Appendix D-8

Avian Baseline Studies 2011

Avian Baseline Studies at the Alta East Wind Resource Area Kern County, California

Final Report
July 10, 2010 – June 1, 2011

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NATURAL RESOURCES ◆ SCIENTIFIC SOLUTIONS

EXECUTIVE SUMMARY

In July of 2010, on behalf of CH2M HILL Engineers, Inc. and Alta Windpower, LLC (Alta Windpower), Western EcoSystems Technology, Inc. (WEST) initiated a second year of avian studies in the Alta East Wind Resource Area (AEWRA) in Kern County, California. The results of the first year of avian studies conducted at the proposed wind energy facility in 2009 and 2010 indicated that a facility at the AEWRA, with appropriate avoidance and mitigation measures, would not have significant impacts to any avian species. During the 2009 – 2010 surveys, use by golden eagles and two golden eagle nests were documented in areas outside the AEWRA boundary. The use by golden eagles occurred to the north, northeast, and west of the current AEWRA boundary, while the nests were located approximately 3.5 and 11 miles (5.6 and 17.7 kilometers [km]) from the boundary. The project boundary was modified to avoid this area of documented use by eagles and a second year of avian study was initiated. The following document presents results of fixed-point bird use surveys and raptor nest surveys conducted during the second year of baseline avian studies at the AEWRA in 2010 - 2011.

The objective of the fixed-point bird use surveys was to estimate the seasonal, spatial, and temporal use of the Alta East Wind Resource Area by birds, particularly raptors. Bird use surveys were conducted weekly from July 10, 2010, through June 1, 2011, at six points established throughout the AEWRA. A total of 2,493 individuals within 745 separate groups were recorded during surveys, and 48 unique bird species were identified.

Bird use by species was calculated as the mean number of birds per 30-minute survey. Among large birds, common raven had the highest use of any species during spring (0.74 birds/plot/30-minute survey), fall (2.28), and winter (4.00), while California quail had the highest use in the summer (1.56). A total of 48 individual diurnal raptor observations, representing nine unique species, were recorded during surveys. Overall, red-tailed hawk and golden eagle were the most frequently observed diurnal raptors; however, golden eagles were observed only during the fall (n=1) and winter (n=7) survey periods. Diurnal raptor use was highest during the winter (0.27 birds/plot/30-minute survey) and lowest during the summer (0.04). Use by turkey vultures was recorded only during spring (0.40). Among the small birds, use by passerines was higher in spring (7.61 birds/plot/30-minute survey) and winter (7.39), compared to fall (5.33) and summer (1.57). No California condors were observed during fixed point surveys (130 hours of observation) or at other times while biologists were onsite for other purposes or travelling between fixed-point survey locations.

The annual mean raptor use estimate (number of raptors divided by the number of plots and the total number of surveys) in the AEWRA was compared to mean raptor use estimates from 42 other wind resource areas, located in the western and Midwestern U.S., that implemented similar protocols to the present study and had data for three or four different seasons. Based on fixed-point bird use data collected at the AEWRA, the adjusted mean annual raptor use was 0.12 raptors/plot/20-minute survey, ranking third lowest compared to raptor use at these other wind resource areas.

A relative exposure index was calculated for each bird species based on initial flight height observations and relative abundance (defined as the use estimate). Common raven had the highest exposure index of any large bird species (0.85), followed by turkey vulture (0.07). The diurnal raptor species with the highest exposure indices were red-tailed hawk (0.03) and golden eagle (0.01). Of the small bird species, white crowned sparrow had the highest exposure index (0.13), followed by sage sparrow (less than 0.01). All other small bird species had exposure indices of zero.

A regression analysis of raptor use and raptor collision mortality for 16 new-generation wind-energy facilities where similar methods were used to obtain raptor use estimates showed a significant (R^2 = 66.4%) correlation between raptor use and raptor collision mortality. Using this regression to predict raptor collision mortality the AEWRA yields an estimated fatality rate of less than 0.01 fatalities/megawatt/year, or approximately three raptors per year for the proposed 318 MW wind-energy development. Based on species composition of the most common raptor fatalities at other western wind-energy facilities and species composition of raptors observed at the AEWRA during the surveys, the majority of the fatalities of diurnal raptors would likely consist of red-tailed hawks. Based on the seasonal use estimates, it is expected that risk to raptors would be unequal across seasons, with higher risk during the winter and relatively low risk during other times of the year.

Aerial raptor nest surveys were conducted at the AEWRA on February 22, April 12, and June 1-2, 2011. The survey area for golden eagle nests included all suitable eagle nesting habitat within a 10-mile buffer of the AEWRA, while the survey area for all other raptor and large bird nests included a two-mile buffer. Three active golden eagle nests were observed within the 10-mile buffer. These were located 3.0 miles to the northwest, 3.8 miles to the north, and 6.8 miles to the north of the AEWRA. Additionally, 10 inactive golden eagle nests were identified within 10 miles of the AEWRA. No active raptor nests were located within the boundary of the AEWRA or within the surrounding two-mile buffer; however, two active common raven nests, one inactive raptor, and one inactive golden eagle nest were identified within two miles of the study area.

Six species designated as having special conservation status at the state and/or federal levelwere recorded during surveys. These included one state-threatened species (Swainson's hawk), two state fully-protected species (golden eagle and peregrine falcon), two state species of special concern (loggerhead shrike and northern harrier), and three federal species of concern (loggerhead shrike, peregrine falcon, and Le Conte's thrasher). Additionally, the golden eagle receives further protection under the federal Bald and Golden Eagle Protection Act.

Results from the second year of baseline avian surveys at the AEWRA were generally consistent with those from the initial year of study, with both years of surveys indicating low use of the area by raptors and a low density of nesting raptors. The current study found use of the AEWRA by golden eagles during late fall and winter, which was not detected during the 2009 – 2010 surveys; however, the results of this study are consistent with other wind energy facilities in the area that have documented low use by golden eagles, with use occurring primarily in the

fall and winter. Although multiple raptor species would potentially be at risk of collision mortality during operation of this project, the frequency with which they were documented using the site during two years of study suggests that fatality rates would be very low and unlikely to be significant at the population level. With no nesting raptors documented within three miles of the project during two years of study, take associated with nest abandonment or disturbance impacts on nesting adults, nestlings, or fledglings is not likely to occur during construction or operation of the project.

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INTRODUCTION

Alta Windpower, LLC is proposing to develop the Alta East Wind Project, a wind energy facility located in Kern County, California. CH2M HILL Engineers, Inc., a contractor to Alta Windpower, LLC, contracted Western EcoSystems Technology, Inc. (WEST) to develop and implement a standardized protocol for baseline avian studies in the Alta East Wind Project and surrounding area, defined in this report as the Alta East Wind Resource Area (AEWRA), with the purpose of documenting avian use patterns, identifying potential risk issues, and assisting with siting turbines to minimize impacts to avian resources. The protocols for the baseline study are similar to those used at other studies in California and throughout the western US with modifications to accommodate site-specific characteristics of the AEWRA. Additionally, the protocols follow guidance of the California Wind Energy Guidelines (CEC and CDFG 2007) and the US Fish and Wildlife Service (USFWS) Wind Turbine Guidelines Advisory Committee (WTGAC 2010).

The purpose of this report is to discuss the results of fixed-point bird use surveys conducted at the AEWRA from July 10, 2010 to June 1, 2011, and raptor nest surveys conducted during the spring of 2011. Acoustic bat surveys are ongoing at the AEWRA, and will be presented in a separate report. This current survey effort was designed to supplement a previous year-long avian use study conducted at the AEWRA (previously known as the Sun Creek Wind Resource Area) in 2009-2010 (see Chatfield et al. 2010c). The results of the first year of surveys indicated that a wind development at the AEWRA would not have significant impacts to avian species. Because use of adjacent areas by golden eagles (*Aquila chrysaetos*) was documented and golden eagle nests were located in the surrounding landscape, a second year of avian study was initiated to evaluate further the proposed project's potential effects on eagles, as well as to continue to better understand avian use of the project site in general.

In addition to site-specific data, this report presents existing information and results of studies conducted at other wind-energy facilities. The ability to estimate potential avian mortality at the proposed AEWRA is greatly enhanced by operational monitoring data collected at existing facilities. For several wind-energy facilities, standardized data on fixed-point bird use surveys were collected in association with standardized post-construction (operational) monitoring, allowing comparisons of bird use with bird mortality. Where possible, comparisons with regional and local studies were made.

STUDY AREA

The proposed AEWRA is located in southeastern Kern County, approximately two miles (3.2 kilometers [km]) north-northwest of the unincorporated city of Mojave, and 10 miles (16 km) east of the city of Tehachapi (Figure 1). The study area comprises undeveloped rangeland on a combination of privately-owned land and land administered by the Bureau of Land Management (BLM) within the proposed project and the surrounding area.

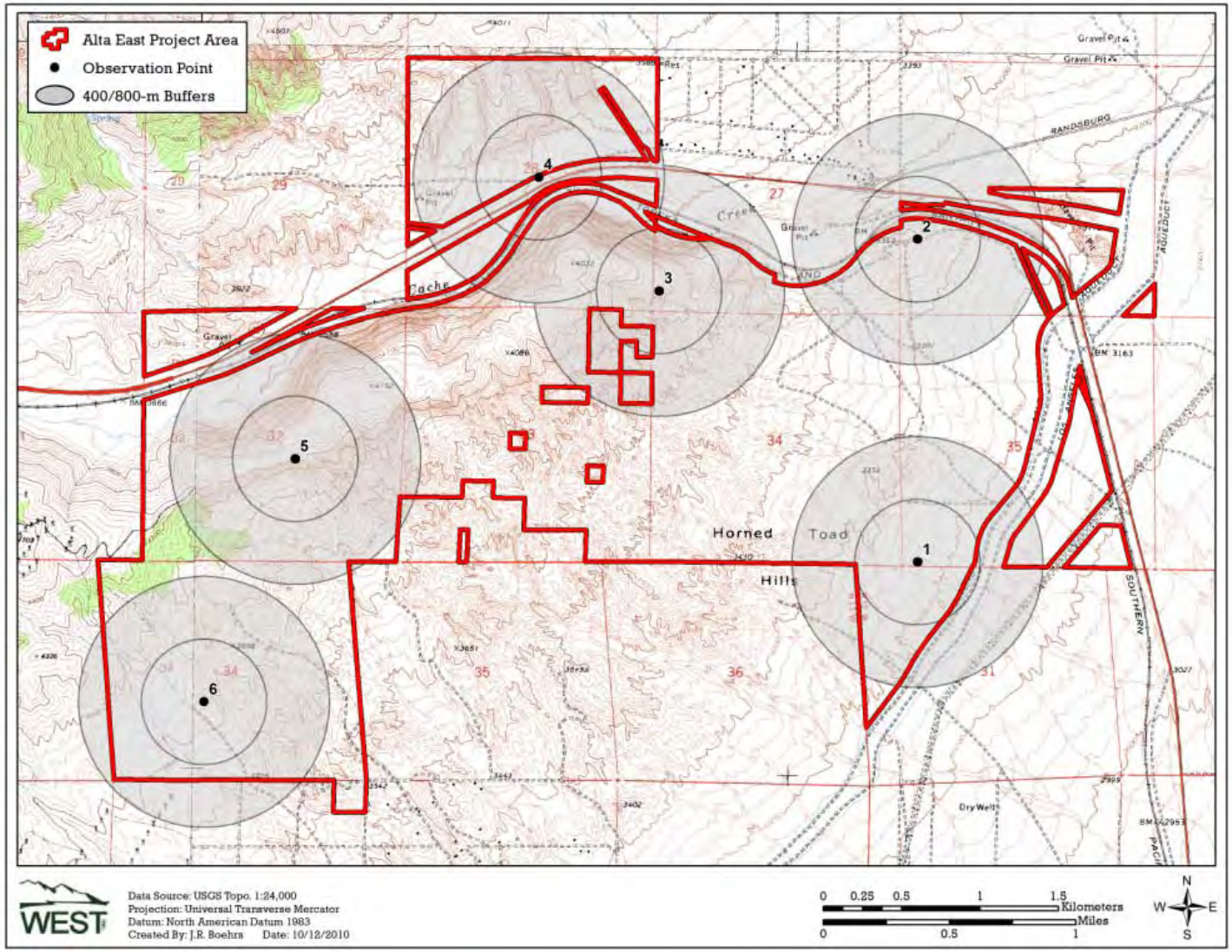


Figure 1. Study area map showing locations of fixed-point bird use survey stations conducted at the Alta East Wind Resource Area from July 10, 2010 – June 1, 2011.

The AEWRA falls within the high desert plains and hills on the western edge of the Mojave Desert. The Tehachapi Mountains are located to the north and west of the project area and transition into Mojave Desert towards the south and east. Elevations within the study area range from approximately 3,100 to 4,200 feet (ft; 940 to 1,280 meters [m]) above sea level, with the highest elevations occurring in the northwestern portion of the study area (Figure 1). The habitat ranges from lowland creosote (*Larrea tridentata*) scrub and Joshua tree (*Yucca brevifolia*) woodland in the southeast to juniper (*Juniperus* spp.) shrubland on the steeper, rocky slopes in the north and west. Water within the AEWRA is limited to a network of ephemeral drainages; there are no perennial surface water sources within the study area. Highway 58 bisects the AEWRA, an underground portion of the Los Angeles Aqueduct runs along the southeast corner of the study area, and a network of dirt roads and off-highway vehicle (OHV) trails run throughout the study area (Figure 1).

METHODS

Baseline avian studies at the AEWRA consisted of two components: 1) fixed-point bird use surveys, and 2) raptor nest surveys.

Fixed-Point Bird Use Surveys

The objective of the fixed-point bird use surveys was to estimate the seasonal and spatial use of the study area by birds, particularly diurnal raptors, defined here as kites, accipiters, buteos, harriers, eagles, falcons, and ospreys. Fixed-point surveys (variable circular plots) were conducted using methods described by Reynolds et al. (1980). All birds seen during each 30-minute (min) fixed-point survey were recorded.

Bird Use Survey Plots

Six points were selected to survey representative habitats and topography of the study area while providing relatively even coverage (Figure 1). Each survey plot was an 800-m (2,625-ft) radius circle centered on the point. To the extent possible, survey stations were selected to be consistent with locations used in the 2009 – 2010 survey effort at the AEWRA (see Chatfield et al. 2010c). However, due to changes to land access and changes to the project boundary, points 4, 5, and 6 were relocated for the July 2010 through May 2011 survey period to more accurately assess the area currently planned for wind turbine installation (Figure 1).

Bird Survey Methods

All species of birds observed during fixed-point surveys were recorded. Observations of large birds beyond the 800-m radius were recorded, but were not included in the statistical analyses. For small birds, observations beyond a 100-m (328-ft) radius were excluded from the analysis. Large birds included waterbirds, waterfowl, rails/coots, shorebirds, diurnal raptors, owls, vultures, upland game birds, doves/pigeons, large corvids (e.g., common raven [*Corvus corax*]), goatsuckers, and large cuckoos (e.g., greater roadrunner [*Geococcyx californianus*]). Passerines (excluding large corvids), swifts/hummingbirds, and woodpeckers were considered small birds.

The date, start, and end time of the survey period, and weather information, such as temperature, wind speed, wind direction, and cloud cover, were recorded for each survey. Species or best possible identification, number of individuals, sex and age class (if possible), distance from plot center when first observed, closest distance, altitude above ground, activity (behavior), and habitat(s) were recorded for each observation. Behavior and habitat type were recorded based on the point of first observation. Approximate flight height and flight direction at first observation were recorded to the nearest 5-m (16-ft) interval. Other information recorded included whether or not the observation was auditory only and the 10-min interval of the 30-min survey in which the observation was initially noted.

Observation Schedule

Sampling intensity was designed to document bird use by habitat and season within the AEWRA. Fixed-point bird use surveys were conducted from July 10, 2010, through June 1, 2011, with surveys conducted approximately once per week during each season: spring (March 1 to May 31), summer (June 1 to August 31), fall (September 1 to November 15), and winter (November 16 to February 28). Surveys were carried out during daylight hours, and survey periods varied to approximately cover all daylight hours during a season. To the extent practical, each point was surveyed about the same number of times.

Raptor Nest Survey

A raptor nest survey was conducted throughout the AEWRA during the spring of 2011. The objective of the survey was to locate nests that may be subject to disturbance and/or displacement effects from the wind-energy facility construction and/or operation. While active and inactive nests of all raptor species were recorded and emphasis was placed on their detection within two miles of the project, the survey specifically targeted golden eagles in the area within 10 miles of the project and was consistent with the USFWS *Interim Golden Eagle Technical Guidance: Inventory and Monitoring Protocols; and other Recommendations in Support of Golden Eagle Management and Permit Issuance* (Pagel et al. 2010). Golden eagles are protected by the Bald and Golden Eagle Protection Act (BGEPA 1940) and are also a fully-protected species in California (CDFG, Fish and Game Code, Section 3511).

Survey Methods

Three aerial surveys were conducted via helicopter by two observers (not including the pilot) during the spring 2011 breeding period. Aerial surveys were flown on February 22, April 12, and June 1-2. Surveys for golden eagles included all suitable eagle nesting habitat within the AEWRA boundary, as well as the area within an approximate 10-mile buffer of the AEWRA. For all other raptor and other large bird species (e.g., hawks, falcons, owls, and ravens), the survey area included all potential nesting habitat within two miles of the AEWRA.

Aerial survey methods involved a comprehensive search of suitable nesting areas and substrate (e.g., isolated trees, open woodland and savanna, rocky outcrops, cliffs, and other nest platforms such as power poles and transmission towers). During surveys, the helicopter was flown at an altitude of tree-top level to approximately 250 ft (76 m) above ground level. If a nest

was observed, the helicopter was moved to a position where nest status and species present could be determined. Efforts were made to minimize disturbance to breeding raptors, including keeping the helicopter a maximum distance from the nest at which the species could be identified, with distances varying depending upon nest location and wind conditions. Data recorded for each nest location included species occupying the nest, nest status (i.e., inactive, bird incubating, young present, eggs present, adult present, or unknown), nest substrate (e.g., pine, cottonwood, rocky outcrop, cliff or power line), number of young present, time and date of observation. All raptor and other large bird nests regardless of nest status were recorded with a Trimble Geo XH global positioning system (GPS) unit with sub-meter accuracy and mapped on a GIS ArcView project utilizing USGS topographic maps (1:24000 scale) as the base. Locations of inactive nests were recorded as they could be occupied during subsequent years.

Ground-based surveys were also conducted in conjunction with fixed-point bird use surveys during the peak of the breeding season (March – June), when target species would be actively incubating eggs or attending young. If nesting species, status, or outcome could not be determined from aerial surveys, ground-based follow-up visits were made provided the nest site could be accessed from the ground.

Statistical Analysis

Quality Assurance and Quality Control

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

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 format to facilitate subsequent QA/QC and data analyses. All data forms, field notebooks, and electronic data files were retained for reference.

Fixed-Point Bird Use Surveys

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

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. Species richness was calculated as the mean number of species observed per plot per survey (number of species/plot/30-min survey). Species diversity and richness were compared among seasons for fixed-point bird use surveys.

Bird Use, Percent Composition, and Frequency of Occurrence

For the standardized fixed-point bird use estimates, only observations of large birds detected within the 800-m radius plot were used; small bird observations were limited to 100 m. Estimates of mean bird use (number of birds/plot/30-min survey) were used to compare and contrast among bird types and seasons. Mean raptor use estimates (number of raptors divided by the number of 800-m plots) were calculated for each season. To allow comparison with data collected at other US wind resource areas (WRAs), raptor use estimates from this study were adjusted from 30-min to 20-min, by including only those raptors observed during the first 20-min of the survey period.

Percent composition was calculated as the proportion of the overall mean use for a particular bird type or species, and the frequency of occurrence was calculated as the percent of surveys in which a particular bird type or species was observed. Frequency of occurrence and percent composition provide relative estimates of species exposure to the proposed wind-energy facility. For example, a particular species might have high use estimates for the study area based on just a few observations of large groups. However, the frequency of occurrence would indicate that the species only occurred during a few of the surveys, therefore the species would be less likely to be affected by the wind-energy facility or transmission corridor.

Bird Flight Height and Behavior

To calculate potential risk to bird species, the first flight height recorded was used to estimate the percentages of birds flying within the likely RSH for collision with turbine blades of 115 to 427 ft (35 to 130 m) above ground level, which is the blade height of typical turbines that could be used at the AEWRA.

Bird Exposure Index

A relative index of collision 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

To determine spatial use within the AEWRA, data were analyzed by comparing use among plots. Mapped flight paths were qualitatively compared to study area features (e.g., topographic features). The objective of mapping observed bird locations and flight paths was to look for areas of concentrated use by raptors and other large birds and/or consistent flight patterns

within the study area. This information can be useful in turbine layout design or adjustments of individual turbines for micro-siting.

RESULTS

Fieldwork for the baseline studies was conducted at the AEWRA from July 10, 2010, through June 1, 2011, during which 48 bird species were identified. Results of the fixed-point bird use surveys and raptor nest surveys are discussed in the sections below.

Fixed-Point Bird Use Surveys

A total of 260 30-minute (min) fixed-point bird use surveys were conducted at the AEWRA during 47 site visits (Table 1). Two different viewsheds were utilized when calculating the different statistics (species richness, use, percent composition, percent frequency, and exposure index): 800 m for large birds and 100 m for small birds.

Table 1. Summary of species richness (species/plot[a]/30-min survey) and sample size, by season and overall, during the fixed-point bird use surveys at the Alta East Wind Resource Area, July 10, 2010 to June 1, 2011.

Season	Number of Visits	# Surveys Conducted	# Unique Species	Species Richness Large Birds	Species Richness Small Birds
Spring	13	70	38	0.69	2.03
Summer	9	54	16	0.35	0.91
Fall	10	60	26	0.67	1.28
Winter	15	76	20	0.94	1.26
Overall	**47**	**260**	**48**	**0.67**	**1.37**

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

Bird Diversity and Species Richness

Forty-eight unique species were observed during the fixed-point bird use surveys, with a mean of 0.67 large bird species/800-m plot/30-min survey and 1.37 small bird species/100-m plot/30-min survey (Table 1). Bird diversity (number of unique species) was greater in the spring (38 species) than in the fall (26), winter (20), and summer (16; Table 1). Large bird species richness (mean number of species per survey) was highest in the winter (0.94 species/survey), followed by spring (0.69), fall (0.67), and summer (0.35; Table 1). For small birds, the highest species richness was observed in the spring (2.03 species/survey), followed by fall (1.28), winter (1.26) and summer (0.91; Table 1). A total of 2,493 individual birds within 745 separate groups were recorded during the fixed-point bird surveys (Appendix A). Cumulatively, regardless of bird size, six species (12.5% of all species) composed 74.6% of total observations: common raven (*Corvus corax*; 451 observations), sage sparrow (*Amphispiza belli*; 409), white-crowned sparrow (*Zonotrichia leucophrys*; 404), western meadowlark (*Sturnella neglecta*; 269), western bluebird (*Sialia Mexicana*; 214), and California quail (*Callipepla californica*; 112). All other species composed less than 4% of total observations, individually. A total of 48 individual raptors were recorded within the AEWRA, representing nine species: Cooper's hawk (*Accipiter cooperii*; one observations), red-tailed hawk (*Buteo jamaicensis*; 18), Swainson's hawk (*Buteo swainsoni*; one), northern harrier (*Circus cyaneus*; two), golden eagle (*Aquila chrysaetos*; eight), American

kestrel (*Falco sparverius*; seven), peregrine falcon (*Falco peregrines*; one), prairie falcon (*Falco mexicanus*; two), and osprey (*Pandion haliaetus*; one; Appendix A). Unidentified accipiter (one observation) and unidentified hawk (six) were also observed during surveys.

Bird Use, Percent Composition, and Frequency of Occurrence

Mean bird use, percent composition, and frequency of occurrence were calculated by season for each bird type and species (Tables 2a and 2b). Large bird use (within 800-m plot) was highest in the winter (4.41 birds/plot/30-min survey), followed by fall (2.75), summer (2.39), and spring (1.64; Table 2a). For small birds (i.e., passerines, swifts/hummingbirds, and woodpeckers), use (within 100-m plots) was highest in the spring and winter (7.70 and 7.41 birds/plot/30-min survey, respectively), and lower in fall (5.35) and summer (1.65; Table 2b). Because different viewsheds were used in the analyses for large and small birds, use estimates calculated for the two groups are not directly comparable.

Table 2a. Mean bird use (number of birds/800-meter plot/30-minunte survey), percent of total composition (%), and frequency of occurrence (%) for each large bird type and species by season during the fixed-point bird use surveys at the Alta East Wind Resource Area from July 10, 2010 – June 1, 2011.

	Mean Use				Percent Composition				Frequency of Occurrence			
Bird Type or Species	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
Diurnal Raptors	**0.19**	**0.04**	**0.18**	**0.27**	**11.7**	**1.6**	**6.7**	**6.0**	**13.8**	**3.7**	**13.3**	**22.7**
Accipiters	*0.02*	*0.02*	*0*	*0*	*0.9*	*0.8*	*0*	*0*	*1.5*	*1.9*	*0*	*0*
Cooper's hawk	0.02	0	0	0	0.9	0	0	0	1.5	0	0	0
unidentified accipiter	0	0.02	0	0	0	0.8	0	0	0	1.9	0	0
Buteos	*0.09*	*0.02*	*0.08*	*0.09*	*5.7*	*0.8*	*3.0*	*2.0*	*9.4*	*1.9*	*8.3*	*8.9*
red-tailed hawk	0.08	0.02	0.08	0.09	4.8	0.8	3.0	2.0	7.8	1.9	8.3	8.9
Swainson's hawk	0.02	0	0	0	0.9	0	0	0	1.5	0	0	0
Northern Harrier	*0*	*0*	*0*	*0.03*	*0*	*0*	*0*	*0.7*	*0*	*0*	*0*	*3.0*
northern harrier	0	0	0	0.03	0	0	0	0.7	0	0	0	3.0
Eagles	*0*	*0*	*0.02*	*0.08*	*0*	*0*	*0.6*	*1.9*	*0*	*0*	*1.7*	*7.1*
golden eagle	0	0	0.02	0.08	0	0	0.6	1.9	0	0	1.7	7.1
Falcons	*0.06*	*0*	*0.07*	*0.02*	*3.5*	*0*	*2.4*	*0.6*	*3.8*	*0*	*3.3*	*2.4*
American kestrel	0.04	0	0.07	0	2.3	0	2.4	0	1.9	0	3.3	0
peregrine falcon	0	0	0	0.01	0	0	0	0.3	0	0	0	1.1
prairie falcon	0.02	0	0	0.01	1.2	0	0	0.3	1.9	0	0	1.3
Osprey	*0.01*	*0*	*0*	*0*	*0.8*	*0*	*0*	*0*	*1.3*	*0*	*0*	*0*
Osprey	0.01	0	0	0	0.8	0	0	0	1.3	0	0	0
Other Raptors	*0.01*	*0*	*0.02*	*0.04*	*0.8*	*0*	*0.6*	*0.9*	*1.3*	*0*	*1.7*	*3.9*
unidentified hawk	0.01	0	0.02	0.04	0.8	0	0.6	0.9	1.3	0	1.7	3.9
Vultures	**0.40**	**0**	**0**	**0**	**24.1**	**0**	**0**	**0**	**5.0**	**0**	**0**	**0**
turkey vulture	0.40	0	0	0	24.1	0	0	0	5.0	0	0	0
Upland Game Birds	**0.29**	**2.06**	**0.22**	**0.14**	**17.5**	**86.0**	**7.9**	**3.1**	**12.8**	**11.1**	**5.0**	**5.4**
California quail	0.24	1.56	0.02	0.14	14.8	65.1	0.6	3.1	12.8	9.3	1.7	5.4
chukar	0.04	0.50	0.20	0	2.7	20.9	7.3	0	2.8	1.9	3.3	0
Doves/Pigeons	**0.02**	**0.17**	**0.03**	**0.01**	**0.9**	**7**	**1.2**	**0.3**	**1.5**	**13.0**	**3.3**	**1.1**
mourning dove	0.02	0.17	0.03	0	0.9	7	1.2	0	1.5	13.0	3.3	0
rock pigeon	0	0	0	0.01	0	0	0	0.3	0	0	0	1.1
Large Corvids	**0.74**	**0.13**	**2.28**	**4.00**	**44.9**	**5.4**	**83.0**	**90.6**	**28.3**	**7.4**	**40.0**	**62.6**
common raven	0.74	0.13	2.28	4.00	44.9	5.4	83.0	90.6	28.3	7.4	40.0	62.6
Large Cuckoos	**0.01**	**0**	**0.03**	**0**	**0.8**	**0**	**1.2**	**0**	**1.3**	**0**	**3.3**	**0**
greater roadrunner	0.01	0	0.03	0	0.8	0	1.2	0	1.3	0	3.3	0
Overall	**1.64**	**2.39**	**2.75**	**4.41**	**100**	**100**	**100**	**100**				

Table 2b. Mean bird use (number of birds/100-meter plot/30-minute survey), percent of total composition (%), and frequency of occurrence (%) for each small bird type and species by season during the fixed-point bird use surveys at the Alta East Wind Resource Area from July 10, 2010 – June 1, 2011.

	Mean Use				Percent Composition				Frequency of Occurrence			
Bird Type or Species	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
Passerines	**7.61**	**1.57**	**5.33**	**7.39**	**98.8**	**95.5**	**99.7**	**99.8**	**88.5**	**59.3**	**70**	**77.3**
ash-throated flycatcher	0	0	0.02	0	0	0	0.3	0	0	0	1.7	0
barn swallow	0.05	0	0	0	0.7	0	0	0	1.3	0	0	0
cactus wren	0.10	0.43	0.07	0.08	1.3	25.8	1.2	1.1	6.9	33.3	5.0	6.9
chipping sparrow	0	0	0.35	0.18	0	0	6.5	2.4	0	0	5.0	3.6
common grackle	0.02	0	0	0	0.2	0	0	0	1.5	0	0	0
dark-eyed junco	0.03	0	0.12	0.92	0.4	0	2.2	12.5	1.5	0	1.7	8.7
European starling	0.16	0	0	0.03	2.0	0	0	0.5	10.4	0	0	1.7
horned lark	0.47	0	0.13	0	6.2	0	2.5	0	13.8	0	8.3	0
house finch	0.39	0	0.82	0	5.1	0	15.3	0	12.3	0	6.7	0
lark sparrow	0.09	0	0	0	1.2	0	0	0	2.8	0	0	0
Le Conte's thrasher	0	0.04	0.02	0	0	2.2	0.3	0	0	3.7	1.7	0
loggerhead shrike	0.08	0.22	0.05	0.1	1.0	13.5	0.9	1.4	8.1	13	5.0	10.0
rock wren	0.01	0	0	0.05	0.2	0	0	0.7	1.3	0	0	1.3
ruby-crowned kinglet	0.03	0	0	0	0.4	0	0	0	1.5	0	0	0
sage sparrow	2.05	0.63	2.70	0.76	26.6	38.2	50.5	10.3	33.3	24.1	55.0	17.6
savannah sparrow	0.01	0	0	0	0.2	0	0	0	1.3	0	0	0
Say's phoebe	0	0	0.02	0	0	0	0.3	0	0	0	1.7	0
Scott's oriole	0.01	0	0	0	0.2	0	0	0	1.3	0	0	0
Townsend's warbler	0.02	0	0	0	0.2	0	0	0	1.5	0	0	0
tree swallow	0.10	0	0	0	1.3	0	0	0	1.3	0	0	0
unidentified flycatcher	0.02	0	0	0	0.2	0	0	0	1.5	0	0	0
unidentified gnatcatcher	0	0	0	0.01	0	0	0	0.2	0	0	0	1.3
unidentified sparrow	0	0.02	0	0	0	1.1	0	0	0	1.9	0	0
unidentified swallow	0.01	0.13	0	0	0.2	7.9	0	0	1.3	1.9	0	0
unidentified warbler	0.01	0	0.02	0	0.2	0	0.3	0	1.3	0	1.7	0
western bluebird	0.15	0	0.08	0.72	2.0	0	1.6	9.7	1.5	0	3.3	11.4
western kingbird	0.02	0	0	0	0.2	0	0	0	1.5	0	0	0
western meadowlark	1.55	0.09	0.48	0.91	20.1	5.6	9.0	12.3	35.9	3.7	13.3	13.3
western scrub-jay	0.05	0.02	0.02	0	0.6	1.1	0.3	0	4.6	1.9	1.7	0
white-crowned sparrow	1.93	0	0.42	3.36	25.0	0	7.8	45.4	41.7	0	13.3	44.2
yellow-rumped warbler	0.25	0	0.03	0.25	3.2	0	0.6	3.4	5.6	0	1.7	4.7

Table 2b. Mean bird use (number of birds/100-meter plot/30-minute survey), percent of total composition (%), and frequency of occurrence (%) for each small bird type and species by season during the fixed-point bird use surveys at the Alta East Wind Resource Area from July 10, 2010 – June 1, 2011.

	Mean Use				Percent Composition				Frequency of Occurrence			
Bird Type or Species	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
Swifts/Hummingbirds	**0.04**	**0.06**	**0.02**	**0**	**0.6**	**3.4**	**0.3**	**0**	**4.4**	**5.6**	**1.7**	**0**
Anna's hummingbird	0.02	0	0	0	0.2	0	0	0	1.5	0	0	0
unidentified hummingbird	0.03	0.04	0.02	0	0.4	2.2	0.3	0	2.8	3.7	1.7	0
white-throated swift	0	0.02	0	0	0	1.1	0	0	0	1.9	0	0
Woodpeckers	**0.02**	**0.02**	**0**	**0**	**0.2**	**1.1**	**0**	**0**	**1.5**	**1.9**	**0**	**0**
ladder-backed woodpecker	0.02	0.02	0	0	0.2	1.1	0	0	1.5	1.9	0	0
Unidentified Birds	**0.03**	**0**	**0**	**0.02**	**0.4**	**0**	**0**	**0.2**	**1.5**	**0**	**0**	**1.7**
unidentified bird (small)	0.03	0	0	0.02	0.4	0	0	0.2	1.5	0	0	1.7
Overall	**7.70**	**1.65**	**5.35**	**7.41**	**100**	**100**	**100**	**100**				

Diurnal Raptors

Diurnal Raptor use was highest during the winter (0.27 birds/800-m plot/30-min survey), with spring and fall having moderate use (0.19 and 0.18, respectively) and summer having considerably lower use (0.04; Table 2a). Higher use in the winter was primarily due to higher use of the area by red-tailed hawk (0.09 birds/plot/30-min survey) and golden eagle (0.08). Red tailed hawk and American kestrel comprised the majority of raptor use during both spring (0.08 and 0.04 birds/plot/3-min survey; respectively) and fall (0.08 and 0.07; respectively). Diurnal raptor use in summer was attributed entirely to a single red-tailed hawk and a single unidentified accipiter. Diurnal raptors comprised 11.7% of overall large bird use in spring, 6.7% in fall, 6.0% in winter, and 1.6% in summer. Diurnal raptors were observed during 13.8% of spring surveys, 3.7% of summer surveys, 13.3% of fall surveys, and 22.7% of winter surveys (Table 2a).

Due to the age of the eagles observed during fall/winter, it is evident that at least three separate individuals were recorded; however, it cannot be determined whether these detections were of unique nomadic individuals or repeat observations of local/resident birds. All eight of these fall and winter observations were of flying eagles, indicating movement through the project area and possible foraging. No perching eagles, or those actually feeding on prey items, have been recorded within or near the project boundary.

Vultures

Vultures, comprised entirely of turkey vultures (*Cathartes aura*), were observed only during spring with a use estimate of 0.40 birds/800-m plot/30-min (Table 2a). Vultures comprised 24.1% of overall large bird use in spring and were observed during 5.0% of spring surveys (Table 2a).

Upland Game Birds

Use by upland game birds was much higher in the summer (2.06 birds/800-m plot/30-min survey) compared to spring (0.29), fall (0.22), and winter (0.14; Table 2a). California quail encompassed the majority of upland game bird use in spring, summer, and winter, while use by chukar (*Alectoris chukar*) was dominant in the fall. Upland game birds comprised 86.0% of overall large bird use in summer, 17.5% in spring, 7.9% in fall, and 3.1% in winter. Upland game birds were observed during 12.8% of spring surveys, 11.1% of summer surveys, 5.4% of winter surveys, and 5.0% of fall surveys (Table 2a).

Doves/Pigeons

Use by doves/pigeons was highest in summer (0.17 birds/800-m plot/30-min survey), followed by fall (0.03), spring (0.02), and winter (0.01; Table 2a). Mourning dove (*Zenaida macroura*) was the only dove/pigeon species observed during spring, summer, and fall, while rock pigeon (*Columba livia*) was the only dove/pigeon species observed during winter. Dove/pigeons comprised 7.0% of overall large bird use during summer, but less than 2% of use during other seasons. Doves/pigeons were observed during 13.0% of summer surveys, and during less than 4% of survey during other seasons (Table 2a).

Large Corvids

Use by large corvids, comprised entirely of common raven, was higher in the winter and fall (4.00 and 2.28 bird/800-m plot/30-min survey, respectively), compared to spring and summer (0.74 and 0.13, respectively; Table 2a). Large corvids comprised 90.6% of overall large bird use in winter, 83.0% in fall, 44.9% in spring, and 5.4% in summer. Large corvids were observed during 62.6% of winter surveys, 40.0% of fall surveys, 28.3% of spring surveys, and 7.4% of summer surveys (Table 2a).

Large Cuckoos

Large cuckoos, comprised solely of greater roadrunner (*Geococcyx californianus*), were observed only during fall and spring surveys with seasonal use estimates of 0.03 and 0.01 birds/800-m plot/30-min survey, respectively (Table 2a). Large cuckoos comprised 1.2% of overall large bird use in fall and 0.8% in spring. Greater roadrunners were observed during 3.3% of fall surveys and 1.3% of spring surveys (Table 2a).

Passerines

Use by passerines was highest in spring (7.61 birds/100-m plot/30-min survey) and winter (7.39), with intermediate use in fall (5.33) and low use in summer (1.57; Table 2b). Sage sparrow had the highest use of any passerine species in the spring, summer, and fall (2.05, 2.70, and 0.63 birds/plot/30-min survey, respectively), while white-crowned sparrow had the highest use in winter (3.36). Passerines comprised over 95% of overall small bird use during all four seasons. Passerines were recorded during 88.5% of spring surveys, 59.3% of summer surveys, 70.0% of fall surveys, and 77.3% of winter surveys (Table 2b).

Swifts/Hummingbirds

Swifts/hummingbirds had low use throughout the year (0.06 birds/100-m plot/30-min survey in summer, 0.04 in spring, and 0.02 in fall); no swifts/hummingbirds were observed in winter (Table 2b). Swifts/hummingbirds comprised less than 4% of overall small bird use during each season, and were observed during less than 6% of surveys during each season (Table 2b).

Woodpeckers

Use by woodpeckers was observed during only the spring (0.02 birds/100-m plot/30-min plot) and summer (0.02; Table 2b). Ladder-backed woodpecker (*Picoides scalaris*) was the only woodpecker species observed during surveys (Appendix A). Woodpeckers comprised less than 2% of overall small bird use during each season and were observed during less than 2% of surveys (Table 2b).

Bird Flight Height and Behavior

Flight height characteristics were estimated for both bird types and species (Tables 4 and 5). During fixed-point bird use surveys, 181 groups of large birds totaling 585 individuals were observed flying within 800-m plots (Table 3). Overall, 41.0% of flying large birds were observed within the RSH for collision with turbine blades of 115 to 427 feet (35 to 130 m) above ground level, while 49.1% were observed below the RSH, and 9.9% were above the RSH (Table 3). The large bird types with the greatest percentage of observations within the RSH were vultures

(68.2%) and large corvids (48.9%). For diurnal raptors, 44.4% were observed flying within the RSH, while 50.0% were below the RSH and 5.6% were flying above the RSH. Of the raptor subtypes, red-tailed hawk was observed most frequently within the RSH (61.5%).

Table 3. Flight height characteristics by bird type during fixed-point bird use surveys at the Alta East Wind Resource Area from July 10, 2010 – June 1, 2011. Large bird observations were limited to within an 800-meter (m) radius and small bird observations were limited to within a 100-m radius.

Bird Type	# Groups Flying	# Obs Flying	Mean Flight Height (m)	% Obs Flying	% Within Flight Height Categories		
					0 - 35 m	35 - 130 m[a]	> 130 m
Diurnal Raptors	35	36	43.26	78.3	50.0	44.4	5.6
Accipiters	*2*	*2*	*34.00*	*100*	*50.0*	*50.0*	*0*
Buteos	*13*	*13*	*57.15*	*68.4*	*30.8*	*61.5*	*7.7*
Northern Harrier	*2*	*2*	*11.00*	*100*	*100*	*0*	*0*
Eagles	*7*	*8*	*66.43*	*100*	*37.5*	*50.0*	*12.5*
Falcons	*6*	*6*	*13.33*	*66.7*	*83.3*	*16.7*	*0*
Osprey	*1*	*1*	*25.00*	*100*	*100*	*0*	*0*
Other Raptors	*4*	*4*	*27.75*	*80.0*	*50.0*	*50.0*	*0*
Vultures	3	22	100	100	4.5	68.2	27.3
Upland Game Birds	3	92	1.00	59.7	100	0	0
Doves/Pigeons	8	9	8.62	69.2	88.9	11.1	0
Large Corvids	131	425	59.11	94.2	39.3	48.9	11.8
Large Cuckoos	1	1	0	33.3	100	0	0
Large Birds Overall	**181**	**585**	**53.20**	**84.9**	**49.1**	**41.0**	**9.9**
Passerines	152	679	3.22	45.1	94.7	5.3	0
Swifts/Hummingbirds	6	6	8.50	85.7	100	0	0
Woodpeckers	1	1	2.00	50.0	100	0	0
Unidentified Birds	0	0	0	0	0	0	0
Small Birds Overall	**159**	**686**	**3.42**	**45.2**	**94.8**	**5.2**	**0**

[a] the likely rotor-swept heights for potential collision with a turbine blade or 115 - 427 feet (35 – 130 m) above ground level.

Doves/pigeons, upland game birds, and large cuckoos were generally observed flying below the RSH (Table 3). A total of 159 groups of small birds totaling 686 individuals were observed flying within the 100-m plots (Table 3). Overall, 5.2% of small birds were observed flying within the estimated RSH. The majority (94.7%) of passerines, and all (100%) of the woodpeckers and swifts/hummingbirds were observed flying below the RSH. No small birds were recorded flying above the RSH (Table 3).

Among large bird types, four species (common raven, red-tailed hawk, golden eagle, and mourning dove) had at least five groups observed flying. Of these, golden eagle had the greatest percentage of observations within the RSH (87.5%), followed by common raven (75.0%), and red-tailed hawk (73.4%; Table 4a). Four other species (osprey, Copper's hawk, Swainson's hawk, and rock pigeon) were recorded flying within the RSH during 100% of the observations; however this was based on only a single observation (Table 4a). Among small bird types, nine species had at least five groups observed flying. Of these, the only species observed flying within the RSH were white-crowned sparrow (21.6% of observations) and sage sparrow (3.1%; Table 4b).

Table 4a. Relative exposure index and flight characteristics for large bird species during the fixed-point bird use surveys at the Alta East Wind Resource Area from July 10, 2010 – June 1, 2011.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying Within RSH[a] Based on Initial Obs	Exposure Index	% Flying Within RSH at Anytime
common raven	131	1.84	94.2	48.9	0.85	73.4
turkey vulture	3	0.10	100	68.2	0.07	72.7
red-tailed hawk	12	0.07	66.7	58.3	0.03	75.0
golden eagle	7	0.03	100	50.0	0.01	87.5
unidentified hawk	4	0.02	80.0	50.0	<0.01	75.0
prairie falcon	2	<0.01	100	50.0	<0.01	50.0
Swainson's hawk	1	<0.01	100	100	<0.01	100
Cooper's hawk	1	<0.01	100	100	<0.01	100
rock pigeon	1	<0.01	100	100	<0.01	100
California quail	1	0.50	48.2	0	0	0
chukar	2	0.18	90.5	0	0	0
mourning dove	7	0.05	66.7	0	0	0
American kestrel	3	0.02	50.0	0	0	33.3
greater roadrunner	1	0.01	33.3	0	0	0
northern harrier	2	<0.01	100	0	0	0
unidentified accipiter	1	<0.01	100	0	0	0
osprey	1	<0.01	100	0	0	100
peregrine falcon	1	<0.01	100	0	0	0

[a] RSH - The likely rotor-swept heights for potential collision with a turbine blade or 115 - 427 feet (35 - 130 meters) above ground level.

Table 4b. Relative exposure index and flight characteristics for small bird species during the fixed-point bird use surveys at the Alta East Wind Resource Area from July 10, 2010 – June 1, 2011.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying Within RSH[a] Based on Initial Obs	Exposure Index	% Flying Within RSH at Anytime
white-crowned sparrow	34	1.54	58.6	14.8	0.13	21.6
sage sparrow	39	1.46	39.8	0.6	<0.01	3.1
western meadowlark	12	0.78	16.5	0	0	0
dark-eyed junco	3	0.30	81.0	0	0	0
house finch	11	0.27	63.3	0	0	0
western bluebird	5	0.26	30.6	0	0	0
cactus wren	6	0.17	20.0	0	0	0
horned lark	3	0.15	13.6	0	0	0
yellow-rumped warbler	5	0.14	59.5	0	0	0
chipping sparrow	4	0.12	40.0	0	0	0
loggerhead shrike	7	0.12	25.0	0	0	0
European starling	6	0.05	53.8	0	0	0
unidentified swallow	2	0.04	100	0	0	12.5
tree swallow	1	0.03	100	0	0	0
lark sparrow	2	0.02	100	0	0	0
unidentified hummingbird	4	0.02	80.0	0	0	0
western scrub-jay	1	0.02	20.0	0	0	0
rock wren	2	0.02	100	0	0	0
barn swallow	1	0.01	100	0	0	0
Le Conte's thrasher	0	0.01	0	0	0	0
unidentified bird (small)	0	0.01	0	0	0	0
ladder-backed woodpecker	1	<0.01	50	0	0	0
ruby-crowned kinglet	1	<0.01	100	0	0	0
unidentified warbler	2	<0.01	100	0	0	0
white-throated swift	1	<0.01	100	0	0	0
unidentified sparrow	0	<0.01	0	0	0	0
western kingbird	0	<0.01	0	0	0	0
unidentified flycatcher	1	<0.01	100	0	0	0
Townsend's warbler	1	<0.01	100	0	0	0
common grackle	1	<0.01	100	0	0	0
Anna's hummingbird	1	<0.01	100	0	0	0
unidentified gnatcatcher	0	<0.01	0	0	0	0
Say's phoebe	0	<0.01	0	0	0	0
ash-throated flycatcher	0	<0.01	0	0	0	0
Scott's oriole	1	<0.01	100	0	0	0
savannah sparrow	1	<0.01	100	0	0	0

[a] RSH - The likely rotor-swept heights for potential collision with a turbine blade or 115 - 427 feet (35 - 130 meters) above ground level.

Bird Exposure Index

A relative exposure index was calculated for each bird species based on initial flight height observations and relative abundance (defined as the use estimate; Tables 2a and 2b). This index does not account for other possible collision risk factors (e.g., foraging or courtship behavior). Common raven had the highest exposure index of any large bird species (0.85). All other large bird species had an exposure index of 0.07 or less. The diurnal raptor species with the greatest exposure indices were red tailed hawk (0.03) and golden eagle (0.01; Table 4a).

Prairie falcon, Swainson's hawk, and Copper's hawk all had an index less than 0.01. Among the small birds, the only two species with an exposure index greater than zero were white crown sparrow (0.13) and sage sparrow (<0.01, Table 4b).

Spatial Use

For all large bird species combined, use was highest at point three (5.15 birds/30-min survey); large bird use ranged from 0.65 to 3.89 birds/30-min survey at other points (Appendix B). The high mean use estimate for point three was largely due to higher use by large corvids and upland game birds at this point (2.59 and 2.17 birds/30-min survey, respectively). Diurnal raptor use was also highest at point 3 (0.37 birds/30-min plot) and ranged from 0.06 to 0.24 at other points. Relatively high raptor use at point 3 was primarily attributed to use by buteos (0.09 birds/30-min survey) and eagles (0.09); however, the accipiters, northern harrier, and osprey were observed only at point 3. Vultures were observed only at points 4 and 6 (0.45 and 0.02 birds/30-min survey, respectively). Upland game bird use varied greatly among points, ranging from 0.04 birds/30-min survey at point 1 to 2.17 at point 3. Use by large corvids (common ravens) was highest at point four (2.94 birds/30-min survey), and ranged from 0.32 to 2.59 at other points. Among small bird types, use was highest at point 6 (9.53 birds/30-min survey) and lowest at point 4 (2.04; Appendix B).

Flight paths for raptors and vultures were digitized and mapped by season (Appendix C). A qualitative comparison of mapped flight paths across survey points indicate higher use for some raptor species (e.g., red-tailed hawks and golden eagles) at points three and four, in the areas of greater topographic relief, particularly during the winter. Higher use of this area by golden eagles may be explained by the proximity of these points to several active eagle nests identified during raptor nest surveys (see Figure 2). Observations of other raptor species (e.g., falcons, harriers, and accipiters) and turkey vultures were too few to make inferences on spatial use of the study area by these species.

Sensitive Species Observations

Six species designated as having special conservation status at the state and/or federal level (BGEPA 1940, CDFG 2011, USFWS 2011) were recorded (Table 5). These included one state-threatened species (Swainson's hawk [CDFG 2011]), two state fully-protected species (golden eagle and peregrine falcon [CDFG 2011]), two state species of special concern (loggerhead shrike [*Lanius ludovicianus*] and northern harrier [CDFG 2011]), and three federal species of concern (loggerhead shrike, peregrine falcon, and Le Conte's thrasher [*Toxostoma lecontei*]; USFWS 2011). Additionally, the golden eagle receives further protection under the BGEPA (1940) and all are protected under the Migratory Bird Treaty Act (MBTA 1918).

Table 5. Summary of sensitive species observed at the Alta East Wind Resource Area during fixed-point bird use surveys (FP) from July 10, 2010 – June 1, 2011.

Species	Scientific Name	Status	Total # of grps	Total # of obs
loggerhead shrike	*Lanius ludovicianus*	SSC, FSC	32	36
golden eagle	*Aquila chrysaetos*	SFP, EA	7	8
Le Conte's thrasher	*Toxostoma lecontei*	FSC	3	3
northern harrier	*Circus cyaneus*	SSC	2	2
peregrine falcon	*Falco peregrinus*	SFP, FSC	1	1
Swainson's hawk	*Buteo swainsoni*	ST	1	1
Total	**6 Species**		**46**	**51**

SSC - state species of concern (CDFG 2011);
FSC - federal species of concern (USFWS 2011);
SFP – state fully-protected species (CDFG 2011);
EA – federal Bald and Golden Eagle Protection Act (BGEPA 1940);
ST – state threatened (CDFG 2011).

Raptor Nest Surveys

Aerial raptor nest surveys were conducted via helicopter on February 22, April 12, and June 1-2, 2011, at the AEWRA. The survey area for golden eagles included all eagle nesting habitat within a 10-mile buffer of the proposed AEWRA, while the survey area for all other raptors and common ravens included a two-mile buffer of the AEWRA.

Golden Eagle Nests

Three active golden eagle nests were identified within 10 miles of the AEWRA. These nests were located approximately 3.0 miles (4.8 km) to the northwest, 3.8 miles (6.1 km) to the north, and 6.8 miles (10.9 km) to the north of the AEWRA (Figure 2). All three nests were located during the February 22 flight, but were found to be inactive during that time. During the second round of surveys on April 12, adults were observed incubating at each nest. During the final survey on June 1, the nest to the northwest was found to be empty (presumed to have failed), while two young were observed in the northern-most nest and a single nestling was observed on the third nest. The age of the young was estimated to be between seven and eight weeks. Additionally, 10 inactive golden eagle nests were identified within the 10-mile buffer and three additional inactive nests were identified just outside the 10-mile buffer (Figure 2). The closest of these inactive golden eagle nests to the AEWRA is located approximately 1.2 miles (1.9 km) to the northwest.

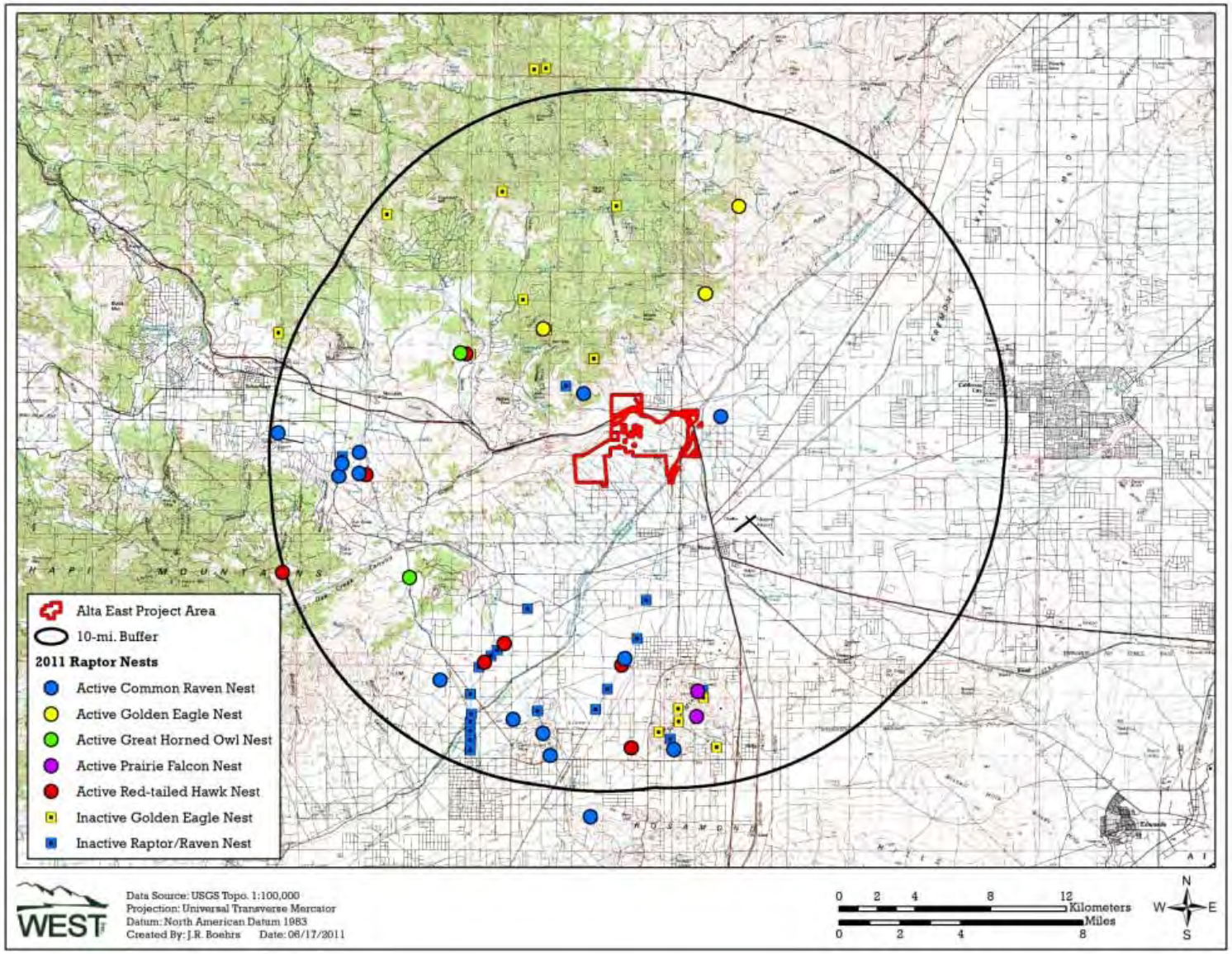


Figure 2. Location of raptor nests at the Alta East Wind Resource Area.

Other Raptor Nests

No active raptor nests were located within the boundary of the AEWRA, or within the surrounding 2-mile buffer. However, one inactive raptor nest and two active common raven nests were identified within two miles of the AEWRA (Figure 2). Additionally, while conducting surveys for golden eagles within the 10-mile buffer, a number of active raptor nests were identified in the region: two great horned owl (*Bubo virginianus*) nests, two prairie falcon nests, and seven red-tailed hawk nests. No Swainson's hawk nests were observed within the survey area. Additionally, thirteen active common raven nests and 28 inactive raptor nests were observed. It should be noted that only the area encompassed by a 2-mile buffer of the AEWRA was systematically searched for raptor nests and nests of other large birds. Outside of this area, the survey effort focused on golden eagle nesting habitat; however, any raptor or raven nest encountered was recorded as an incidental nest observation.

DISCUSSION AND IMPACT ASSESSMENT

Potential Impacts

Impacts to avian resources from wind energy facilities can be direct or indirect. Direct impacts are considered to be the potential for fatalities from construction and operation of the facility. Indirect impacts include the potential to displace wildlife, either temporarily or permanently, during the facility's construction or during the period of operation.

Direct Effects

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

Substantial data on bird mortality at wind energy facilities are available from studies throughout North America (Appendix D1). For the purpose of comparison with the AEWRA, a list of avian fatality estimates for facilities in California and the Pacific Northwest with publically-available data is presented in Table 6. Mortality rates for all bird species combined has varied greatly at these facilities, ranging from 0.16 birds/MW/year to 9.57 birds/MW/year (Table 6). Not all studies with publically-available fatality data have data on specific species or mortality estimates for avian subtypes. One study looked at 12 fatality studies, primarily in the Pacific Northwest, and found that diurnal raptor fatalities comprised just 2% of the wind-energy facility-related fatalities. Passerines (excluding house sparrows [*Passer domesticus*] and European starlings

[*Sturnus vulgaris*]) were the most common collision victims, comprising 82% of the 225 fatalities documented (Erickson et al. 2002b). Another study, focusing on the western United States, reported passerines were the most common fatalities, comprising 59.3% of all avian fatalities, while raptors comprised 19.4% of all avian fatalities. Upland game birds, shorebirds, waterbirds, and waterfowl were also found as fatalities, but were much less common (Johnson and Stephens 2011).

Table 6. Wind energy facilities in California and the Pacific Northwest with fatality data for all bird species.

Wind Energy Facility	Fatality Estimate[A]	No. of Turbines	Total MW
California			
Altamont Pass, CA	9.57	over 5,000	about 550
Pine Tree, CA	8.30*	90	135
Dillon, CA	4.71	45	45
Diablo Winds, CA	4.29	31	20
High Winds, CA (2004)	1.62	90	162
High Winds, CA (2005)	1.10	90	162
SMUD Solano, CA	0.99		15
Alite, CA	0.55	8	24
Pacific Northwest			
Leaning Juniper, OR	6.66	67	100.5
Stateline, OR/WA (2002)	3.17	454	263
Klondike II, OR	3.10	50	75
Klondike III, OR	3.02	122	375
Hopkins Ridge, WA (2008)	2.99	83	150
Nine Canyon, WA	2.76	37	48
Stateline, OR/WA (2003)	2.68	454	263
Combine Hills, OR	2.56	41	41
Big Horn, WA	2.54	133	199.5
Biglow Canyon, OR (Phase I; 2009)	2.47	76	125.4
Biglow Canyon, OR (Phase I; 2008)	1.76	76	125.4
Wild Horse, WA	1.55	127	229
Stateline II, OR/WA (2006)	1.23	454	263
Hopkins Ridge, WA (2006)	1.23	83	150
Vansycle, OR	0.95	38	24.9
Klondike, OR	0.95	16	24
Elkhorn, OR	0.64	61	101
Marengo I, WA	0.27	78	140.4
Marengo II, WA	0.16	39	70.2

A=number of bird fatalities/MW/study period
*fatality estimate corrected for mathematical error in number reported by BioResource Consultants (2010).
Data from the following sources:

Wind Energy Facility	Fatality Estimate	Wind Energy Facility	Fatality Estimate
ICF 2011	ICF 2011	Stateline, OR/WA (03)	Erickson et al. 2004
BioResource Consultants 2010	BRC 2010	Combine Hills, OR	Young et al. 2006
Dillon, CA	Chatfield et al. 2009	Big Horn, WA	Kronner et al. 2008
Diablo Winds, CA	WEST 2008	Biglow Canyon, OR (Phase I; 09)	Enk et al. 2010
High Winds, CA (04)	Kerlinger et al. 2006	Biglow Canyon I, OR (Phase I; 08)	Jeffrey et al. 2009a
High Winds, CA (05)	Kerlinger et al. 2006	Wild Horse, WA	Erickson et al. 2008
SMUD Solano, CA	Erickson and Sharp 2005	Stateline II, OR/WA	Erickson et al. 2007
Alite, CA	Chatfield et al. 2010 a	Hopkins Ridge, WA (06)	Young et al. 2007a
Leaning Juniper, OR	Gritski et al. 2008	Vansycle, OR	Erickson et al. 2000
Stateline, OR/WA (02)	Erickson et al. 2004	Klondike, OR	Johnson et al. 2003
Klondike II, OR	NWC and WEST 2007	Elkhorn, OR	Jeffrey et al. 2009b
Klondike III, OR	Gritski et al. 2009	Marengo I, WA	URS Corporation 2010a
Hopkins Ridge, WA (08)	Young et al. 2009b	Marengo II, WA	URS Corporation 2010b
Nine Canyon, WA	Erickson et al. 2003c		

Based on studies conducted at newer wind energy facilities, overall bird mortality in California is moderate compared to other sites in the Pacific Northwest (Table 6) and throughout North America (Appendix D1). The Altamont Pass WRA (APWRA), located in west-central California, had the highest mortality rate among facilities in California and the Pacific Northwest, with a rate of 9.57 birds/MW/year (IFC 2011). The APWRA currently contains over 5,000 wind turbines,

with a total capacity of 550 MW. The APWRA uses older, smaller wind turbines that typically range in size from 40 kilowatts (kW) to 300 kW (Arnett 2007), while most recent wind-energy facilities use larger turbines, ranging in size from 600 kW to 2.5 MW. The higher mortality rates observed at the APWRA have not been observed at other old-generation wind farms in California, namely the Tehachapi Pass and San Gorgonio WRAs (Anderson et al. 2004, 2005). A relatively high mortality rate was also observed at the Pine Tree Wind Farm (PTWF) located in southeastern Kern County (8.3 birds/MW/year), during 12 consecutive months of fatality monitoring in 2009-2010 (BRC 2010). According to BRC (2010), the estimated fatality rate at the PTWF may be inflated due to the dual effect of low searcher efficiency and high scavenger removal rates. The Dillon facility in Riverside County (Chatfield et al. 2009) and the Diablo Winds facility in Alameda County (WEST 2008) had more moderate fatality estimates (4.71 and 4.29 birds/MW/year, respectively). Two years of study were conducted at the High Winds facility, with a fatality estimate of 1.62 birds/MW/year in 2004 and 1.10 birds/MW/year in 2005 (Kerlinger et al. 2006). The Alite facility, located several miles to the southwest of the AEWRA, recorded the lowest mortality rate of sites reviewed in California, with an estimate of 0.55 birds/MW/year (Chatfield et al. 2010a; Table 6).

With the possible exception of golden eagles at the APWRA in California, where an estimated 40–70 golden eagles are killed each year (Hunt 2002, Smallwood and Thelander 2004), no wind-energy facilities have been documented to cause population declines of any species (Johnson and Stephens 2011). In the only study to quantitatively assess potential population level impacts, Hunt (2002) conducted a four year radio telemetry study of golden eagles at the APWRA and found that the resident golden eagle population appeared to be self-sustaining despite high levels of fatalities, but the effect of these fatalities on eagle populations wintering within and adjacent to the APWRA was unknown. All 58 territories occupied by golden eagle pairs in the APWRA in 2000 remained active in 2005 (Hunt and Hunt 2006).

Raptor Use and Exposure Risk

Annual mean raptor use (number of raptors divided by the number of 800-m plots and the total number of surveys) at the AEWRA was compared with raptor use at 43 other sites proposed for wind-energy development in the western and Midwestern US that implemented similar protocols and had data for three or four seasons. The annual mean raptor use at these wind-energy facilities ranged from 0.06 to 2.34 raptors/plot/20-min survey (Figure 3). Based on the results from these wind-energy facilities, a ranking of seasonal mean raptor use was developed as low (0 – 0.5 raptors/plot/20-min survey), low to moderate (0.5 – 1.0), moderate (1.0 – 2.0), high (2.0 – 3.0), and very high (more than 3.0). Under this ranking, mean raptor use at the AEWRA (0.12 raptors/plot/20-min survey) is considered to be low, ranking third lowest compared to the other wind-energy facilities (Figure 3). On a seasonal basis, mean raptor use estimates at the AEWRA are consistently low across all seasons when compared with other projects with the highest ranking occurring during the winter, when the AEWRA presents the 13th lowest mean use value out of 41 sites (Appendix E).

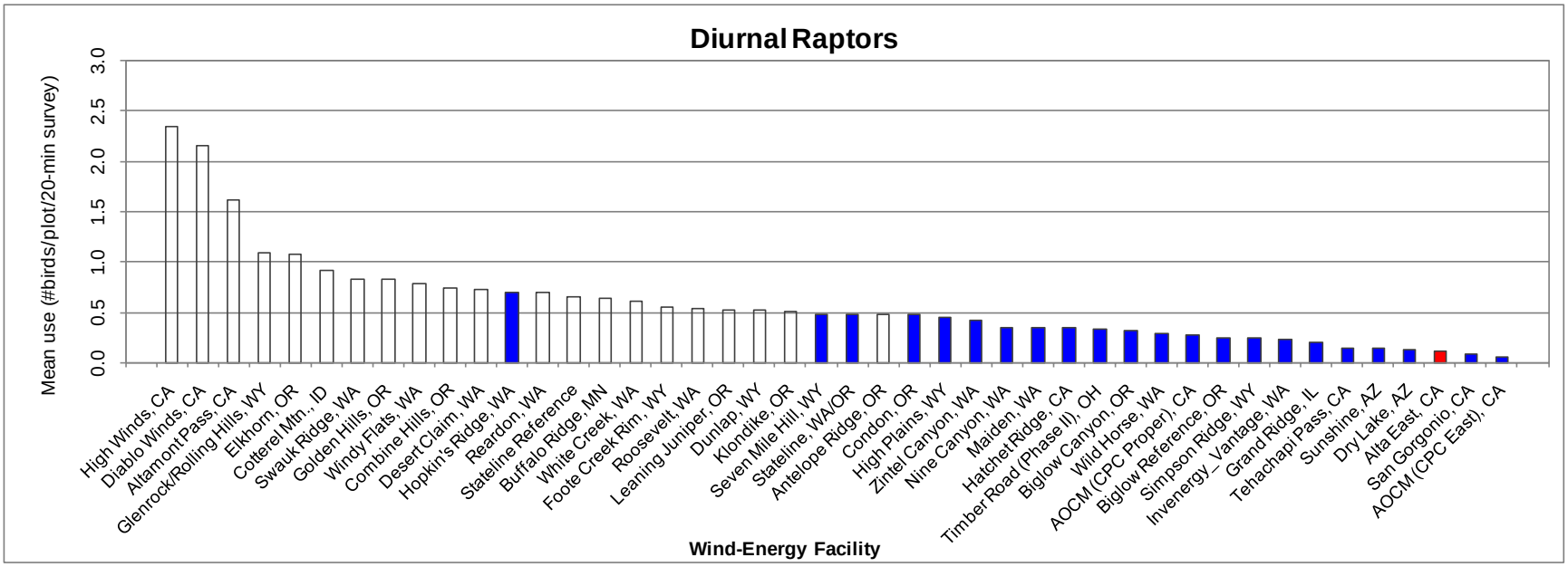


Figure 3. Comparison of annual raptor use between the Alta East Wind Resource Area and other wind-energy facilities in the western and Midwestern United States.

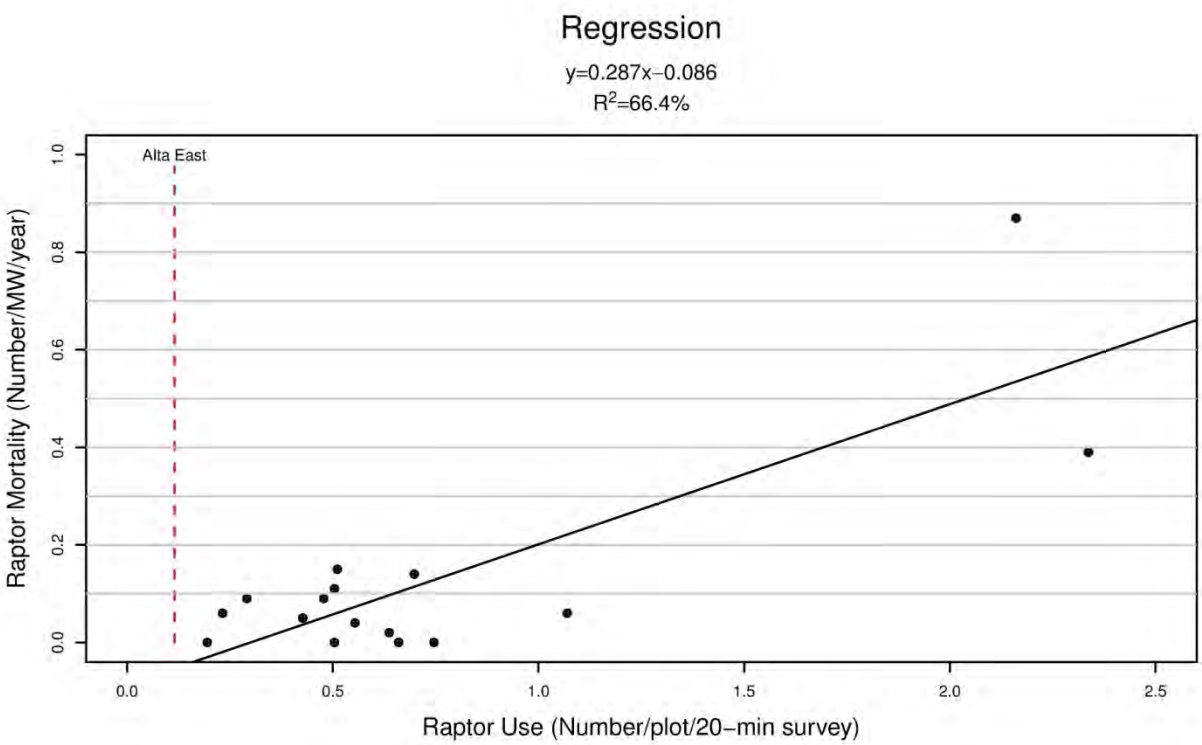
Data from the following sources:

Wind Energy Facility	Reference	Wind Energy Facility	Reference	Wind Energy Facility	Reference
Alta East, CA	This study.				
High Winds, CA	Kerlinger et al. 2005	White Creek, WA	NWC and WEST 2005	Timber Road (Phase II), OH	Good et al. 2010
Diablo Winds, CA	WEST 2006	Foote Creek Rim, WY	Erickson et al. 2002b	Biglow Canyon, OR	WEST 2005d
Altamont Pass, CA	Erickson et al. 2002b	Roosevelt, WA	NWC and WEST 2004	Wild Horse, WA	Erickson et al. 2003d
Glenrock/Rolling Hills, WY	Johnson et al. 2008a	Leaning Juniper, OR	Kronner et al. 2005	AOCM (CPC Proper), CA	Chatfield et al. 2010c
Elkhorn, OR	WEST 2005a	Dunlap, WY	Johnson et al. 2009a	Biglow Reference, OR	WEST 2005d
Cotterel Mtn., ID	BLM 2006	Klondike, OR	Johnson et al. 2002	Simpson Ridge, WY	Johnson et al. 2000b
Swauk Ridge, WA	Erickson et al. 2003a	Seven Mile Hill, WY	Johnson et al. 2008b	Invenergy_Vantage, WA	WEST 2007
Golden Hills, OR	Jeffrey et al. 2008	Stateline, WA/OR	Erickson et al. 2002b	Grand Ridge, IL	Derby et al. 2009
Windy Flats, WA	Johnson et al. 2007b	Antelope Ridge, OR	WEST 2009	Tehachapi Pass, CA	Erickson et al. 2002b
Combine Hills, OR	Young et al. 2003d	Condon, OR	Erickson et al. 2002b	Sunshine, AZ	WEST and the CPRS 2006
Desert Claim, WA	Young et al. 2003b	High Plains, WY	Johnson et al. 2009b	Dry Lake, AZ	Young et al. 2007c
Hopkin's Ridge, WA	Young et al. 2003a	Zintel Canyon, WA	Erickson et al. 2002a	San Gorgonio, CA	Erickson et al. 2002b
Reardon, WA	WEST 2005b	Nine Canyon, WA	Erickson et al. 2001b	AOCM (CPC East), CA	Chatfield et al. 2010c
Stateline Reference	URS et al. 2001	Maiden, WA	Erickson et al. 2002b		
Buffalo Ridge, MN	Erickson et al. 2002b	Hatchet Ridge, CA	Young et al. 2007b		

Although high numbers of raptor fatalities have been documented at some wind-energy facilities (e.g., Altamont Pass), a review of studies at wind-energy facilities across the United States reported that only 3.2% of casualties were raptors (Erickson et al. 2001a). Indeed, although raptors occur in most areas with the potential for wind-energy development, individual species appear to differ from one another in their susceptibility to collision (NRC 2007). Although the data set is limited, it indicates that, while several factors likely influence raptor fatality rates, the level of raptor use may be one factor in estimating raptor mortality.

Exposure indices analysis may provide insight into which species might be the most likely turbine casualties. However, the index only considers relative probability of exposure based on abundance, proportion of birds observed flying, and proportion of flight height of each species within the RSH for turbines likely to be used at the wind-energy facility. This analysis is based on observations of birds during the surveys and does not take into consideration behavior (e.g., foraging, courtship), habitat selection, the ability to detect and avoid turbines, and other factors that may vary among species and influence the likelihood of turbine collision. For these reasons, the index is only a relative index among species observed during the surveys and within the AEWRA, and actual risk for some species may be lower or higher than indicated by these data. At the AEWRA, the raptor species with the highest exposure indices were red-tailed hawk (which was influenced by relatively high use of the AEWRA) and golden eagle (which was influenced by the relatively high proportion (50%) of individuals observed within the RSH).

A regression analysis of raptor use and mortality for 16 new-generation wind-energy facilities, where similar methods were used to estimate raptor use and mortality, found that there was a significant correlation between use and mortality (R^2 = 66.4%; Figure 4). Using this regression to predict raptor collision mortality at the AEWRA (based on an adjusted mean raptor use of 0.12 raptors/20-min survey) yields an estimated fatality rate of less than 0.01 fatalities/MW/year or less than one raptor fatality per year for each 100-MW of wind-energy development. A 90% prediction interval around this estimate is zero to 0.19 raptor fatalities per MW per year.



Overall Raptor Use 0.12
Predicted Fatality Rate < 0.01 fatalities/MW/year
90.0% Prediction Interval (0, 0.19 fatalities/MW/year)

Figure 4. Regression analysis comparing raptor use estimations versus estimated raptor mortality. Data from the following sources:

Wind Energy Facility	Raptor Use (birds/plot /20-min survey)	Reference	Raptor Fatality Rate (fatalities/MW/yr)	Reference
Diablo Winds, CA	2.161	WEST 2006	0.87	WEST 2008
High Winds, CA	2.34	Kerlinger et al. 2005	0.39	Kerlinger et al. 2006
Bighorn, WA	0.51	Johnson and Erickson 2004	0.15	Kronner et al. 2008
Hopkins Ridge, WA	0.70	Young et al. 2003a	0.14	Young et al. 2007a
Klondike II, OR	0.50	Johnson 2004	0.11	NWC and WEST 2007
Stateline, WA/OR	0.48	Erickson et al. 2004	0.09	Erickson et al. 2002b
Wild Horse, WA	0.29	Erickson et al. 2003d	0.09	Erickson et al. 2008
Wessington Springs, SD	0.23	Derby et al. 2008	0.06	Derby et al. 2010f
Elkhorn Valley, OR	1.1	WEST 2005c	0.06	Jeffrey et al. 2009b
Zintel, WA	0.43	Erickson et al. 2002a	0.05	Erickson et al. 2002b
Foote Creek Rim, WY	0.55	Johnson et al. 2000b	0.04	Young et al. 2003c
Buffalo Ridge, MN	0.64	Erickson et al. 2002b	0.02	Erickson et al. 2002b
Combine Hills, OR	0.75	Young et al. 2003d	0.00	Young et al. 2006
Klondike, OR	0.50	Johnson et al. 2002	0.00	Johnson et al. 2003
Vansycle, OR	0.66	WCIA and WEST 1997	0.00	Erickson et al. 2000
Grand Ridge, IL	0.20	Derby et al. 2009	0	Derby et al. 2010g

Mean annual diurnal raptor use at the AEWRA was compared with other wind energy facilities in California and the Pacific Northwest with publically available post-construction fatality data and corresponding raptor use data (Table 7). Raptor mortality rates at these facilities ranged from zero to 2.18 raptors/MW/year (Table 7). Raptor use estimates at these same facilities range

from 0.21 raptors/20-min survey at the Stateline facility in Oregon and Washington (Erickson et al. 2003b), to 2.16 raptors /20-min survey at the Diablo Winds facility in California (WEST 2006).

The annual raptor use estimate for the AEWRA is considerably lower than the two facilities in California, as well as facilities in the Oregon and Washington (Table 7). Assuming a correlation between use and fatality rates exists, raptor mortality at the AEWRA is expected to be lower than mortality observed at sites in California and the Pacific Northwest (Table 7, see Appendix D2). Although multiple raptor species would potentially be at risk of collision mortality during operation of the AEWRA, the frequency with which they were documented using the site during two years of study suggests that fatality rates would be very low and unlikely to be significant at the population level.

Table 7. Wind-energy facilities in North America with fatality data for raptor species, grouped by geographic region.

Wind Energy Facility	Use Estimate[A]	Raptor Fatality[B]	No. of Turbines	Total MW
Alta East, CA, 2010-2011	**0.12**			
Alta East, CA, 2009-1010	0.09			
	California			
Altamont Pass, CA	1.62	2.18	over 5,000	over 550
Diablo Winds, CA	2.16	0.87	31	20
Pine Tree, CA		0.40*	90	135
SMUD Solano, CA		0.53		15
Alite, CA		0.12	8	24
Dillon, CA		0	45	45
	Pacific Northwest			
Leaning Juniper, OR	0.52	0.21	67	100.5
Klondike III, OR		0.15	122	375
Big Horn, WA	0.51	0.15	133	199.5
Hopkins Ridge, WA (2006)	0.70	0.14	83	150
Stateline, OR/WA (2006)		0.11	454	263
Klondike II, OR	0.50	0.11	50	75
Stateline, OR/WA (2002)	0.23	0.09	454	263
Stateline, OR/WA (2003)	0.21	0.09	454	263
Wild Horse, WA	0.29	0.09	127	229
Hopkins Ridge, WA (2008)		0.07	83	150
Elkhorn, OR (2008)		0.06	61	101
Nine Canyon, WA		0.05	37	48
Marengo II, WA (2009)		0.05	39	70.2
Biglow Canyon, WA (Phase I; 2009)		0.04	76	125.4
Biglow Canyon, WA (Phase I; 2008)		0.03	76	125.4
Combine Hills, OR	0.75	0	41	41
Vansycle, OR	0.66	0	38	24.9
Klondike, OR	0.50	0	16	24
Marengo I, WA (2009)		0	78	140.4

A=number of raptors/plot/20min survey
B=number of fatalities/MW/study period
* fatality estimate reported for Pine Tree was for large birds (16-32 inches), not raptors specifically; estimate corrected for mathematical error in fatality estimate (0.2 fatalities/MW/studyperiod) reported by BioResource Consultants (2010).

Table 7. Wind-energy facilities in North America with fatality data for raptor species, grouped by geographic region.

Data from the following sources:

Wind Energy Facility	Use Estimate	Fatality Estimate	Wind Energy Facility	Use Estimate	Fatality Estimate
Alta East, CA (10-11)	This study				
Alta East, CA (09-10)	Chatfield et al. 2010c		Stateline, OR/WA (03)	Erickson et al. 2003b	Erickson et al. 2004
Altamont Pass, CA	Erickson et al. 2002b	ICF 2011	Wild Horse, WA	Erickson et al. 2003d	Erickson et al. 2008
Diablo Winds, CA	WEST 2006	WEST 2008	Hopkins Ridge, WA (08)		Young et al. 2009b
Pine Tree, CA		BRC 2010	Elkhorn, OR		Jeffrey et al. 2009b
SMUD Solano, CA		Erickson and Sharp 2005	Nine Canyon, WA	Erickson et al. 2001b	Erickson et al. 2003c
Alite, CA	Chatfield et al. 2010a		Marengo II, WA		URS Corporation 2010b
Dillon, CA		Chatfield et al. 2009	Biglow Canyon, WA (Phase I; 09)		Enk et al. 2010
Leaning Juniper, OR	Kronner et al. 2005	Gritski et al. 2008	Biglow Canyon, WA (Phase I; 08)		Jeffrey et al. 2009a
Klondike III, OR		Gritski et al. 2009	Combine Hills, OR	Young et al. 2003d	Young et al. 2006
Big Horn, WA	Johnson and Erickson 2004	Kronner et al. 2008	Vansycle, OR	WCIA and WEST 1997	Erickson et al. 2000
Hopkins Ridge, WA (06)	Young et al. 2003a	Young et al. 2007a	Klondike, OR	Johnson et al. 2002	Johnson et al. 2003
Stateline, OR/WA (06)		Young et al. 2007a	Marengo II, WA		URS Corporation 2010b
Klondike II, OR	Johnson 2004	NWC and WEST 2007	Klondike, OR	Johnson et al. 2002	Johnson et al. 2003
Stateline, OR/WA (02)	Erickson et al. 2002b	Erickson et al. 2004	Marengo I, WA		URS Corporation 2010a

Non-Raptor Use and Exposure Risk

Passerines (primarily perching birds) have been the most abundant bird fatality at wind energy facilities outside California (Erickson et al. 2001a, 2002b), often comprising more than 80% of bird fatalities. Both migrant and resident passerine fatalities have been observed. Given that passerines made up a large proportion of the birds observed during the baseline study, passerines would be expected to make up the largest proportion of fatalities at the AEWRA. Of the small birds observed during fixed-point surveys, exposure indices indicate that white-crowned sparrow is the most likely passerine species to be exposed to collision with wind turbines at the AEWRA. At the nearby PTWF, passerines comprised approximately 58% of annual avian mortality, with western scrub-jay (*Aphelocoma californica*) and western meadowlark (*Sturnella neglecta*) the most common passerine fatalities encountered during the study (BRC 2010).

Of the large bird species observed at the AEWRA, common raven had the highest exposure index. Despite the high use estimates and the high exposure index calculated for ravens, which comprised 18.1% of the individual large birds observed during surveys, post-construction fatality studies at other wind energy facilities in the western US reveal relatively low mortality for common ravens, suggesting this species is not very susceptible to collisions. At existing wind energy facilities in the region, ravens comprised 6.3% of fatalities at the Tehachapi WRA (Anderson et al. 2004), 4.2% of fatalities at the PTWF (BRC 2010), and none of the fatalities at the Alite Wind Energy Facility (Chatfield et al. 2010a). Turkey vulture had the second highest exposure index (0.22) at the AEWRA; however, they were only observed during spring. Post-construction avian fatality monitoring studies at facilities in California have documented very few vulture fatalities, and Orloff and Flannery (1992) suggest that turkey vultures are killed less often than predicted based on abundance at older-generation wind-energy facilities. Out of 127 fatalities at the Tehachapi Pass WRA (Anderson et al. 2004), and 439 fatalities at Altamont Pass WRA (Thelander et al. 2003), there were no documented vulture fatalities. During a 2-year study at the new-generation High Winds WRA, only four vultures were found among 301 total fatalities (Kerlinger et al. 2006). While fatality data for new-generation WRAs is limited, Tierney

(2007, 2009) suggests that turkey vultures may show higher susceptibility to collision at the new-generation facilities than previously believed. During post-construction monitoring conducted at the Buffalo Gap Wind Farm in Texas, turkey vultures comprised approximately 52% of total avian fatalities during two year of monitoring (Tierney 2007, 2009).

The project area appears to receive very little use by waterfowl, waterbirds, or shorebirds (none were observed during surveys), and mortality involving these groups is expected to be inconsequential. The area does receive considerable use by upland game birds (mainly California quail and chukar), but these species are not expected to be highly susceptible to turbine collisions because they spend most of their time on the ground and were never observed flying at turbine rotor-swept heights during this study. However, based on the results of other post-construction monitoring in southern California, some mortality is expected. At the nearby PTWF and Alite facilities, upland game birds comprised 25% and 29% of overall avian mortality, respectively (BRC 2010, Chatfield et al. 2010a).

With the exception of ravens and turkey vultures, all non-raptors had relatively low exposure indices due to low use estimates and/or the majority of individuals flying below the RSH. It is unlikely that non-raptor populations will be adversely affected by direct mortality from the operation of the wind-energy facility.

Indirect Effects

The presence of wind turbines may alter the landscape so that wildlife use patterns are affected, displacing wildlife away from the project facilities and suitable habitat. Some studies from wind energy facilities in Europe consider displacement effects to have a greater impact on birds than collision mortality (Gill et al. 1996). The greatest concern with displacement impacts for wind energy facilities in the US has been where these facilities have been constructed in grassland or other native habitats (Leddy et al. 1999, Mabey and Paul 2007). Although Crockford (1992) suggests that disturbance appears to impact feeding, resting, and migrating birds (rather than breeding birds), results from studies at the Stateline wind energy facility in Washington and Oregon (Erickson et al. 2004) and the Buffalo Ridge wind energy facility in Minnesota (Johnson et al. 2000a) suggest that breeding birds are also affected by wind energy facility operations.

<u>Raptor Displacement</u>

Birds displaced from wind energy facilities might move to lower quality habitat with fewer disturbances, with an overall effect of reducing breeding success. Most studies on raptor displacement at wind energy facilities, however, indicate effects to be negligible (Howell and Noone 1992; Johnson et al. 2000a, 2003; Whitfield and Madders 2006). Notable exceptions include a study in Scotland that described territorial golden eagles avoiding the entire wind energy facility area, except when intercepting non-territorial birds (Walker et al. 2005), and a study at the Buffalo Ridge wind energy facility in Minnesota which found evidence of northern harriers avoiding turbines on both a small scale (less than 100 m from turbines) and a larger scale in the year following construction (Johnson et al. 2000a). Two years following construction, however, no large-scale displacement of northern harriers was detected. Additionally, the only published report suggesting avoidance of wind turbines by nesting raptors

was from this same facility in Minnesota, where raptor nest density on 101 mi^2 (262 km^2) of land surrounding the wind energy facility was 5.94 nests/39 mi^2 (101 km^2), yet no nests were present in the 12 mi^2 (31 km^2) facility itself, even though habitat was similar (Usgaard et al. 1997). However, this analysis assumes that raptor nests are uniformly distributed across the landscape (an unlikely event), and only two nests would be expected for an area 12 mi^2 in size if the nests were distributed uniformly.

Based on extensive monitoring using helicopter flights and ground observations, raptors continued to nest at a wind energy facility in eastern Washington at approximately the same levels after construction, and several nests were located within a half-mile of turbines (Erickson et al. 2004). At the Foote Creek Rim wind energy facility in southern Wyoming, one pair of red-tailed hawks nested within 0.3 miles (0.5 km) of the turbine strings, and seven red-tailed hawk nests, one great horned owl nest, and one golden eagle nest located within one mile of the wind energy facility successfully fledged young (Johnson et al. 2000b). The golden eagle pair successfully nested a half-mile from the facility for three different years after it became operational. In Oregon, a Swainson's hawk also nested within a quarter-mile (0.4 km) of a turbine string at the Klondike I wind energy facility after the facility was operational (Johnson et al. 2003). These observations suggest that there will be limited nesting displacement of raptors at the AEWRA, although the creation of a buffer surrounding any known nests when siting turbines will further reduce any impact.

Displacement of Non-Raptor Bird Species

Studies concerning displacement of non-raptor species have concentrated on grassland passerines and waterfowl/waterbirds (Winkelman 1990, Larsen and Madsen 2000, Mabey and Paul 2007). Wind energy facility construction appears to cause small-scale local displacement of grassland passerines and is likely due to the birds avoiding turbine noise and maintenance activities. Construction also reduces habitat effectiveness because of the presence of access roads and large gravel pads surrounding turbines (Leddy 1996, Johnson et al. 2000a). Leddy et al. (1999) surveyed bird densities in Conservation Reserve Program (CRP) grasslands at the Buffalo Ridge wind energy facility in Minnesota, and found mean densities of 10 grassland bird species were four times higher at areas located 180 m (591 ft) from turbines than they were at grasslands nearer turbines. Johnson et al. (2000a) found reduced use of habitat by seven of 22 grassland-breeding birds following construction of the Buffalo Ridge wind energy facility. Results from the Stateline wind energy facility in Oregon and Washington (Erickson et al. 2004) and the Combine Hills wind energy facility in Oregon (Young et al. 2005) suggest a relatively small impact of the wind energy facilities on grassland-nesting passerines. Transect surveys conducted prior to and after construction of the wind energy facilities found that grassland passerine use was significantly reduced within approximately 50 m (164 ft) of turbine strings, but areas further away from turbine strings did not have reduced bird use.

CONCLUSIONS AND RECOMMENDATIONS

While higher use by some raptor species was observed in the northern portion of the AEWRA, overall raptor use was lower than nearly all other WRAs evaluated throughout the western and

Midwestern US. The data collected during this study suggest that the AEWRA is not within a high bird use area or major spring migration pathway. As well, the habitat and features of the AEWRA are not unique to the surrounding landscape, nor do they appear to be particularly preferred or critical to migrants. No active raptor nests were located within the boundary of the AEWRA, or within the surrounding two-mile buffer, indicating a very low raptor nest density. The results of the current study are consistent with the results of the initial year of baseline surveys at the AEWRA, as well as other sites proposed for wind-energy development in the region (Chatfield et al. 2010b, 2010c; Erickson et al. 2009). Use of the area by sensitive species, especially state and federal listed species, appears to be very low as well. A single Swainsons' hawk (state-threatened [CDFG 2011]) was observed within the AEWRA on April 1, 2011, and was likely a migrant passing through the region. Overall, results of the studies to date do not suggest that a wind development at the AEWRA would have significant impacts to avian species.

The use of the area by golden eagles and the proximity to golden eagle nests in the surrounding landscape may warrant consideration. The initial year of baseline surveys documented golden eagle use occurring to the north of the current AEWRA boundary; however, the current study documented golden eagle use within the boundary, concentrated in the north-central portions of the study area. These golden eagle observations were limited to the fall (one observation) and winter (seven observations), suggesting a potential seasonal relationship with golden eagle use at the AEWRA that was not evident during the year one study. Despite several active golden eagle nests identified to the north of the AEWRA, use of the study area by golden eagles was not observed during the breeding season.

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Appendix A. Summary of Individuals and Group Observations, by Bird Type or Species, for Fixed-Point Bird Use Surveys at the Alta East Wind Resource Area from July 10, 2010 – June 1, 2011

Appendix A. Summary of individuals (# obs) and group observations (# grps), by bird type or species, for fixed-point bird use surveys at the Alta East Wind Resource Area[a] from July 10, 2010 – June 1, 2011.

		Spring		Summer		Fall		Winter		Total	
Bird Type or Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Diurnal Raptors		**12**	**12**	**2**	**2**	**12**	**12**	**21**	**22**	**47**	**48**
Accipiters		*1*	*1*	*1*	*1*	*0*	*0*	*0*	*0*	*2*	*2*
Cooper's hawk	*Accipiter cooperii*	1	1	0	0	0	0	0	0	1	1
unidentified accipiter		0	0	1	1	0	0	0	0	1	1
Buteos		*6*	*6*	*1*	*1*	*5*	*5*	*7*	*7*	*19*	*19*
red-tailed hawk	*Buteo jamaicensis*	5	5	1	1	5	5	7	7	18	18
Swainson's hawk	*Buteo swainsoni*	1	1	0	0	0	0	0	0	1	1
Northern Harrier		*0*	*0*	*0*	*0*	*0*	*0*	*2*	*2*	*2*	*2*
northern harrier	*Circus cyaneus*	0	0	0	0	0	0	2	2	2	2
Eagles		*0*	*0*	*0*	*0*	*1*	*1*	*6*	*7*	*7*	*8*
golden eagle	*Aquila chrysaetos*	0	0	0	0	1	1	6	7	7	8
Falcons		*3*	*3*	*0*	*0*	*5*	*5*	*2*	*2*	*10*	*10*
American kestrel	*Falco sparverius*	2	2	0	0	5	5	0	0	7	7
peregrine falcon	*Falco peregrinus*	0	0	0	0	0	0	1	1	1	1
prairie falcon	*Falco mexicanus*	1	1	0	0	0	0	1	1	2	2
Osprey		*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*
osprey	*Pandion haliaetus*	1	1	0	0	0	0	0	0	1	1
Other Raptors		*1*	*1*	*0*	*0*	*1*	*1*	*4*	*4*	*6*	*6*
unidentified hawk		1	1	0	0	1	1	4	4	6	6
Vultures		**3**	**22**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**22**
turkey vulture	*Cathartes aura*	3	22	0	0	0	0	0	0	3	22
Upland Game Birds		**11**	**20**	**9**	**111**	**3**	**13**	**4**	**10**	**27**	**154**
California quail	*Callipepla californica*	9	17	8	84	1	1	4	10	22	112
chukar	*Alectoris chukar*	2	3	1	27	2	12	0	0	5	42
Doves/Pigeons		**1**	**1**	**8**	**9**	**2**	**2**	**1**	**1**	**12**	**13**
mourning dove	*Zenaida macroura*	1	1	8	9	2	2	0	0	11	12
rock pigeon	*Columba livia*	0	0	0	0	0	0	1	1	1	1
Large Corvids		**26**	**54**	**5**	**7**	**40**	**137**	**79**	**253**	**150**	**451**
common raven	*Corvus corax*	26	54	5	7	40	137	79	253	150	451
Large Cuckoos		**1**	**1**	**0**	**0**	**2**	**2**	**0**	**0**	**3**	**3**
greater roadrunner	*Geococcyx californianus*	1	1	0	0	2	2	0	0	3	3
Passerines		**166**	**548**	**55**	**86**	**126**	**357**	**144**	**759**	**491**	**1,750**
ash-throated flycatcher	*Myiarchus cinerascens*	0	0	0	0	1	1	0	0	1	1
barn swallow	*Hirundo rustica*	1	4	0	0	0	0	0	0	1	4

Appendix A. Summary of individuals (# obs) and group observations (# grps), by bird type or species, for fixed-point bird use surveys at the Alta East Wind Resource Area[a] from July 10, 2010 – June 1, 2011.

		Spring		Summer		Fall		Winter		Total	
Bird Type or Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
black-throated sparrow	*Amphispiza bilineata*	1	2	0	0	0	0	0	0	1	2
Brewer's blackbird	*Euphagus cyanocephalus*	1	2	0	0	0	0	0	0	1	2
cactus wren	*Campylorhynchus brunneicapillus*	5	7	21	24	6	7	6	7	38	45
chipping sparrow	*Spizella passerina*	0	0	0	0	4	21	5	14	9	35
common grackle	*Quiscalus quiscula*	1	1	0	0	0	0	0	0	1	1
dark-eyed junco	*Junco hyemalis*	1	2	0	0	3	7	7	75	11	84
European starling	*Sturnus vulgaris*	9	12	0	0	0	0	3	6	12	18
horned lark	*Eremophila alpestris*	11	36	0	0	6	9	0	0	17	45
house finch	*Carpodacus mexicanus*	12	33	0	0	8	49	0	0	20	82
lark sparrow	*Chondestes grammacus*	2	7	0	0	0	0	0	0	2	7
Le Conte's thrasher	*Toxostoma lecontei*	0	0	2	2	1	1	0	0	3	3
loggerhead shrike	*Lanius ludovicianus*	5	5	9	12	3	3	15	16	32	36
rock wren	*Salpinctes obsoletus*	1	1	0	0	1	1	2	5	4	7
ruby-crowned kinglet	*Regulus calendula*	1	2	0	0	0	0	0	0	1	2
sage sparrow	*Amphispiza belli*	28	140	17	34	64	172	19	63	128	409
savannah sparrow	*Passerculus sandwichensis*	1	1	0	0	0	0	0	0	1	1
Say's phoebe	*Sayornis saya*	0	0	0	0	1	1	0	0	1	1
Scott's oriole	*Icterus parisorum*	1	1	0	0	0	0	0	0	1	1
Townsend's warbler	*Dendroica townsendi*	1	1	0	0	0	0	0	0	1	1
tree swallow	*Tachycineta bicolor*	1	8	0	0	0	0	0	0	1	8
unidentified flycatcher		1	1	0	0	0	0	0	0	1	1
unidentified gnatcatcher		0	0	0	0	0	0	1	1	1	1
unidentified sparrow		0	0	1	1	0	0	0	0	1	1
unidentified swallow		1	1	1	7	1	7	0	0	3	15
unidentified warbler		1	1	0	0	1	1	0	0	2	2
western bluebird	*Sialia mexicana*	1	10	0	0	2	5	16	199	19	214
western kingbird	*Tyrannus verticalis*	1	1	0	0	0	0	0	0	1	1
western meadowlark	*Sturnella neglecta*	35	108	3	5	11	44	22	112	71	269
western scrub-jay	*Aphelocoma californica*	3	3	1	1	1	1	0	0	5	5
white-crowned sparrow	*Zonotrichia leucophrys*	36	140	0	0	11	25	43	239	90	404
yellow-rumped warbler	*Dendroica coronata*	4	18	0	0	1	2	5	22	10	42
Swifts/Hummingbirds		**3**	**3**	**3**	**3**	**1**	**1**	**0**	**0**	**7**	**7**
Anna's hummingbird	*Calypte anna*	1	1	0	0	0	0	0	0	1	1
unidentified hummingbird		2	2	2	2	1	1	0	0	5	5
white-throated swift	*Aeronautes saxatalis*	0	0	1	1	0	0	0	0	1	1

Appendix A. Summary of individuals (# obs) and group observations (# grps), by bird type or species, for fixed-point bird use surveys at the Alta East Wind Resource Area[a] from July 10, 2010 – June 1, 2011.

		Spring		Summer		Fall		Winter		Total	
Bird Type or Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
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		**1**	**2**	**0**	**0**	**0**	**0**	**2**	**41**	**3**	**43**
unidentified bird (small)		1	2	0	0	0	0	2	41	3	43
Overall		**225**	**664**	**83**	**219**	**186**	**524**	**251**	**1,086**	**745**	**2,493**

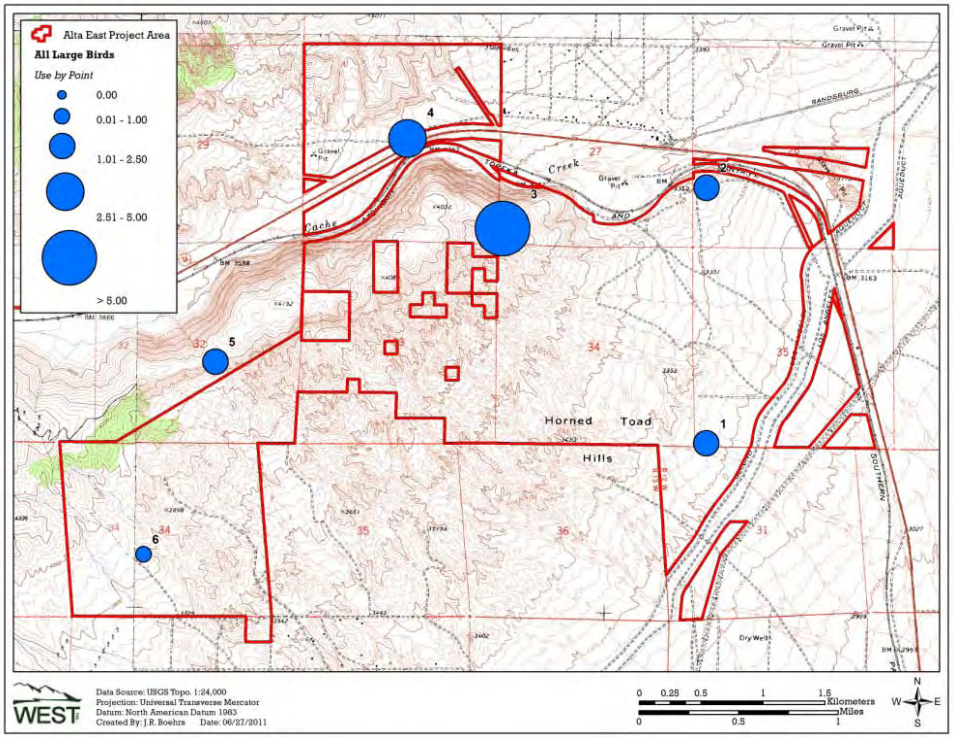
[a] Regardless of distance from observer.

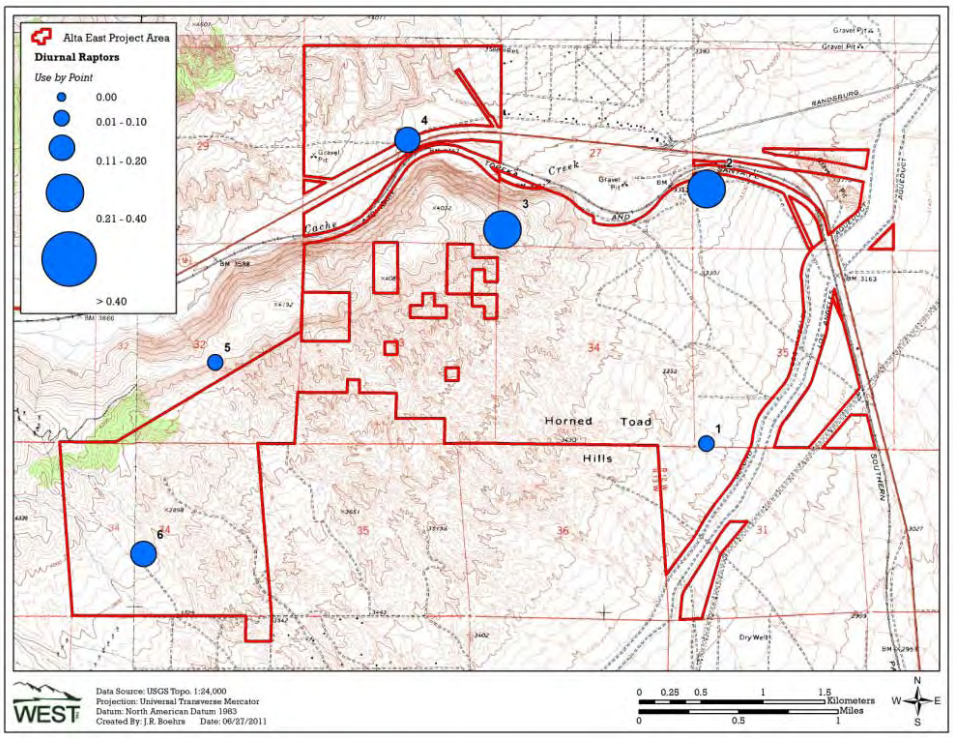
Appendix B. Mean Use by Point for All Birds, Major Bird Types, and Raptor Subtypes Observed at the Alta East Wind Resource Area During Fixed-Point Bird Use Surveys from July 10, 2010 – June 1, 2011

Appendix B1. Mean use (number of birds/20-minute survey) by point for all birds[a], major bird types, and raptor subtypes observed at the Alta East Wind Resource Area during fixed-point bird use surveys from July 10, 2010 – June 1, 2011.

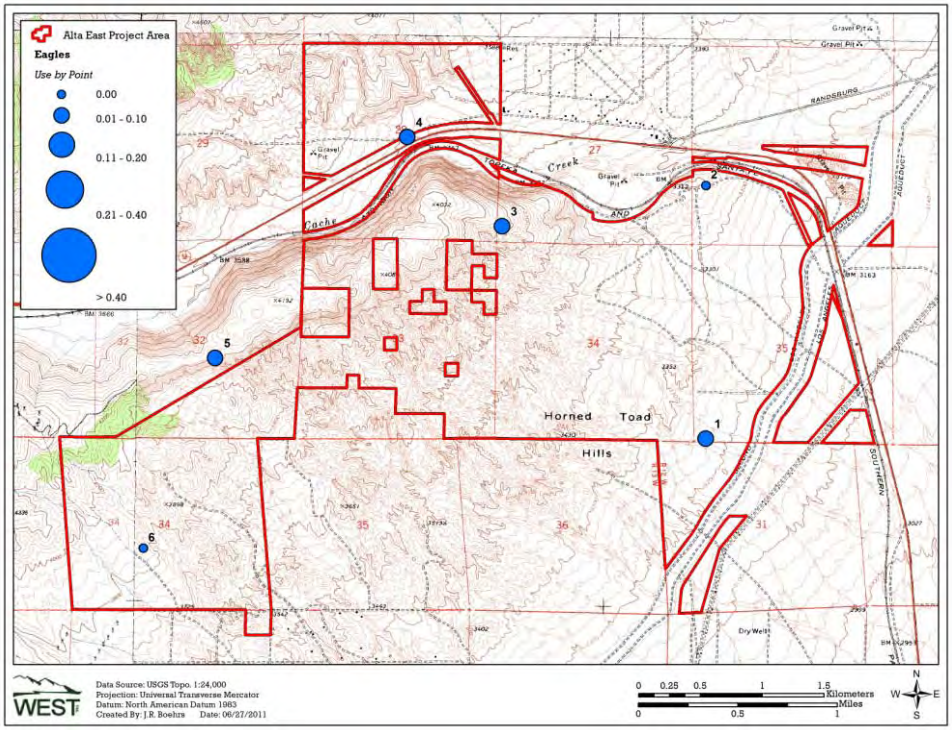
	Survey Point					
Bird Type	**1**	**2**	**3**	**4**	**5**	**6**
Diurnal Raptors	0.07	0.24	0.37	0.11	0.06	0.20
Accipiters	*0*	*0*	*0.04*	*0*	*0*	*0*
Buteos	*0.02*	*0.20*	*0.09*	*0.02*	*0*	*0.10*
Northern Harrier	*0*	*0*	*0.04*	*0*	*0*	*0*
Eagles	*0.02*	*0*	*0.09*	*0.04*	*0.03*	*0*
Falcons	*0.02*	*0.04*	*0.07*	*0*	*0*	*0.08*
Osprey	*0*	*0*	*0.02*	*0*	*0*	*0*
Other Raptors	*0*	*0*	*0.02*	*0.04*	*0.03*	*0.02*
Vultures	0	0	0	0.45	0	0.02
Upland Game Birds	0.04	0.22	2.17	0.23	0.80	0.08
Doves/Pigeons	0.04	0.04	0.02	0.15	0	0.02
Large Corvids	1.70	1.61	2.59	2.94	0.83	0.32
Large Cuckoos	0.02	0.02	0	0.02	0	0
All Large Birds	**1.87**	**2.13**	**5.15**	**3.89**	**1.69**	**0.65**
Passerines	5.35	5.91	8.13	2.04	3.91	9.50
Swifts/Hummingbirds	0.04	0	0.09	0	0.03	0
Woodpeckers	0	0	0	0.02	0	0.02
Unidentified Birds	0	0.04	0	0.02	0	0
All Small Birds	**5.39**	**5.96**	**8.22**	**2.09**	**3.94**	**9.53**

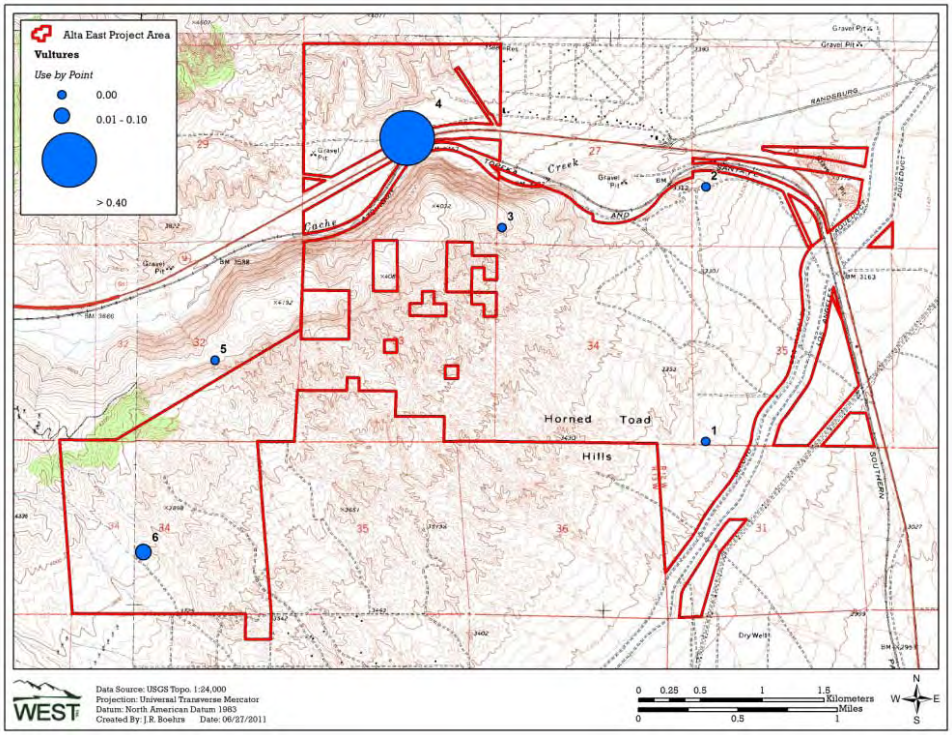
[a.] 800-meter (m) radius plot for large birds, 100-m for small birds.



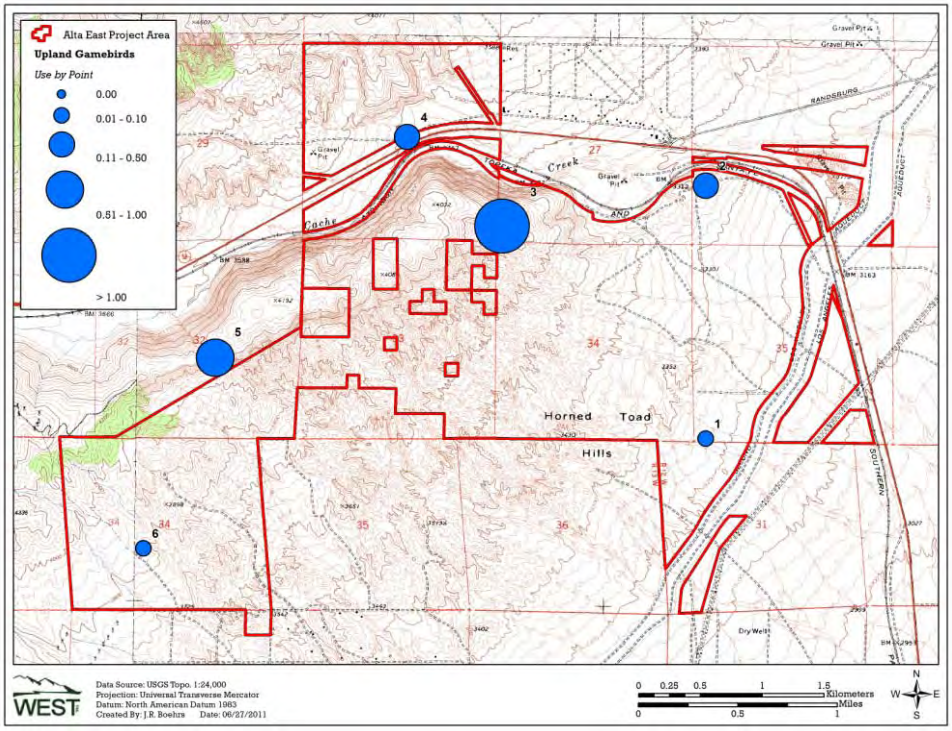


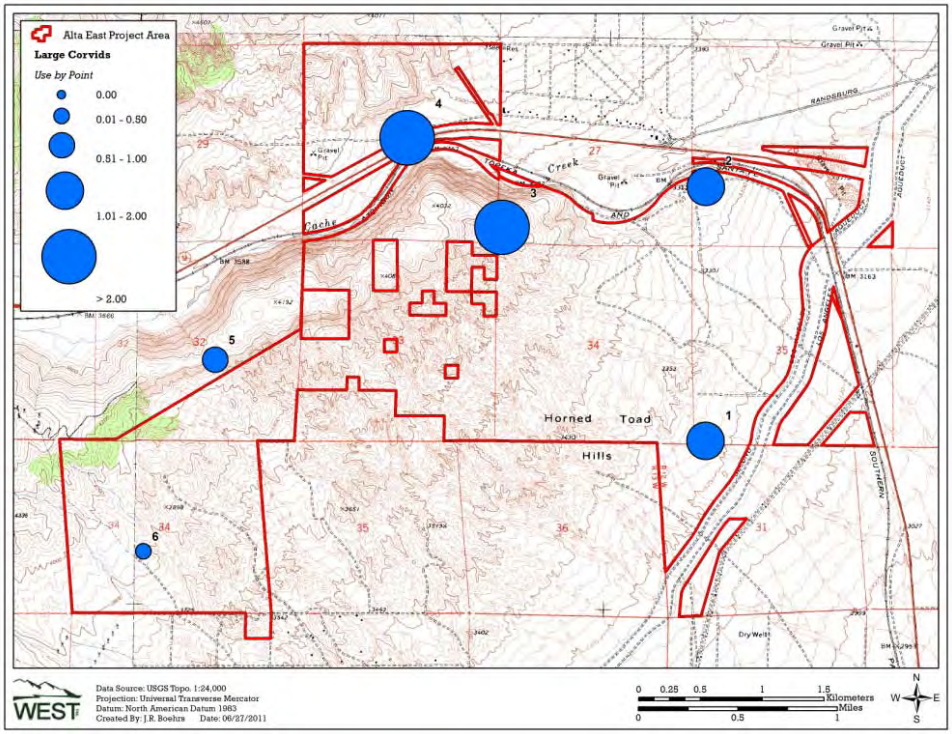
Appendix B2. Mean bird use (number of birds/30-minute survey) at each fixed-point bird use point for all birds and major bird types at the Alta East Wind Resource Area.



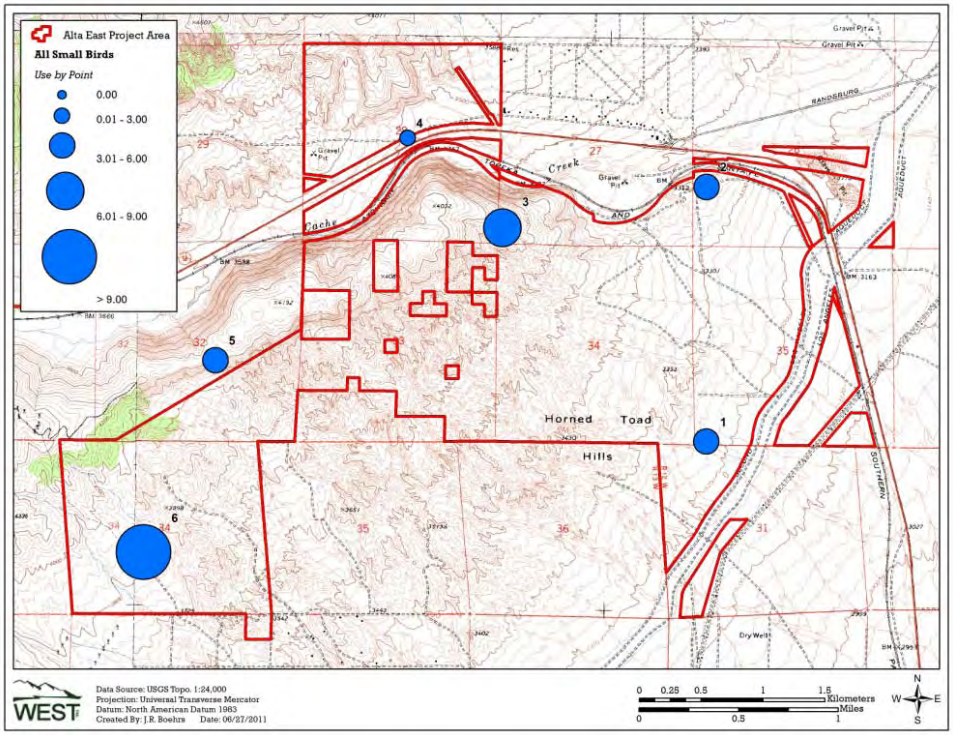


Appendix B2 (*continued*). Mean bird use (number of birds/30-minute survey) at each fixed-point bird use point for all birds and major bird types at the Alta East Wind Resource Area.



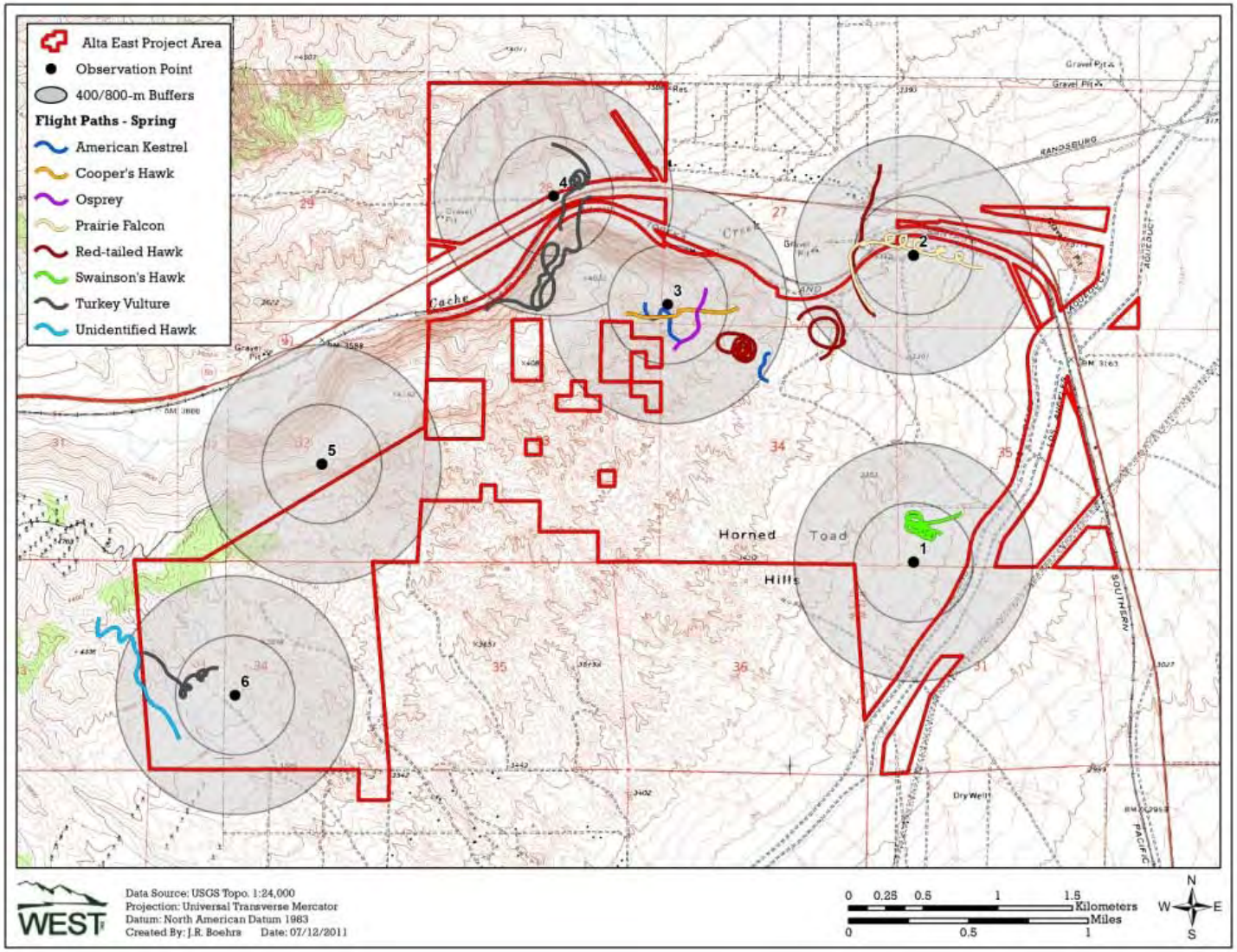


Appendix B2 (*continued*). Mean bird use (number of birds/30-minute survey) at each fixed-point bird use point for all birds and major bird types at the Alta East Wind Resource Area.

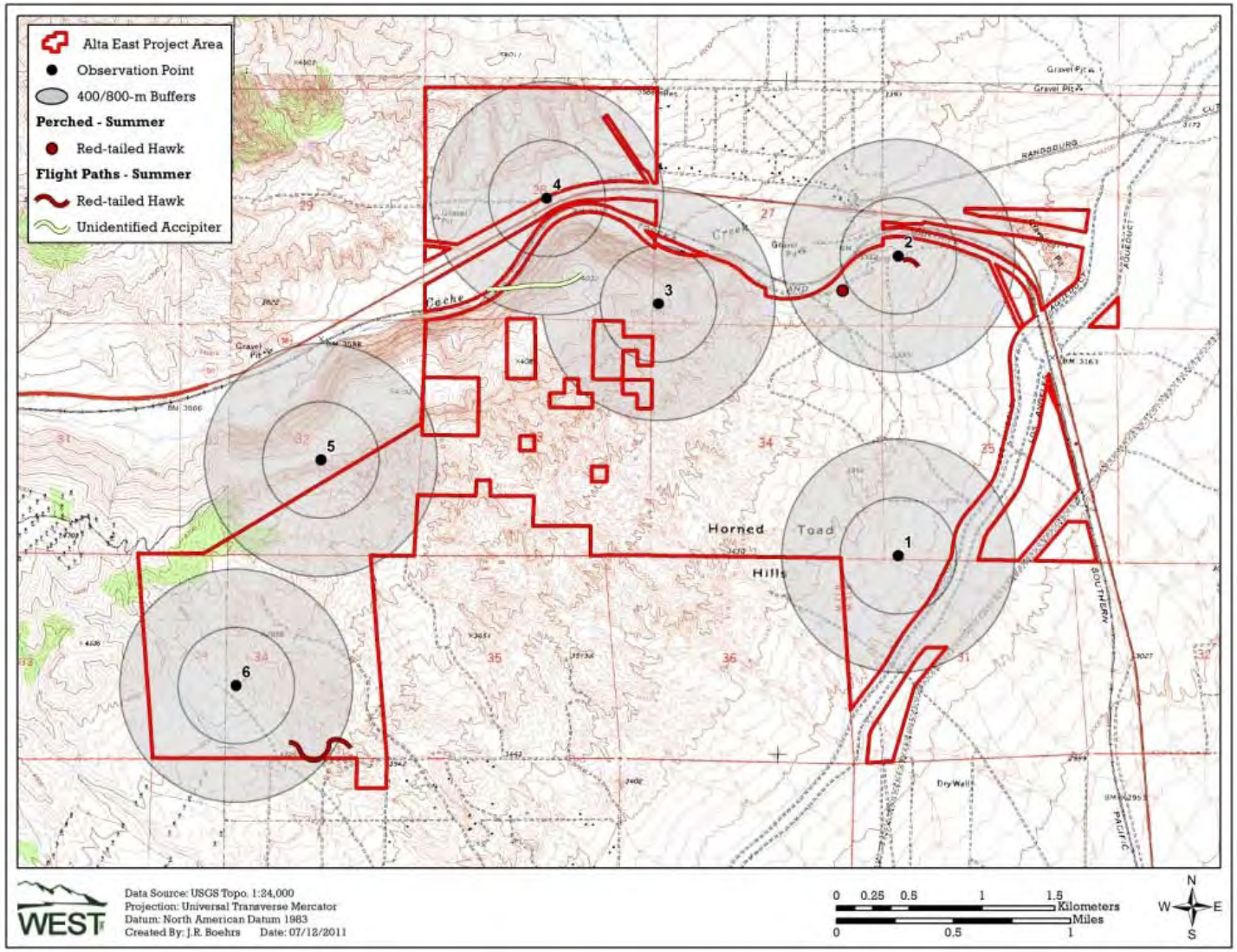


Appendix B2 (*continued*). Mean bird use (number of birds/30-minute survey) at each fixed-point bird use point for all birds and major bird types at the Alta East Wind Resource Area.

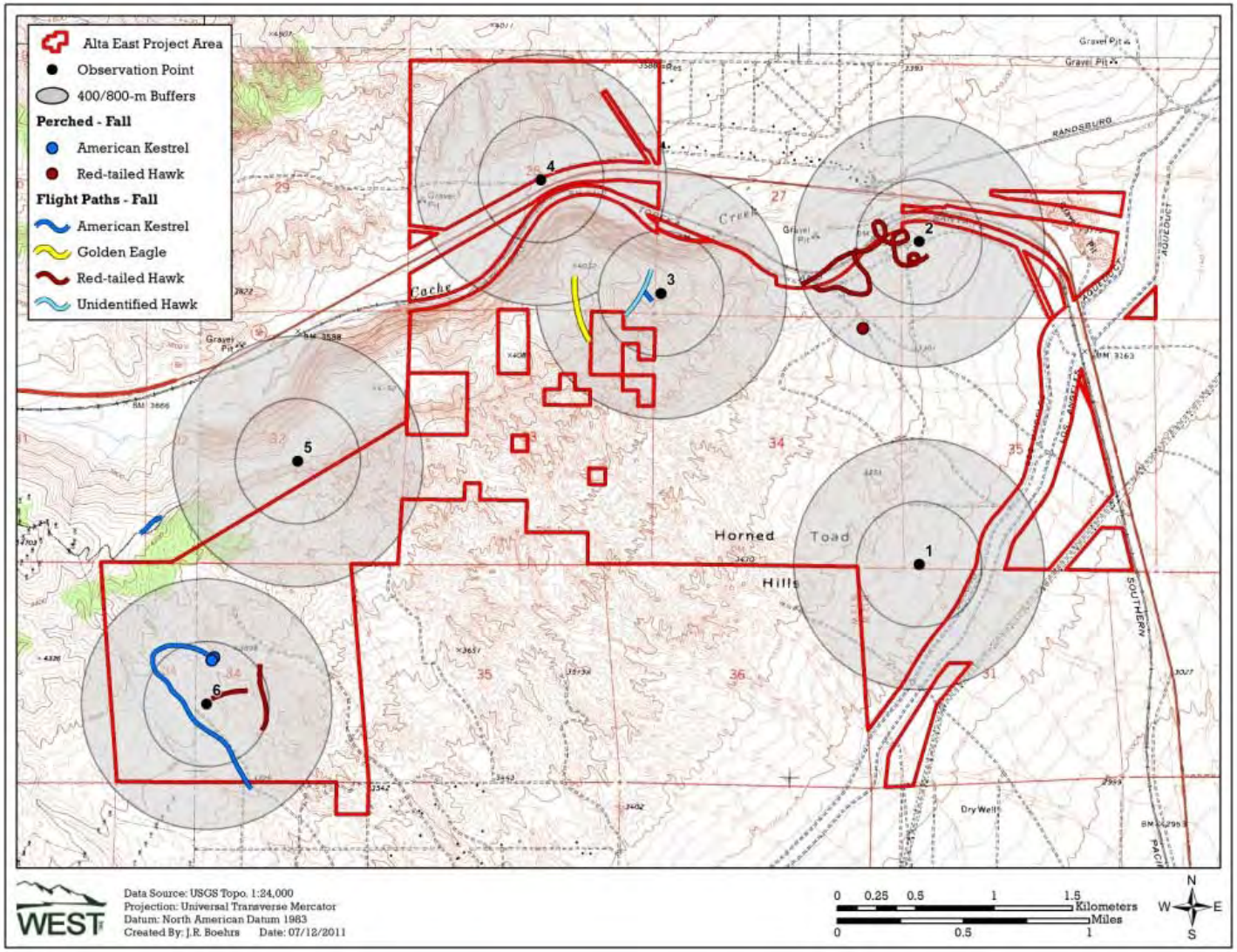
Appendix C. Flight Paths of Raptors and Vultures Observed During Fixed-Point Bird Use Surveys Conducted During Each Season at the Alta East Wind Resource Area



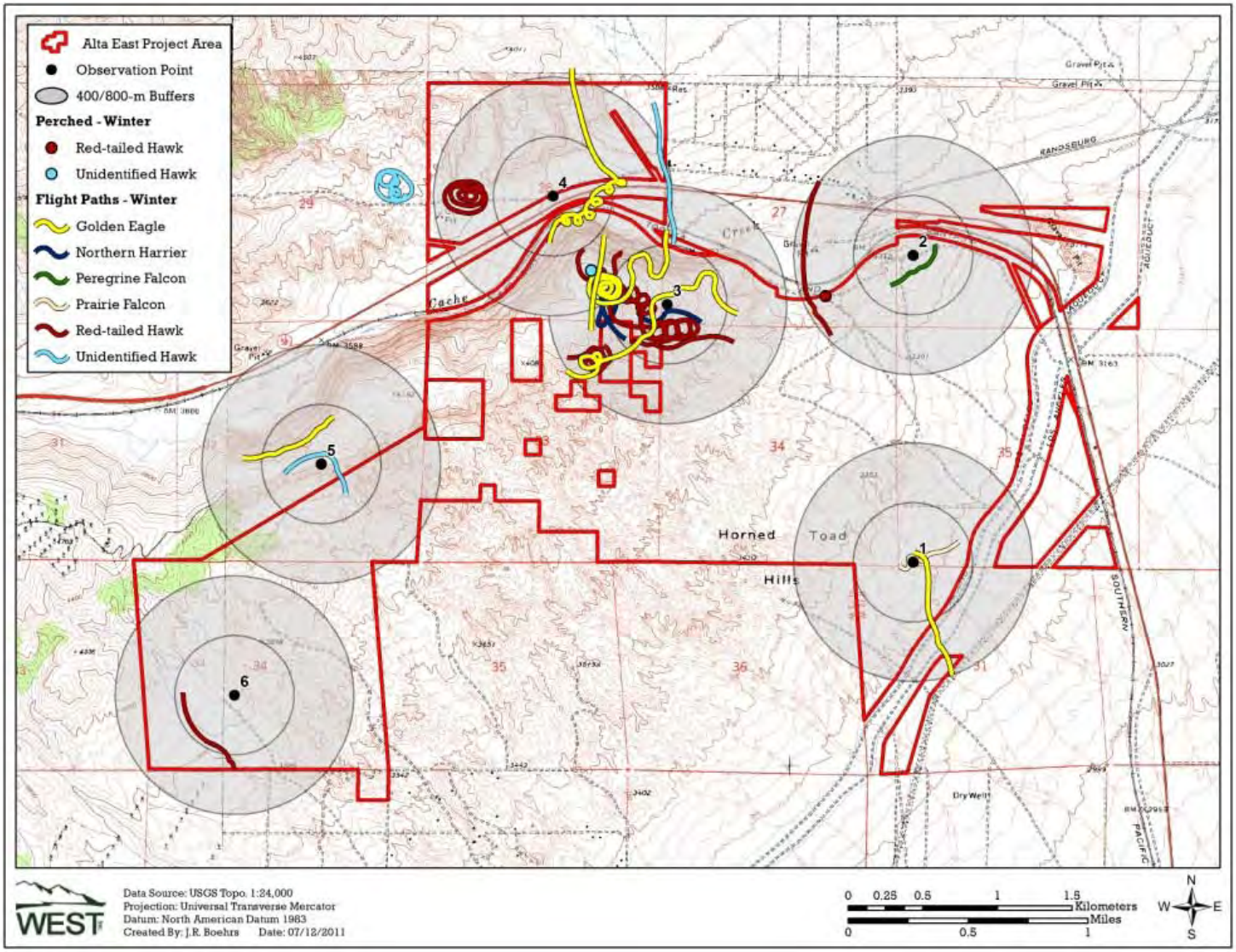
Appendix C1. Flight paths of raptors and vultures observed during fixed-point bird use surveys conducted in spring (March 1 – May 31, 2011) at the Alta East Wind Resource Area.



Appendix C2. Flight paths of raptors and vultures observed during fixed-point bird use surveys conducted in summer (June 1 – August 31, 2010) at the Alta East Wind Resource Area.



Appendix C3. Flight paths of raptors and vultures observed during fixed-point bird use surveys conducted in fall (September 1 – November 15, 2010) at the Alta East Wind Resource Area.



Appendix C4. Flight paths of raptors and vultures observed during fixed-point bird use surveys conducted in winter (November 16, 2010 – February 28, 2011) at the Alta East Wind Resource Area.

Appendix D. North American Fatality Comparison Tables

Appendix D1. Wind energy facilities in North America with fatality data for all bird species, grouped by geographic region.

Wind Energy Facility	Fatality Estimate[A]	No. of Turbines	Total MW
California			
Altamont Pass, CA	9.57	over 5,000	about 550
Pine Tree, CA	8.3*	90	135
Dillon, CA	4.71	45	45
Diablo Winds, CA	4.29	31	20
High Winds, CA (2004)	1.62	90	162
High Winds, CA (2005)	1.10	90	162
SMUD Solano, CA	0.99		15
Alite, CA	0.55	8	24
Pacific Northwest			
Leaning Juniper, OR	6.66	67	100.5
Stateline, OR/WA (2002)	3.17	454	263
Klondike II, OR	3.10	50	75
Klondike III, OR	3.02	122	375
Hopkins Ridge, WA (2008)	2.99	83	150
Nine Canyon, WA	2.76	37	48
Stateline, OR/WA (2003)	2.68	454	263
Combine Hills, OR	2.56	41	41
Big Horn, WA	2.54	133	199.5
Biglow Canyon, OR (Phase I; 2009)	2.47	76	125.4
Biglow Canyon, OR (Phase I; 2008)	1.76	76	125.4
Wild Horse, WA	1.55	127	229
Stateline II, OR/WA (2006)	1.23	454	263
Hopkins Ridge, WA (2006)	1.23	83	150
Vansycle, OR	0.95	38	24.9
Klondike, OR	0.95	16	24
Elkhorn, OR	0.64	61	101
Marengo I, WA	0.27	78	140.4
Marengo II, WA	0.16	39	70.2
Rocky Mountains			
Foote Creek Rim, WY (Phase I; 1999)	3.40	69	41.4
Judith Gap, MT	3.01	90	135
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. (2006)	1.06	39	70.2
Southern Plains			
Buffalo Gap, TX	1.32	67	134
Oklahoma Wind Energy Center, OK	0.08	68	102

Appendix D1. Wind energy facilities in North America with fatality data for all bird species, grouped by geographic region.

Wind Energy Facility	Fatality Estimate[A]	No. of Turbines	Total MW
Midwest			
Wessington Springs, SD	8.25	34	51
Blue Sky Green Field, WI	7.17	88	145
Cedar Ridge, WI	6.55	41	68
Buffalo Ridge, MN (Phase III; 1999)	5.93	138	103.5
Moraine II, MN	5.59	33	49.5
Buffalo Ridge I, SD	5.06	24	50.4
Winnebago, IA	3.88	10	20
Buffalo Ridge, MN (Phase II; 1999)	3.57	143	107.25
Ripley, Ont.	3.09	38	76
Buffalo Ridge, MN (Phase II; 1998)	2.46	143	107.25
Buffalo Ridge, MN (Phase I; 1996)	2.19	73	25
Kewaunee County, WI	1.98	31	20
Buffalo Ridge, MN (Phase I; 1998)	1.67	73	25
NPPD Ainsworth, NE	1.63	36	59.4
Elm Creek, MN	1.55	67	100
Buffalo Ridge, MN (Phase I; 1997)	1.33	73	25
Crescent Ridge, IL	0.87	33	49.5
Buffalo Ridge, MN (Phase I; 1999)	0.76	73	25
Top of Iowa, IA (2004)	0.73	89	80
Grand Ridge, IL	0.48	66	99
Top of Iowa, IA (2003)	0.42	89	80
Southeast			
Buffalo Mountain, TN (2000-2003)	13.93	3	1.98
Buffalo Mountain, TN (2005)	1.10	18	28.98
Northeast			
Maple Ridge, NY (2006)	5.81	120	198
Mount Storm, WV (2009)	5.73	82	164
Noble Ellenburg, NY (2009)	3.79	54	80
Maple Ridge, NY (2007)	3.44	195	321.75
Casselman, PA (Spring & Fall 2008)	3.13	23	34.5
Wolfe Island, Ont. (Report 1; May- June 2009)	3.04	86	197.8
Mountaineer, WV	3.00	44	66
Noble Bliss, NY (2008)	2.86	67	100
Noble Bliss, NY (2009)	2.81	67	100
Stetson Mountain, ME	2.68	38	57
Noble Clinton, NY (2008)	2.17	67	100
Maple Ridge, NY (2008)	2.07	195	321.75
Mount Storm, WV (2008)	1.91	82	164
Cohocton/Dutch Hill, NY	1.88	50	125
Mars Hill, ME (2008)	1.76	28	42
Mars Hill, ME (2007)	1.67	28	42
Munnsville, NY	1.48	23	34.5
Noble Ellenburg, NY (2008)	1.40	54	80
Noble Clinton, NY (2009)	1.17	67	100

A=number of bird fatalities/MW/study period

*fatality estimate corrected for mathematical error in number reported by BioResource Consultants (2010).

Appendix D1 (*continued*). Wind energy facilities in North America with fatality data for all bird species, grouped by geographic region.

Data from the following sources:

Wind Energy Facility	Fatality Estimate	Wind Energy Facility	Fatality Estimate
Altamont Pass, CA	ICF 2011	Moraine II, MN	Derby et al. 2010e
Pine Tree, CA	BRC 2010	Buffalo Ridge I, SD	Derby et al. 2010b
Dillon, CA	Chatfield et al. 2009	Winnebago, IA	Derby et al. 2010a
Diablo Winds, CA	WEST 2008	Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000a
High Winds, CA (04)	Kerlinger et al. 2006	Ripley, Ont.	Jacques Whitford 2009
High Winds, CA (05)	Kerlinger et al. 2006	Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000a
SMUD Solano, CA	Erickson and Sharp 2005	Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000a
Alite, CA	Chatfield et al. 2010a	Kewaunee County, WI	Howe et al. 2002
Leaning Juniper, OR	Gritski et al. 2008	Buffalo Ridge, MN (Phase I; 98)	Johnson et al. 2000a
Stateline, OR/WA (02)	Erickson et al. 2004	NPPD Ainsworth, NE	Derby et al. 2007
Klondike II, OR	NWC and WEST 2007	Elm Creek, MN	Derby et al. 2010d
Klondike III, OR	Gritski et al. 2009	Crescent Ridge, IL	Kerlinger et al. 2007
Hopkins Ridge, WA (08)	Young et al. 2009b	Buffalo Ridge, MN (Phase I; 97)	Johnson et al. 2000a
Nine Canyon, WA	Erickson et al. 2003c	Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000a
Stateline, OR/WA (03)	Erickson et al. 2004	Top of Iowa, IA (04)	Jain 2005
Combine Hills, OR	Young et al. 2006	Grand Ridge, IL	Derby et al. 2010g
Big Horn, WA	Kronner et al. 2008	Top of Iowa, IA (03)	Jain 2005
Biglow Canyon, OR (Phase I; 09)	Enk et al. 2010	Buffalo Mountain, TN (00-03)	Nicholson et al. 2005
Biglow Canyon I, OR (Phase I; 08)	Jeffrey et al. 2009a	Buffalo Mountain, TN (05)	Fiedler et al. 2007
Wild Horse, WA	Erickson et al. 2008	Maple Ridge, NY (06)	Jain et al. 2007
Stateline II, OR/WA	Erickson et al. 2007	Mount Storm, WV (09)	Young et al. 2010
Hopkins Ridge, WA (06)	Young et al. 2007a	Noble Ellenburg, NY (09)	Jain et al. 2010c
Vansycle, OR	Erickson et al. 2000	Maple Ridge, NY (07)	Jain et al. 2008
Klondike, OR	Johnson et al. 2003	Casselman, PA (Spring & Fall 08)	Arnett et al. 2009
Elkhorn, OR	Jeffrey et al. 2009b	Wolfe Island, Ont. (Report 1: May - June 09)	Stantec Ltd. 2010
Marengo I, WA	URS Corporation 2010a	Mountaineer, WV	Kerns and Kerlinger 2004
Marengo II, WA	URS Corporation 2010b	Noble Bliss, NY (08)	Jain et al. 2009e
Foote Creek Rim, WY (Phase I; 99)	Young et al. 2003c	Noble Bliss, NY (09)	Jain et al. 2010a
Judith Gap, MT	TRC 2008	Stetson Mountain, ME	Stantec 2009b
Foote Creek Rim, WY (Phase I; 00)	Young et al. 2003c	Noble Clinton, NY (08)	Jain et al. 2009c
Foote Creek Rim, WY (Phase I; 01/02)	Young et al. 2003c	Maple Ridge, NY (08)	Jain et al. 2009d
Summerview, Alb. (06)	Brown and Hamilton 2006	Mount Storm, WV (08)	Young et al. 2009a
Buffalo Gap, TX	Tierney 2007	Cohocton/Dutch Hill, NY	Stantec 2010
Oklahoma Wind Energy Center, OK	Piorkowski 2006	Mars Hill, ME (08)	Stantec 2009a
Wessington Springs, SD	Derby et al. 2010f	Mars Hill, ME (07)	Stantec 2008a
Blue Sky Green Field, WI	Gruver et al. 2009	Munnsville, NY	Stantec 2008b
Cedar Ridge, WI	BHE Environmental 2010	Noble Ellenburg, NY (08)	Jain et al. 2009b
Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000a	Noble Clinton, NY (09)	Jain et al. 2010b

Appendix D2. Comparison of raptor use estimates and raptor fatality estimates between the Alta East Wind Resource Area and other wind energy facilities in North America.

Wind Energy Facility	Use Estimate[A]	Raptor Fatality Rate[B]	# of Turbines	Total (MW)
Alta East, CA (2010-2011)	0.12			
Alta East, CA (2009-2010)	0.09			
California				
Altamont Pass, CA	1.62	2.18	over 5,000	over 550
Diablo Winds, CA	2.16	0.87	31	20
Pine Tree, CA		0.40*	90	135
SMUD Solano, CA		0.53		15
Alite, CA		0.12	8	24
Dillon, CA		0	45	45
Pacific Northwest				
Leaning Juniper, OR	0.52	0.21	67	100.5
Klondike III, OR		0.15	122	375
Big Horn, WA	0.51	0.15	133	199.5
Hopkins Ridge, WA (2006)	0.70	0.14	83	150
Stateline, OR/WA (2006)		0.11	454	263
Klondike II, OR	0.50	0.11	50	75
Stateline, OR/WA (2002)	0.23	0.09	454	263
Stateline, OR/WA (2003)	0.21	0.09	454	263
Wild Horse, WA	0.29	0.09	127	229
Hopkins Ridge, WA (2008)		0.07	83	150
Elkhorn, OR (2008)		0.06	61	101
Nine Canyon, WA		0.05	37	48
Marengo II, WA (2009)		0.05	39	70.2
Biglow Canyon, WA (Phase I; 2009)		0.04	76	125.4
Biglow Canyon, WA (Phase I; 2008)		0.03	76	125.4
Combine Hills, OR	0.75	0	41	41
Vansycle, OR	0.66	0	38	24.9
Klondike, OR	0.50	0	16	24
Marengo I, WA (2009)		0	78	140.4
Rocky Mountains				
Summerview, Alb. (2006)		0.11	39	70.2
Judith Gap, MT		0.09	90	135
Foote Creek Rim, WY (Phase I; 1999)		0.08	69	41.4
Foote Creek Rim, WY (Phase I; 2000)		0.05	69	41.4
Foote Creek Rim, WY (Phase I; 2001-2002)		0	69	41.4
Southern Plains				
Buffalo Gap, TX		0.10	67	134
Oklahoma Wind Energy Center, OK		0	68	102
Midwest				
Moraine II, MN		0.37	33	49.5
Winnebago, IA		0.27	10	20
Buffalo Ridge I, SD		0.20	24	50.4
NPPD Ainsworth, NE		0.06	36	59.4
Grand Ridge, IL	0.20	0	66	99
Blue Sky Green Field, WI		0	88	145
Elm Creek, MN		0	67	100

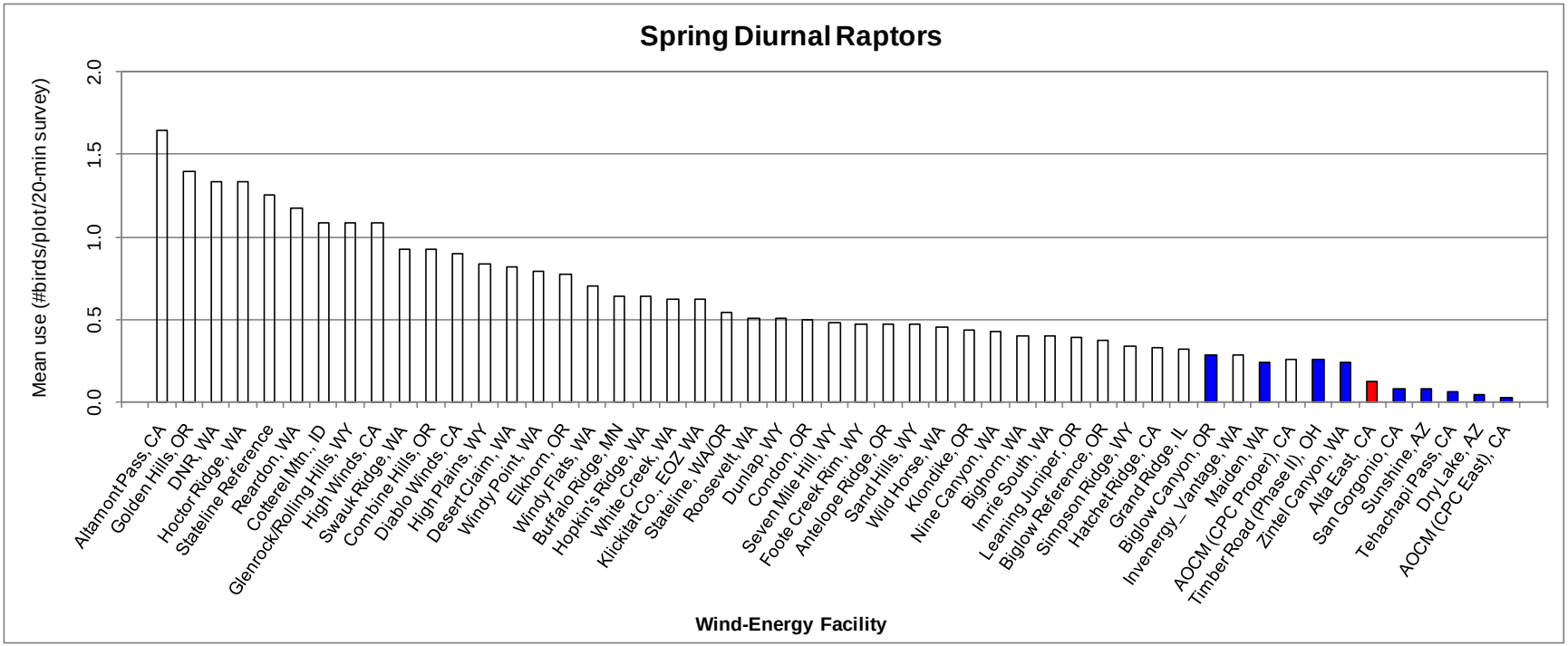
Appendix D2. Comparison of raptor use estimates and raptor fatality estimates between the Alta East Wind Resource Area and other wind energy facilities in North America.

Wind Energy Facility	Use Estimate[A]	Raptor Fatality Rate[B]	# of Turbines	Total (MW)
		Southeast		
Buffalo Mountain, TN (2005)		0	18	29
Buffalo Mountain, TN (2000-2003)		0	3	1.98
		Northeast		
Noble Ellenburg, NY (2009)		0.49	54	80
Noble Ellenburg, NY (2008)		0.32	54	80
Noble Clinton, NY (2008)		0.29	67	100.5
Maple Ridge, NY (2007)		0.25	195	321.75
Noble Clinton, NY (2009)		0.24	67	100
Noble Bliss, NY (2008)		0.19	67	100
Noble Bliss, NY (2009)		0.18	67	100
Maple Ridge, NY (2006)		0.04	120	198
Wolfe Island, Ont. (Report 1; May- June 2009)		0.04	86	197.8
Maple Ridge, NY (2008)		0.03	195	321.75
Mount Storm, WV (2008)		0	82	164

A=number of raptors/plot/20min survey
B=number of fatalities/MW/study period
* fatality estimate reported for Pine Tree was for large birds (16-32 inches), not raptors specifically; estimate corrected for mathematical error in number reported by BioResource Consultants (2010).
Data from the following sources:

Wind Energy Facility	Use Estimate	Fatality Estimate
Alta East, CA (10-11)	This study	
Alta East, CA (09-10)	Chatfield et al. 2010c	
Altamont Pass, CA	Erickson et al. 2002b	ICF 2011
Diablo Winds, CA	WEST 2006	WEST 2008
Pine Tree		BRC 2010
SMUD Solano, CA		Erickson and Sharp 2005
Alite, CA		Chatfield et al. 2010a
Dillon, CA		Chatfield et al. 2009
Leaning Juniper, OR	Kronner et al. 2005	Gritski et al. 2008
Klondike III, OR		Gritski et al. 2009
Big Horn, WA	Johnson and Erickson 2004	Kronner et al. 2008
Hopkins Ridge, WA (06)	Young et al. 2003a	Young et al. 2007a
Stateline, OR/WA (06)		Young et al. 2007a
Klondike II, OR	Johnson 2004	NWC and WEST 2007
Stateline, OR/WA (02)	Erickson et al. 2002b	Erickson et al. 2004
Stateline, OR/WA (03)	Erickson et al. 2003b	Erickson et al. 2004
Wild Horse, WA	Erickson et al. 2003d	Erickson et al. 2008
Hopkins Ridge, WA (08)		Young et al. 2009b
Elkhorn, OR		Jeffrey et al. 2009b
Nine Canyon, WA	Erickson et al. 2001b	Erickson et al. 2003c
Marengo II, WA		URS Corporation 2010b
Biglow Canyon, WA (Phase I; 09)		Enk et al. 2010
Biglow Canyon, WA (Phase I; 08)		Jeffrey et al. 2009a
Combine Hills, OR	Young et al. 2003d	Young et al. 2006
Vansycle, OR	WCIA and WEST 1997	Erickson et al. 2000
Marengo II, WA		URS Corporation 2010b
Klondike, OR	Johnson et al. 2002	Johnson et al. 2003
Marengo I, WA		URS Corporation 2010a
Summerview, Alb. (06)		Brown and Hamilton 2006
Judith Gap, MT		TRC 2008
Foote Creek Rim, WY (Phase I; 99)		Young et al. 2003c
Foote Creek Rim, WY (Phase I; 00)		Young et al. 2003c
Foote Creek Rim, WY (Phase I; 01/02)		Young et al. 2003c
Buffalo Gap, TX		Tierney 2007
Oklahoma Wind Energy Center, OK		Piorkowski 2006
Moraine II, MN		Derby et al. 2010e
Winnebago, IA		Derby et al. 2010a
Buffalo Ridge, SD		Derby et al. 2010b
NPPD Ainsworth, NE		Derby et al. 2007
Grand Ridge, IL	Derby et al. 2009	Derby et al. 2010g
Blue Sky Green Field, WI		Gruver et al. 2009
Elm Creek, MN		Derby et al. 2010c
Buffalo Mountain, TN (05)		Fiedler et al. 2007
Buffalo Mountain, TN (00-03)		Nicholson 2003, Nicholson et al. 2005
Noble Ellenburg, NY (09)		Jain et al. 2010c
Noble Ellenburg, NY (08)		Jain et al. 2009b
Noble Clinton, NY (08)		Jain et al. 2009c
Maple Ridge, NY (07)		Jain et al. 2009a
Noble Clinton, NY (09)		Jain et al. 2010b
Noble Bliss, NY (08)		Jain et al. 2009e
Noble Bliss, NY (09)		Jain et al. 2010a
Maple Ridge, NY (06)		Jain et al. 2007
Wolfe Island, Ont. (Report 1: May - June 09)		Stantec Ltd. 2010
Maple Ridge, NY (08)		Jain et al. 2009d
Mount Storm, WV (08)		Young et al. 2009a

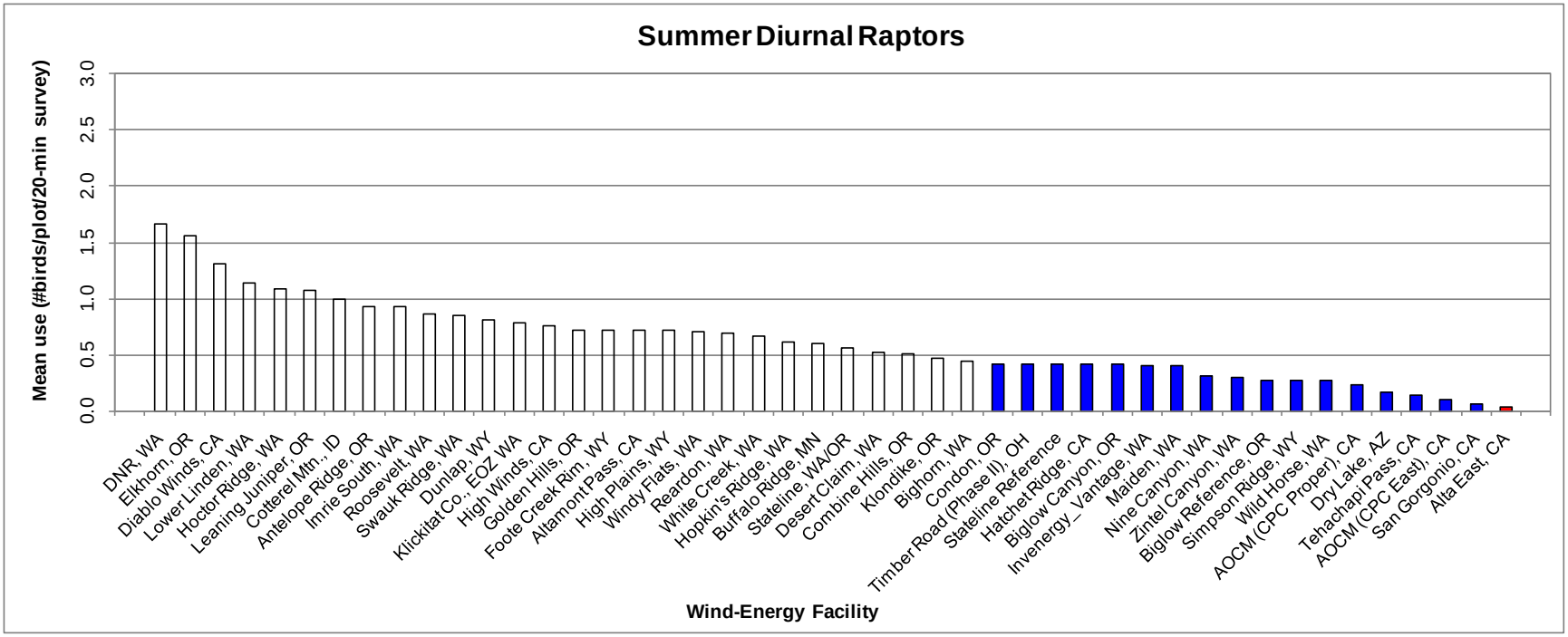
Appendix E. Comparison of Seasonal Raptor Use Between the Alta East Wind Resource Area and Other Wind Energy Facilities in the United States



Appendix E1. Comparison of spring raptor use between the Alta East Wind Resource Area and other wind energy facilities in the United States.

Data from the following sources:

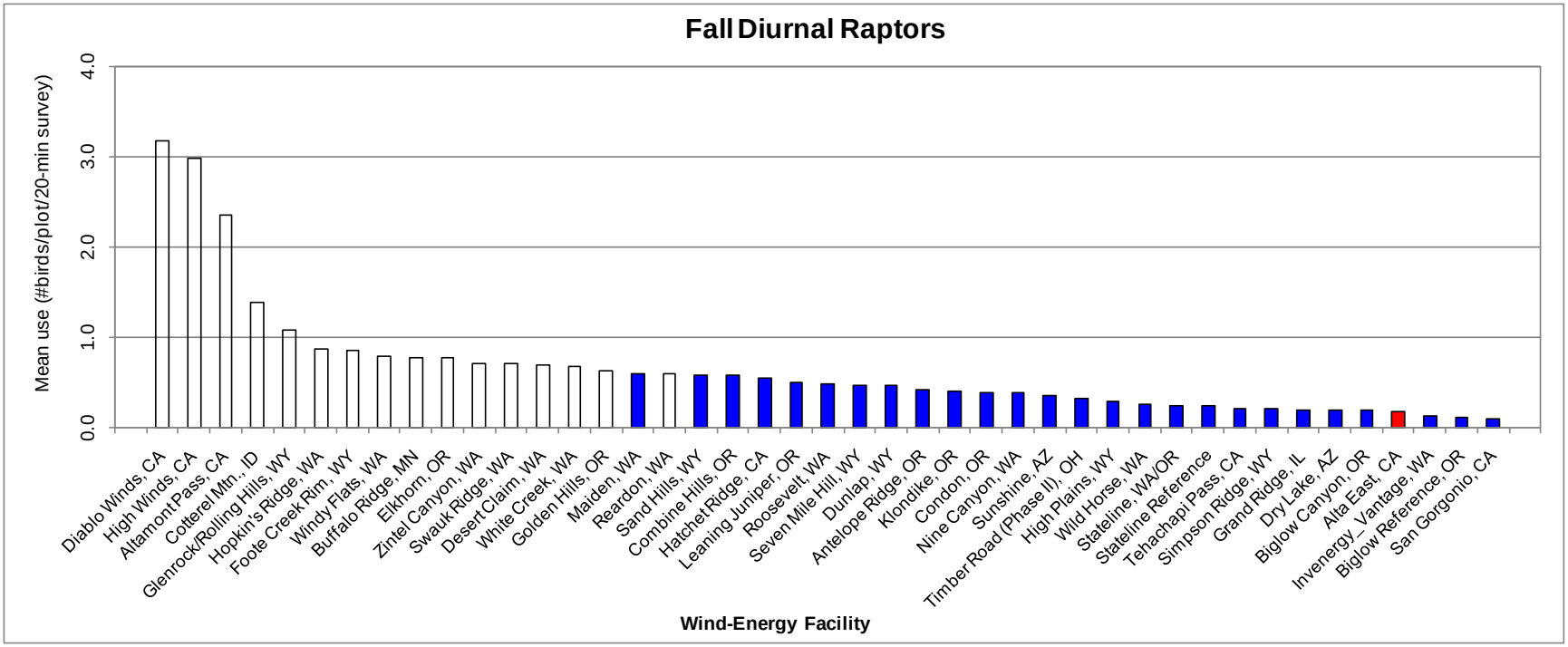
Wind Energy Facility	Reference	Wind Energy Facility	Reference	Wind Energy Facility	Reference
Alta East, CA	This study.				
Altamont Pass, CA	Erickson et al. 2002b	Buffalo Ridge, MN	Erickson et al. 2002b	Leaning Juniper, OR	Kronner et al. 2005
Golden Hills, OR	Jeffrey et al. 2008	Hopkin's Ridge, WA	Young et al. 2003a	Biglow Reference, OR	WEST 2005d
DNR, WA	Johnson et al. 2006c	White Creek, WA	NWC and WEST 2005	Simpson Ridge, WY	Johnson et al. 2000b
Hoctor Ridge, WA	Johnson et al. 2006d	Klickitat Co., EOZ WA	WEST and NWC 2003	Hatchet Ridge, CA	Young et al. 2007b
Stateline Reference	URS et al. 2001	Stateline, WA/OR	Erickson et al. 2002b	Grand Ridge, IL	Derby et al. 2009
Reardon, WA	WEST 2005b	Roosevelt, WA	NWC and WEST 2004	Biglow Canyon, OR	WEST 2005d
Cotterel Mtn., ID	BLM 2006	Dunlap, WY	Johnson et al. 2009a	Invenergy_Vantage, WA	WEST 2007
Glenrock/Rolling Hills, WY	Johnson et al. 2008a	Condon, OR	Erickson et al. 2002b	Maiden, WA	Erickson et al. 2002b
High Winds, CA	Kerlinger et al. 2005	Seven Mile Hill, WY	Johnson et al. 2008b	AOCM (CPC Proper), CA	Chatfield et al. 2010c
Swauk Ridge, WA	Erickson et al. 2003a	Foote Creek Rim, WY	Erickson et al. 2002b	Timber Road (Phase II), OH	Good et al. 2010
Combine Hills, OR	Young et al. 2003d	Sand Hills, WY	Johnson et al. 2006a	Zintel Canyon, WA	Erickson et al. 2002a
Diablo Winds, CA	WEST 2006	Antelope Ridge, OR	WEST 2009	San Gorgonio, CA	Erickson et al. 2002b
High Plains, WY	Johnson et al. 2009b	Wild Horse, WA	Erickson et al. 2003d	Sunshine, AZ	WEST and the CPRS 2006
Desert Claim, WA	Young et al. 2003b	Klondike, OR	Johnson et al. 2002	Tehachapi Pass, CA	Erickson et al. 2002b
Windy Point, WA	Johnson et al. 2006b	Nine Canyon, WA	Erickson et al. 2001b	Dry Lake, AZ	Young et al. 2007c
Elkhorn, OR	WEST 2005a	Bighorn, WA	Johnson and Erickson 2004	AOCM (CPC East, CA)	Chatfield et al. 2010c
Windy Flats, WA	Johnson et al. 2007b	Imrie South, WA	Johnson et al. 2006e		



Appendix E2. Comparison of summer raptor use between the Alta East Wind Resource Area and other wind energy facilities in the United States.

Data from the following sources:

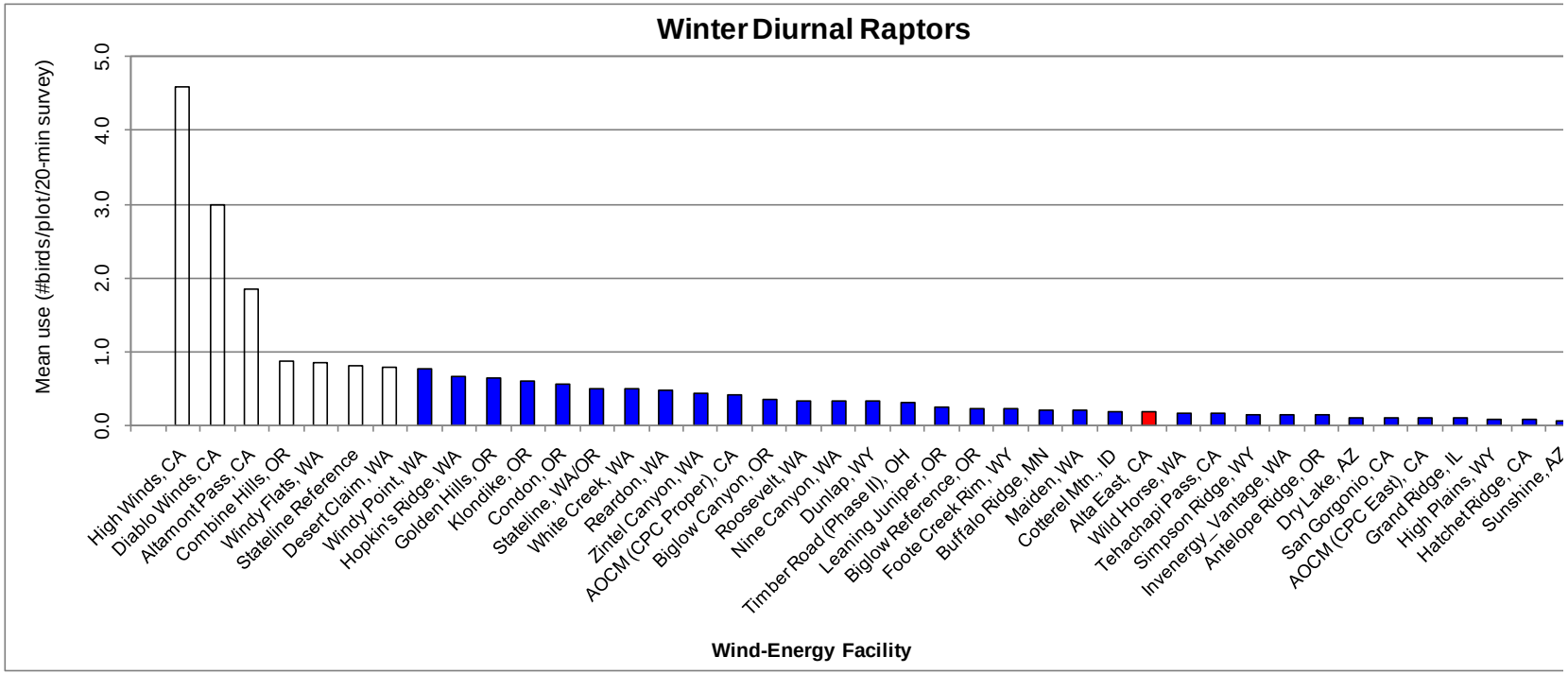
Wind Energy Facility	Reference	Wind Energy Facility	Reference	Wind Energy Facility	Reference
Alta East, CA	This study.				
DNR, WA	Johnson et al. 2006c	Foote Creek Rim, WY	Erickson et al. 2002b	Stateline Reference	URS et al. 2001
Elkhorn, OR	WEST 2005a	Altamont Pass, CA	Erickson et al. 2002b	Hatchet Ridge, CA	Young et al. 2007b
Diablo Winds, CA	WEST 2006	High Plains, WY	Johnson et al. 2009b	Biglow Canyon, OR	WEST 2005d
Lower Linden, WA	Johnson et al. 2007a	Windy Flats, WA	Johnson et al. 2007b	Invenergy_Vantage, WA	WEST 2007
Hoctor Ridge, WA	Johnson et al. 2006d	Reardon, WA	WEST 2005b	Maiden, WA	Erickson et al. 2002b
Leaning Juniper, OR	Kronner et al. 2005	White Creek, WA	NWC and WEST 2005	Nine Canyon, WA	Erickson et al. 2001b
Cotterel Mtn., ID	BLM 2006	Hopkin's Ridge, WA	Young et al. 2003a	Zintel Canyon, WA	Erickson et al. 2002a
Antelope Ridge, OR	WEST 2009	Buffalo Ridge, MN	Erickson et al. 2002b	Biglow Reference, OR	WEST 2005d
Imrie South, WA	Johnson et al. 2006e	Stateline, WA/OR	Erickson et al. 2002b	Simpson Ridge, WY	Johnson et al. 2000b
Roosevelt, WA	NWC and WEST 2004	Desert Claim, WA	Young et al. 2003b	Wild Horse, WA	Erickson et al. 2003d
Swauk Ridge, WA	Erickson et al. 2003a	Combine Hills, OR	Young et al. 2003d	AOCM (CPC Proper), CA	Chatfield et al. 2010c
Dunlap, WY	Johnson et al. 2009a	Klondike, OR	Johnson et al. 2002	Dry Lake, AZ	Young et al. 2007c
Klickitat Co., EOZ WA	WEST and NWC 2003	Bighorn, WA	Johnson and Erickson 2004	Tehachapi Pass, CA	Erickson et al. 2002b
High Winds, CA	Kerlinger et al. 2005	Condon, OR	Erickson et al. 2002b	AOCM (CPC East), CA	Chatfield et al. 2010c
Golden Hills, OR	Jeffrey et al. 2008	Timber Road (Phase II), OH	Good et al. 2010	San Gorgonio, CA	Erickson et al. 2002b



Appendix E3. Comparison of fall raptor use between the Alta East Wind Resource Area and other wind energy facilities in the United States.

Data from the following sources:

Wind Energy Facility	Reference	Wind Energy Facility	Reference	Wind Energy Facility	Reference
Alta East, CA	This study.				
Diablo Winds, CA	WEST 2006	Golden Hills, OR	Jeffrey et al. 2008	Sunshine, AZ	WEST and CPRS 2006
High Winds, CA	Kerlinger et al. 2005	Maiden, WA	Erickson et al. 2002b	Timber Road (Phase II), OH	Good et al. 2010
Altamont Pass, CA	Erickson et al. 2002b	Reardon, WA	WEST 2005b	High Plains, WY	Johnson et al. 2009b
Cotterel Mtn., ID	BLM 2006	Sand Hills, WY	Johnson et al. 2006a	Wild Horse, WA	Erickson et al. 2003d
Glenrock/Rolling Hills, WY	Johnson et al. 2008a	Combine Hills, OR	Young et al. 2003d	Stateline, WA/OR	Erickson et al. 2002b
Hopkin's Ridge, WA	Young et al. 2003a	Hatchet Ridge, CA	Young et al. 2007b	Stateline Reference	URS et al. 2001
Foote Creek Rim, WY	Erickson et al. 2002b	Leaning Juniper, OR	Kronner et al. 2005	Tehachapi Pass, CA	Erickson et al. 2002b
Windy Flats, WA	Johnson et al. 2007b	Roosevelt, WA	NWC and WEST 2004	Simpson Ridge, WY	Johnson et al. 2000b
Buffalo Ridge, MN	Erickson et al. 2002b	Seven Mile Hill, WY	Johnson et al. 2008b	Grand Ridge, IL	Derby et al. 2009
Elkhorn, OR	WEST 2005a	Dunlap, WY	Johnson et al. 2009a	Dry Lake, AZ	Young et al. 2007c
Zintel Canyon, WA	Erickson et al. 2002a	Antelope Ridge, OR	WEST 2009	Biglow Canyon, OR	WEST 2005d
Swauk Ridge, WA	Erickson et al. 2003a	Klondike, OR	Johnson et al. 2002	Invenergy_Vantage, WA	WEST 2007
Desert Claim, WA	Young et al. 2003b	Condon, OR	Erickson et al. 2002b	Biglow Reference, OR	WEST 2005d
White Creek, WA	NWC and WEST 2005	Nine Canyon, WA	Erickson et al. 2001b	San Gorgonio, CA	Erickson et al. 2002b



Appendix E4. Comparison of winter raptor use between the Alta East Wind Resource Area and other wind energy facilities in the United States.

Data from the following sources:

Wind Energy Facility	Reference	Wind Energy Facility	Reference	Wind Energy Facility	Reference
Alta East, CA	This study.				
High Winds, CA	Kerlinger et al. 2005	Reardon, WA	WEST 2005b	Wild Horse, WA	Erickson et al. 2003d
Diablo Winds, CA	WEST 2006	Zintel Canyon, WA	Erickson et al. 2002a	Tehachapi Pass, CA	Erickson et al. 2002b
Altamont Pass, CA	Erickson et al. 2002b	AOCM (CPC Proper), CA	Chatfield et al. 2010c	Simpson Ridge, WY	Johnson et al. 2000b
Combine Hills, OR	Young et al. 2003d	Biglow Canyon, OR	WEST 2005d	Invenergy_Vantage, WA	WEST 2007
Windy Flats, WA	Johnson et al. 2007b	Roosevelt, WA	NWC and WEST 2004	Antelope Ridge, OR	WEST 2009
Stateline Reference	URS et al. 2001	Nine Canyon, WA	Erickson et al. 2001b	Dry Lake, AZ	Young et al. 2007c
Desert Claim, WA	Young et al. 2003b	Dunlap, WY	Johnson et al. 2009a	San Gorgonio, CA	Erickson et al. 2002b
Windy Point, WA	Johnson et al. 2006b	Leaning Juniper, OR	Kronner et al. 2005	AOCM (CPC East), CA	Chatfield et al. 2010c
Hopkins Ridge, WA	Young et al. 2003a	Biglow Reference, OR	WEST 2005d	Grand Ridge, IL	Derby et al. 2009
Golden Hills, OR	Jeffrey et al. 2008	Foote Creek Rim, WY	Erickson et al. 2002b	High Plains, WY	Johnson et al. 2009b
Klondike, OR	Johnson et al. 2002	Buffalo Ridge, MN	Erickson et al. 2002b	Hatchet Ridge, CA	Young et al. 2007b
Condon, OR	Erickson et al. 2002b	Maiden, WA	Erickson et al. 2002b	Sunshine, AZ	WEST and CPRS 2006
Stateline, WA/OR	Erickson et al. 2002b	Cotterel Mtn., ID	BLM 2006		
White Creek, WA	NWC and WEST 2005	Timber Road (Phase II), OH	Good et al. 2010		