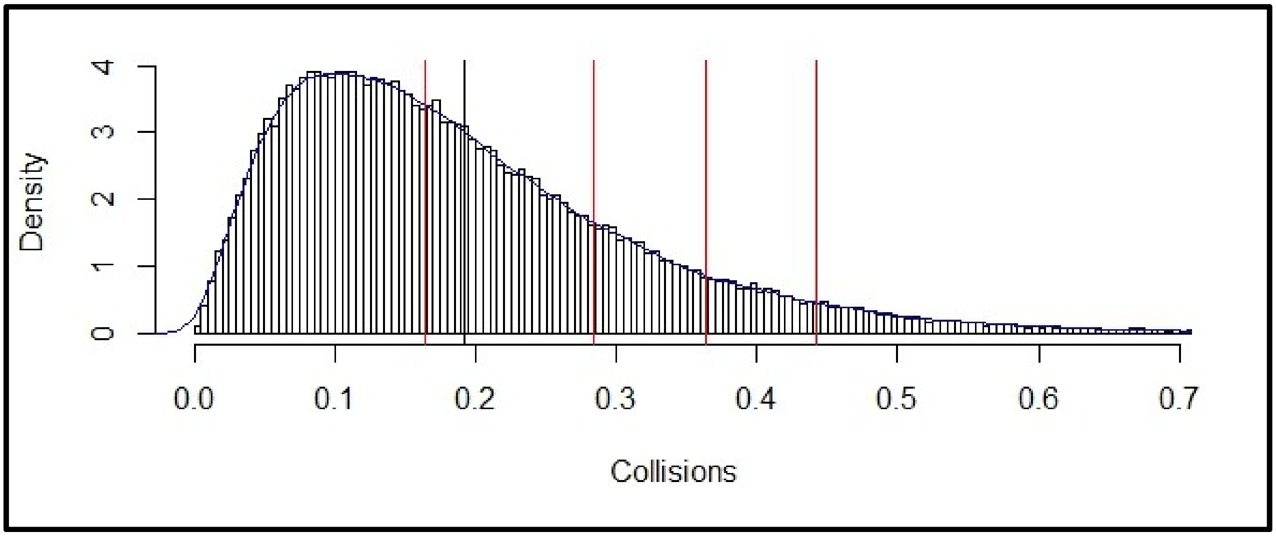


Figure D-1. Annual predicted fatalities for Ocotillo Model Scenario 1a (2745.6 hours of observations) without updating the prior with post-construction mortality data. The probability distribution of the collision probability prior, a Beta distribution with a mean of 0.19 and a standard deviation of 0.13. Moving from left to right, the red lines indicate the 50th, 80th, 90th and 95th confidence intervals for annual predicted golden eagle collision rates.

Table D-2. Annual Predicted Fatalities for Model Scenario 1a

	Mean	SD	CI50	CI80	CI90	CI95
2745.6 hours	0.19	0.13	0.16	0.28	0.36	0.44

Model Scenario 1b: Analysis with both preconstruction use and postconstruction mortality data - 2745.6 observation hours

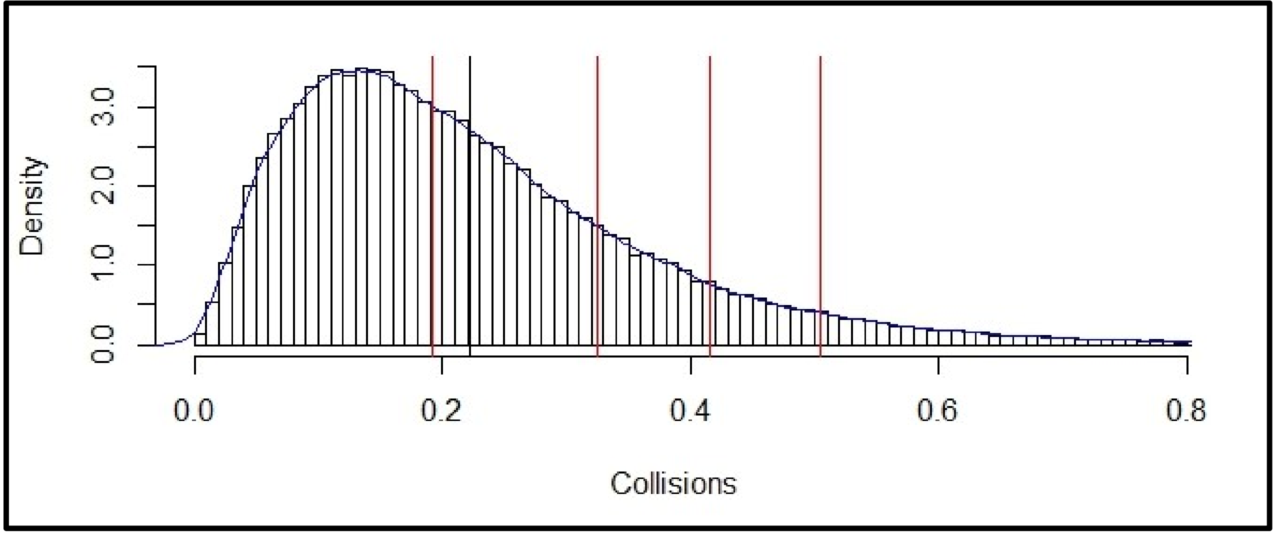


Figure D-2. Annual predicted fatalities for Ocotillo Model Scenario 1b (2745.6 hours of observations). The probability distribution of the collision probability prior, a Beta distribution with a mean of 0.22 and a standard deviation of 0.15. Moving from left to right, the red lines indicate the 50th, 80th, 90th and 95th confidence intervals for annual predicted golden eagle collision rates.

Table D-2. Annual Predicted Fatalities for Model Scenario 1b

	Mean	SD	CI50	CI80	CI90	CI95
2745.6 hours	0.22	0.15	0.19	0.32	0.41	0.50

Model Scenario 2a: Analysis with preconstruction use data only - 3270.1 observation hours

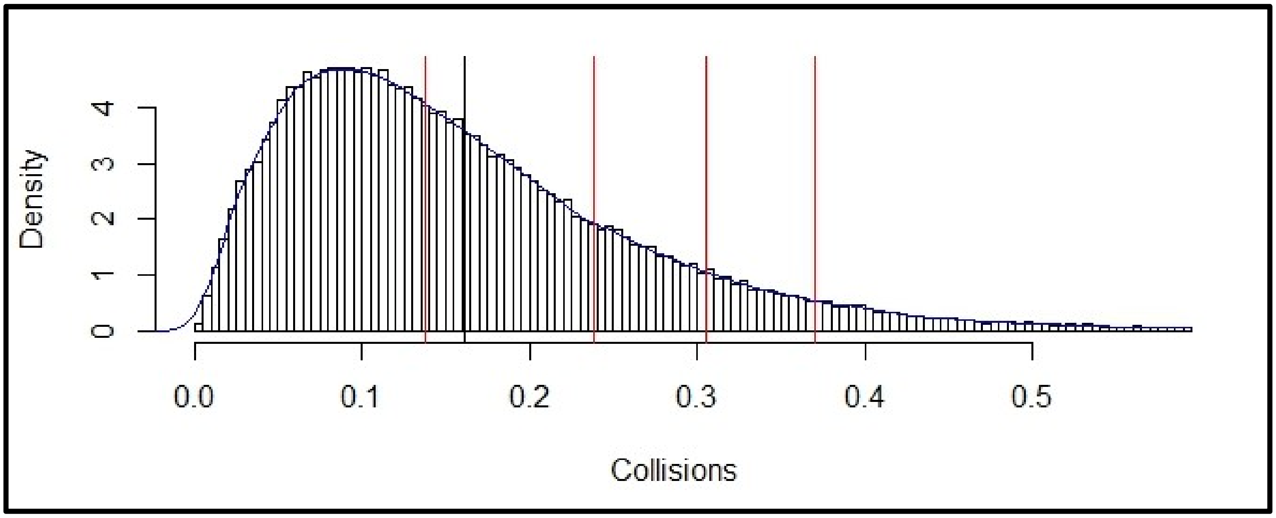


Figure D-3. Annual predicted fatalities for Ocotillo Model Scenario 2a (3270.1 hours of observations). The probability distribution of the collision probability prior, a Beta distribution with a mean of 0.16 and a standard deviation of 0.11. Moving from left to right, the red lines indicate the 50th, 80th, 90th and 95th confidence intervals for annual predicted golden eagle collision rates.

Table D-3. Annual Predicted Fatalities for Model Scenario 2a

	Mean	SD	CI50	CI80	CI90	CI95
3270.1 hours	0.16	0.11	0.14	0.24	0.31	0.37

Model Scenario 2b: Analysis with both preconstruction use and postconstruction mortality data - 3270.1 observation hours

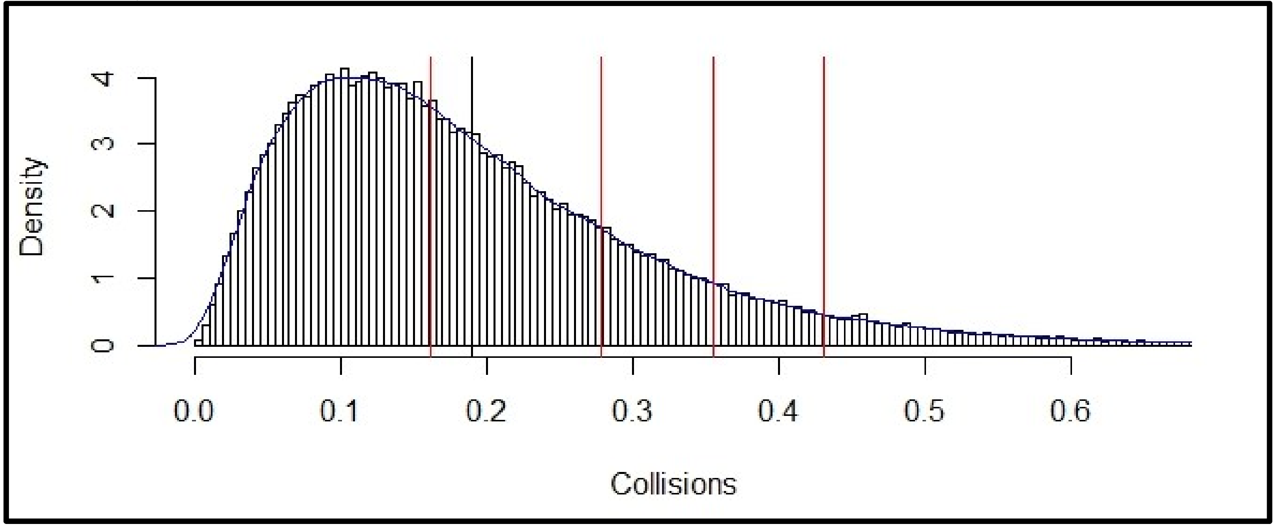


Figure D-4. Annual predicted fatalities for Ocotillo Model Scenario 2a (3270.1 hours of observations). The probability distribution of the collision probability prior, a Beta distribution with a mean of 0.19 and a standard deviation of 0.12. Moving from left to right, the red lines indicate the 50th, 80th, 90th and 95th confidence intervals for annual predicted golden eagle collision rates.

Table D-4. Annual Predicted Fatalities for Model Scenario 2b

	Mean	SD	CI50	CI80	CI90	CI95
3270.1 hours	0.19	0.12	0.16	0.28	0.36	0.43

D.2 Discussion

We modeled different scenarios based on different hours of observations because there was concern that the all bird point counts were not an effective survey method for raptors. Our results indicate that there is a negligible decrease in predicted collision rate at the 80th confidence interval from 2745.6 to 3270.1 hours. Consequently, the more conservative scenario (2745.6 hours of observations) will be used for the risk assessment.

D.3 Literature Cited

California Energy Commission (CEC). 2007. California Guidelines for Reducing Impacts to Birds and Bats From Wind Energy Development (Final Report). October 2007.

HELIX Environmental Planning, Inc. 2010a. Avian Point Count Report for the Ocotillo Wind Energy Project. AEG-09. December 10, 2010.

HELIX Environmental Planning, Inc. 2010b. Raptor Migration Report for the Ocotillo Wind Energy Project. AEG-09. December 10, 2010.

New, L., E. Bjerre, B. Millsap, M. C. Otto, and M. C. Runge. 2015. A collision risk model to predict avian fatalities at wind facilities: an example using golden eagles, Aquila chrysaetos. PLoS ONE 10:e0130978.

Péron, Guillaume, and Hines, J.E., 2014, fatalityCMR—Capture-recapture software to correct raw counts of wildlife fatalities using trial experiments for carcass detection probability and persistence time: U.S. Geological Survey Techniques and Methods 7–C11, 14 p., http://dx.doi.org/10.3133/tm7C11.

U.S. Fish and Wildlife Service. 2013. Eagle conservation plan guidance. Module 1—land-based wind energy. Version 2. https://www.fws.gov/ migratorybirds/pdf/management/eagleconservationplanguidance.pdf. Accessed 5 Feb 2016.

R Code with Data Inputs for Bayesian Eagle Risk Analysis Including update of the prior:

```
source("C:/Eagle risk model/DayLen.R")
### Ocotillo Project - Model Inputs###
SeasonType<-"Annual"
LatLng<-c(lat= 32.750182, -116.054643  )
### run the next 4 lines of code
DayLtHr<-DayLen(LatLng[2],LatLng[1],Type=SeasonType)
colnames(DayLtHr)[1]<-"Season"
DayLtHr$AveDayLen<-with(DayLtHr,DayLtHr/Days)
print(DayLtHr)
cProject<-"Octotillo Express" #project ID to track model outputs

nTurbine<-c(112)  #number of turbines

HazRadKm<-c(54/1000) #rotor radius (in kilometers)

HzKM2<-sum(nTurbine*pi*HazRadKm^2) #calculates the total hazardous area

## (note: this version of the code assumes that eagle suverys for the survey plot size
## indicated were made up to 200-m; if not, we must use a version of the code/model priors
## that account for volume; here the assumption is that observation height and hazardous area
## height cancel out)

CntHr<-c(3270.1)  # count duration (in hours)
## the data provided only included total count hours so they are all included here and
## nCnt in the ExpSvy dataframe is set to 1.
## a separate evaluation of temporal and  geographic representativeness should be made,
## as well as consideration of seasonal or other strata, if appropriate.

## Create the "ExpSvy" data frame:
# this includes the Eagle Minutes observed, number of counts conducted,
# and the area observed at each observation point
ExpSvy<-data.frame(row.names=c("SVW"),
        #EMin=c(45.49),
        EMin=c(47),
        nCnt=c(1),
        CntKM2=c(pi*(800/1000)^2),
        DayLtHr=c(DayLtHr$DayLtHr)
)

AddTot<-TRUE #Add strata for total (TRUE) or not (FALSE)

###' Added for inclusion of post-constructon estimate to update the collision prior
EOutMin <- 0.1528
##' Note: The code beyond the point generally will not need to be modified
##' ------------------------------------------------------------------------------------
```

```
##' -----------------------------------------------------------------------------------
##' -----------------------------------------------------------------------------------
##' -----------------------------------------------------------------------------------
##' Source FatalFcns.R
##'
##' Note: much of this code may be extraneous. Generally there will be no need to modify.

### Fatality Functions - 23 Apr 2013 ###

simFatal<-function(EMin,SmpHrKM2,ExpFac,
                aPriExp=0.9776543,bPriExp=2.777427,aPriCPr=2.31,bPriCPr=396.69){

  require(rv)

  # Update the exposure prior
  aPostExp<-aPriExp+EMin
  bPostExp<-bPriExp+SmpHrKM2
  print(c(aPostExp=aPostExp,bPostExp=bPostExp,aPriCPr=aPriCPr,bPriCPr=bPriCPr))

  Exp<-rvgamma(n=1,aPostExp,bPostExp)
  CPr<-if(bPriCPr==0){
    aPriCPr
  } else {
    rvbeta(n=1,aPriCPr,bPriCPr)
  }
  Fatalities<-ExpFac*Exp*CPr
  attr(Fatalities,"Exp")<-cbind(Mean=rvmean(Exp),SD=rvsd(Exp))
  return(Fatalities)
}

simFatalCPr <- function(EMin, EOutMin, SmpHrKM2, ExpFac, aPriExp=0.97,
                    bPriExp=2.76,aPriCPr=2.31, bPriCPr=396.69){

  # EMin: observed number of eagle minutes
  # EOutMin: annual eagle fatalities on an operational wind facility
  # SmpHrKM2:total hr km2 surveyed for eagle minutes
  # ExpFac:expansion factor
  # aPriExp: alpha parameter for the prior on lambda
  # bPriExp: beta parameter for the prior on lambda
  # aPriCPr: alpha parameter for the prior on C
  # bPriCPr: beta parameter for the prior on C

  # Entering a negative value for EMin or EOutMin indicates that no data
  # were collected for those model inputs

  require(rv)

  # Update the exposure prior
```

```
  if(EMin>=0){
    aPostExp <- aPriExp + EMin
    bPostExp <- bPriExp + SmpHrKM2
  }else{
    aPostExp <- aPriExp
    bPostExp <- bPriExp}

  Exp <- rvgamma(n=1, aPostExp, bPostExp)

  # Update the collisions prior
  if(EOutMin>=0){
    aPostCPr <- aPriCPr + EOutMin
    bPostCPr <- ((rvmean(Exp) * ExpFac) - EOutMin) + bPriCPr
  }else{
    aPostCPr <- aPriCPr
    bPostCPr <- bPriCPr}

  CPr <- rvbeta(n=1, aPostCPr, bPostCPr)

  Fatalities             <- ExpFac * Exp * CPr
  attr(Fatalities,"Exp") <- c(Mean=rvmean(Exp), SD=rvsd(Exp))
  attr(Fatalities,"CPr") <- c(Mean=rvmean(CPr), SD=rvsd(CPr))

  return(Fatalities)}


plotFatal<-function(Fatalities,probs=0.8,PlotHist=TRUE,
                    xlim=NULL,xlab="Collisions",ylab="Density",# bty="o",
                    col="red",add=FALSE,...){
  require(rv)

  Names<-if(is.null(names(Fatalities))) 1:length(Fatalities) else
    names(Fatalities)
  Smry<-RVSmry(Names,Fatalities,probs=probs)
  ColIdx<-grepl("CI",colnames(Smry))
  CIs<-Smry[,ColIdx]

  if(!add){
    if(is.null(xlim)) xlim<-c(0,1.1*rvquantile(Fatalities,probs=0.99))
    rvhist(Fatalities,xlab=xlab,ylab=ylab,
           xlim=xlim,freq=FALSE,# bty=bty,
           ...
    )
  }

  lines(density(as.numeric(Fatalities[[1]],bw="sj")),col=if(add) col else "blue")
  abline(v=Smry$Mean,col=if(add) col else "black")
  abline(v=CIs,col=col)
```

```
  invisible(NULL)
}

##' ------------------------------------------------------------------------------------
##' Source FatalFcns.R
##'
##' Note: much of this code may be extraneous. Generally there will be no need to modify.

### Summary Function ###

RVSmry<-function(Names,Series,probs=c(0.5,0.05,0.95)){
  Smry<-data.frame(
    Mean=as.vector(rvmean(Series)),SD=as.vector(rvsd(Series)),
    #   rvquantile(Series,probs=probs),
    matrix(rvquantile(Series,probs=probs),ncol=length(probs)),
    row.names=rownames(Names)
  )
  colnames(Smry)[2+1:length(probs)]<-paste("CI",format(100*probs),sep="")
  return(data.frame(Names,Smry))
}
##' ------------------------------------------------------------------------------------
### Draft USFWS Collision Fatality Model Code version 4.1 (23 Apr 2013)              ###
### This code is a working version only. It is not intended for general distribution. ###
### Check back often for updates to the model/code                                  ###

## Please review Model Code v4.1 README for general instructions
## requires the rv and maptools package for R

## Analysis Inputs ##

UCI<-c(0.5,0.8,0.9,0.95)

require(maptools)
require(rv)
nSim<-100000
setnsims(nSim)

### Survey Inputs ###

nSvy<-nrow(ExpSvy)
cSvy<-(rownames(ExpSvy))

SmpHrKM2<-with(ExpSvy,nCnt*CntHr*CntKM2)
ExpFac<-ExpSvy$DayLtHr*HzKM2

# Calculate the fatalities and store as a temporary object.
tmp<-
with(ExpSvy,mapply(simFatal,EMin=EMin,SmpHrKM2=SmpHrKM2,ExpFac=ExpFac,
```

```
                        SIMPLIFY=FALSE
))

# R code to get the survey specific simulations in an rv vector.
Fatalities<-rvnorm(nSvy)
Exp<-data.frame(Mean=rep(NA,nSvy),SD=NA,row.names=cSvy)
for(i in 1:nSvy){
  Fatalities[i]<-tmp[[i]]
  Exp[i,]<-attr(tmp[[i]],"Exp")
}
rm(tmp)
names(Fatalities)<-cSvy

# Summarize the results, including a total if needed.
nSvy<-length(Fatalities)
if(is.null(nSvy))nSvy<-1
FatalStats<-RVSmry(cSvy,Fatalities,probs=UCI)
if(AddTot){
  FatalStats<-rbind(
    FatalStats,
    RVSmry("Total",sum(Fatalities),probs=UCI)
  )
}

# Look at the results
cat(cProject,"\n")
#cat(paste(Name,", ",date(),"\n",sep=""))
#Number of Turbines
print(nTurbine)
#Hazardous Area Per Turbine (km^2)
#print(HzKM2PT)
print(ExpSvy)
#Exposure rate
print(Exp,digits=3)
#Annual Collision Fatalities
print(FatalStats,digits=2)

# Plots
nPlot<-nSvy+as.integer(AddTot)
nCol<-floor(sqrt(nPlot))
nRow<-ceiling(nPlot/nCol)
xlim<-range(rvrange(Fatalities))

par(mfrow=c(nRow,nCol))
for(iPlot in 1:nSvy){
  plotFatal(Fatalities[iPlot],probs=UCI,
          #  xlim=xlim,add=FALSE,  # uncomment this line to put the graphs for all of the strata
on the same scale
```

```
          main=cSvy[iPlot])
}
if(AddTot)plotFatal(sum(Fatalities),main="Total")

##' -----------------------------------------------------------------------------------
## Modify to allow post-construction estiamte update of collision probabilty

## Analysis Inputs ##

UCI<-c(0.5,0.8,0.9,0.95)

require(maptools)
require(rv)
nSim<-100000
setnsims(nSim)

### Survey Inputs ###

nSvy<-nrow(ExpSvy)
cSvy<-(rownames(ExpSvy))

SmpHrKM2<-with(ExpSvy,nCnt*CntHr*CntKM2)
ExpFac<-ExpSvy$DayLtHr*HzKM2

# Calculate the fatalities and store as a temporary object.
tmp<-
with(ExpSvy,mapply(simFatalCPr,EMin=EMin,EOutMin=EOutMin,SmpHrKM2=SmpHrK
M2,ExpFac=ExpFac,
                    SIMPLIFY=FALSE
))

# R code to get the survey specific simulations in an rv vector.
Fatalities<-rvnorm(nSvy)
Exp<-data.frame(Mean=rep(NA,nSvy),SD=NA,row.names=cSvy)
for(i in 1:nSvy){
  Fatalities[i]<-tmp[[i]]
  Exp[i,]<-attr(tmp[[i]],"Exp")
}
rm(tmp)
names(Fatalities)<-cSvy

# Summarize the results, including a total if needed.
nSvy<-length(Fatalities)
if(is.null(nSvy))nSvy<-1
FatalStats<-RVSmry(cSvy,Fatalities,probs=UCI)
if(AddTot){
  FatalStats<-rbind(
    FatalStats,
```

```
    RVSmry("Total",sum(Fatalities),probs=UCI)
  )
}

# Look at the results
cat(cProject,"\n")
#cat(paste(Name,", ",date(),"\n",sep=""))
#Number of Turbines
print(nTurbine)
#Hazardous Area Per Turbine (km^2)
#print(HzKM2PT)
print(ExpSvy)
#Exposure rate
print(Exp,digits=3)
#Annual Collision Fatalities
print(FatalStats,digits=2)

# Plots
nPlot<-nSvy+as.integer(AddTot)
nCol<-floor(sqrt(nPlot))
nRow<-ceiling(nPlot/nCol)
xlim<-range(rvrange(Fatalities))

par(mfrow=c(nRow,nCol))
for(iPlot in 1:nSvy){
  plotFatal(Fatalities[iPlot],probs=UCI,
            #  xlim=xlim,add=FALSE,  # uncomment this line to put the graphs for all of the strata
on the same scale
            main=cSvy[iPlot])
}
if(AddTot)plotFatal(sum(Fatalities),main="Total")
```