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WEST's Wildlife Baseline Studies for the Lower Snake River Wind Resource Area, Columbia and Garfield Counties, Washington

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Wildlife Baseline Studies for the Lower Snake River Wind Resource Area Columbia and Garfield Counties, Washington

Final Report
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EXECUTIVE SUMMARY

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1.0 INTRODUCTION

Renewable Energy Systems, Ltd. (RES) and Puget Sound Energy (PSE) have proposed a wind-energy facility in Columbia and Garfield Counties, Washington. RES/PSE contracted Western Ecosystems Technology, Inc. (WEST) to conduct surveys of wildlife resources throughout the Lower Snake River Wind Resource Area (LSRWRA) to provide information on the baseline conditions and that would be useful in assessing potential impacts of wind-energy facility construction and operations on wildlife. The LSRWRA is located north of three existing operational wind energy facilities: Hopkins Ridge, Marengo I, and Marengo II (Figure 1.1).

The principal objectives of the study were to: (1) provide site-specific bird and bat resource and use data that would be useful in evaluating potential impacts from the proposed wind-energy facility, (2) provide information that could be used in project planning and design of the facility to minimize impacts to birds and bats, and (3) recommend further studies or potential mitigation measures, if warranted. The protocols for the baseline studies are similar to those used at other wind-energy facilities within the Pacific Northwest and Columbia Plateau Ecoregion (CPE), and follow guidance of the National Wind Coordinating Collaborative (Anderson et al. 1999) and the Washington Department of Fish and Wildlife (WDFW 2009). The survey protocols have been developed based on WEST's experience studying wildlife at proposed wind-energy facilities throughout the US; and were designed to help assess potential impacts to bird (particularly raptors) and bat species.

Baseline surveys were conducted from April 9, 2007 through January 14, 2009 at various project areas within the LSRWRA. Study components included fixed-point bird use surveys, raptor nest surveys, acoustic bat surveys, and incidental and sensitive-species wildlife observations. 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 bird mortality within the proposed LSRWRA is enhanced by operational monitoring data collected at existing wind-energy facilities. For several wind-energy facilities throughout the CPE, standardized data on fixed-point surveys were collected in association with standardized post-construction (operational) monitoring, allowing comparisons of bird use with bird mortality. Comparison with these CPE regional studies provide an impact assessment tool based on regional information.

Due to the LSRWRA being comprised of four separate project areas encompassing a large area, avian use data is presented separately and for each project area. Analyses are presented for the overall LSRWRA in this report. Further detail is provided for each of the four wind resource areas that make up the LSRWRA within the attached Appendices.

Figure 1.1 Lower Snake River Wind Resource Area location

2.0 STUDY AREA

The LSRWRA is located between the towns of Pomeroy, Starbuck, and Dayton, Washington. The LSRWRA consists of four, smaller project areas identified as Tucannon, Oliphant, Kuhl Ridge, Dutch Flats (Figure 2.1). The LSRWRA is within the Columbia Plateau physiographic province and adjacent the Blue Mountains sub-province to the southeast (Franklin and Dyrness 1988). The landscape of this region consists of incised rivers, extensive plateaus and ridges, and basaltic outcrops and cliffs. The elevation of the project area ranges from approximately 525 feet to 1,760 feet (160-1,760 m; Figure 2.2). The proposed wind resource area is dominated by grassland and agricultural crop land cover/habitats (Figure 2.3). The LSRWRA project area abuts the transition zone between grassland/shrub-steppe and coniferous vegetation zones. The Tucannon River and Pataha Creek corridors bisect the LSRWRA from the northwest to the southeast. The majority of the lands in the study area are privately owned.

Dominant vegetation of the LSRWRA is a mix of rangeland (grassland and/or shrub steppe), Conservation Reserve Program (CRP), or dryland agriculture (Figure 3.3 Approximately 51% of the nearly 128,482.46-acre (200.75 mi^2; 519.95 km^2) area is composed of crops (Table 2.1). Dryland agriculture (cropland) is planted primarily in wheat. Rangeland consists of steppe types that are primarily grass dominated areas with predominantly native bunchgrasses [e.g., Idaho fescue (*Festuca idahoensis*) and bluebunch wheatgrass (*Agropyron spicatum*)] and exotic annuals such as the introduced cheatgrass (*Bromus tectorum*). Of the rangland, grassland comprises 30.5% while shrub/scrub comprises 15.3% of the LSRWRA (Table 2.1). Typical shrubs include sagebrush (*Artemisia* spp.) and rabbitbrush (*Chrysothamnus* spp.). Rangeland also consists of areas located in drainages, ravines, and some slopes of north/northeasterly aspect that harbor larger shrubs such as wild rose (*Rosa* spp.), chokecherry (*Prunus virginiana*), Indian plum (*Oemleria cerasiformis*), hawthorn (*Crataegus* spp.), serviceberry (*Amelanchier* spp.), and snowberry (*Symphoricarpos* spp.; Figure 2.3). The majority of rangeland is grazed by domestic livestock, primarily cattle. Trees are sparse within the project area, with bands and small islands of deciduous trees scattered patchily across the LSRWRA upland areas. Coniferous trees become more prevalent in the southeastern region of the area, primarily on lower elevation slopes and more limited in uplands. Stands of deciduous trees, some conifers, and riparian shrubs and wetlands of various sizes exist along the Pataha Creek and Tucannon River floodplains.

The study area includes the proposed wind power development area and an adjacent buffer of variable width depending on the study component. The primary study area includes the proposed development area or the location where wind turbines and associated facilities such as met towers, substations, roads, operations and maintenance facility, collector lines, powerlines, and construction permit areas for gravel/borrow material, plant sites, equipment storage or lay-down areas, parking areas, would occur. At the time of the project set-up, a conceptual wind project design and a list of participating landowner (leased lands) were used to define the boundaries of the primary study area. All avian use surveys, bat acoustic surveys, general wildlife observations, and vegetation surveys occurred within the primary study area. The raptor nest study area included the primary study area and the surrounding area within two miles (3.2 kilometers [km]).

Table 2.1 The land cover types, coverage, and composition within the Lower Snake River Wind Resource Area.

Habitat	Acres	% Composition
Developed, Low Intensity	2,610.50	2.0
Developed, Medium Intensity	118.77	0.1
Developed, High Intensity	2.64	<0.1
Deciduous Forest	17.02	<0.1
Evergreen Forest	118.60	0.1
Mixed Forest	31.33	<0.1
Scrub-Shrub	19,722.00	15.3
Grassland	39,127.10	30.5
Pasture/Hay	1,013.22	0.8
Crops	65,640.40	51.1
Woody Wetlands	54.72	<0.1
Emergent Wetlands	26.17	<0.1
Total	**128,482.46**	**100**

Data from the National Landcover Database (USGS NLCD 2001).

Figure 2.1 Project areas within the Lower Snake River Wind Resource Area.

Figure 2.2 Digital elevation model of the Lower Snake River Wind Resource Area.

Figure 2.3 Land cover types within the Lower Snake River Wind Resource Area.

3.0 METHODS

The study at LSRWRA consisted of the following research components: 1) fixed-point bird use surveys; 2) raptor nest surveys; 3) acoustic bat surveys; and 4) incidental wildlife observations. In addition, available land use/land cover data were used to map landcover/habitat types over the entire LSRWRA. For the purposes of the analysis, seasons were defined as follows: spring, March 16 through May 31; summer, June 1 through August 15; fall, August 16 to October 31; and winter, November 1to March 15.

3.1 Fixed-Point Bird Use Surveys

The objective of the fixed-point bird use surveys was to estimate the seasonal, spatial, and temporal use of the study area by birds, particularly raptors. Fixed-point surveys (variable circular plots) were conducted using methods described by Reynolds et al. (1980). The points were selected to survey representative habitats and topography of the study area, while also providing relatively even coverage with no overlap of survey plots (see below). All birds seen during fixed-point surveys were recorded. Raptors and other large birds, species of concern, and species not previously seen in the study area that were observed between fixed-point surveys were recorded. GPS coordinates were recorded for species of concern for subsequent mapping.

A total of 57 points were selected within the four separate wind resource areas to achieve optimal coverage of the study area and habitats within the study area. Each survey plot was an 800-meter radius circle centered on a point. All species of birds observed during fixed-point surveys were recorded, and all large birds observed perched within or flying over the plot were recorded and mapped. Small birds (e.g., sparrows) within 100 meters of the point were recorded, but not mapped. Observations of birds beyond the 800-meter radius were recorded, but were not included in the statistical analyses. A unique observation number was assigned to each observation.

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. The behavior of each bird observed, and the vegetation type in which or over which the bird occurred, were recorded based on the point of first observation. Approximate flight height and flight direction at first observation were recorded to the nearest five-meter interval. Other information recorded about the observation included whether or not the observation was auditory only and the 10-minute interval of the 20-minute survey in which it was first observed.

Locations of raptors, other large birds, and species of concern seen during fixed-point bird use surveys were recorded on field maps by observation number. Flight paths and perched locations were digitized using ArcGIS 9.3. Any comments or unusual observations were recorded in the comments section of the data sheet.

Sampling intensity was designed to document bird use and behavior by habitat and season within the study area. Surveys were conducted within the LSRWRA on a weekly basis with each survey point being visited at least twice a month during the spring season (March 16 through May 31), the summer season (June 1 to August 15), fall season (August 16 to October 31), and the winter season (November 1, 2007 to March 15). The Oliphant project area was surveyed earlier (April 9, 2007 through March 25, 2008) than the other wind resource areas, and surveys stations within the OWRA were visited weekly. All surveys were conducted during daylight hours and survey periods varied to approximately cover all daylight hours during a season.

3.2 Aerial Raptor Nest Surveys

The objective of the aerial raptor nest surveys was to locate nests that may be subject to disturbance and/or displacement effects from the wind-energy facility construction and/or operation. The search for raptor, corvid, and other large bird nests included the LSRWRA and an the area encompassed by an approximate 2-mile buffer (Figure __). Surveys within the Oliphant area were conducted from a helicopter on April 24, 2007; surveys in the Kuhl Ridge, Dutch flats, and Tucannon areas were conducted from April 4 to 8, 2008. Search paths were recorded with a real-time differentially-corrected Trimble Trimflight III GPS at 5-second intervals; coordinates were set as Universal Transverse Mercator (UTM) North American Datum (NAD) 27.

Aerial raptor nest surveys were scheduled after most species of raptor had finished courtship and were incubating eggs or brooding young. A focal species for the nest survey was ferruginous hawk (*Buteo regalis*) a state threatened species. Richardson (1996) reports that ferruginous hawks in Washington initiate their nesting activity in late-March and early-April. Surveys were also scheduled just prior to the onset of leaf-out to increase the visibility of nests within deciduous habitats. Nest searches were conducted by searching habitat suitable for most aboveground nesting species, such as cottonwood, ponderosa pine, tall shrubs, and cliffs or rocky outcrops. During surveys, the helicopter was flown at an altitude of tree-top level to approximately 250 ft (~75 m) aboveground. 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 (e.g., inactive, bird incubating, young present, eggs present, adult present, unknown or other), nest substrate (e.g., pine, poplar, cottonwood, juniper, shrub, rocky outcrop, cliff, power line), nest type (e.g., stick, scrape, eyrie), nest size, number of young present, time and date of observation and the nest location (recorded with both a handheld Garmin GPS 12 unit and the differentially-corrected unit). The surveys were conducted by a biologist experienced in raptor nest surveys. Additional data about raptor nest sites that were visible from routes regularly traveled by observers were opportunistically gathered during other surveys in the study area. Some nest sites were ground-truthed when activity was unknown; for example, potential Swainson's hawk (*Buteo swainsoni*) nests.

3.3 Acoustic Bat Surveys

The objective of the bat use surveys was to estimate the seasonal and spatial use of the LSRWRA by bats. Bats were surveyed using Anabat™ SD-1 bat detectors (Titley Scientific™ Pty Ltd., NSW, Australia). Acoustic bat surveys for the four separate wind resource areas were combined using two detectors within each study area. Bat detectors are a recommended method to index and compare habitat use by bats. The use of bat detectors for calculating an index to bat impacts has been used at several wind-energy facilities (Kunz et al. 2007a), and is a primary and economically feasible bat risk assessment tool (Arnett 2007). Bat activity was surveyed using detectors from April 30 to October 31, 2008, a period corresponding to the active season for bats and bat migration at this site. Detectors were placed at eight different locations within the Lower Snake River Wind Resource Area (see below).

Anabat detectors record bat echolocation calls with a broadband microphone. The echolocation sounds are then translated into frequencies audible to humans by dividing the frequencies by a predetermined ratio. A division ratio of 16 was used for the study. Bat echolocation detectors also detect other ultrasonic sounds made by insects, raindrops hitting vegetation, and other sources. A sensitivity level of six was used to reduce interference from these other sources of ultrasonic noise. Calls were recorded to a compact flash memory card with large storage capacity. The Anabat detectors were placed inside plastic weather-tight containers with a hole cut in the side of the container for the microphone to extend through. Microphones were encased in PVC tubing with drain holes that curved skyward at 45 degrees outside the container to minimize the potential for water damage due to rain. Containers were raised approximately 3.3 ft (~1 m) off the ground to minimize echo interference and lift the unit above vegetation. All units were programmed to turn on each night an approximate half-hour before sunset and turn off an approximate half-hour after sunrise.

3.4 Incidental Wildlife Observations

The objective of recording incidental wildlife observations was to provide use and occurrence information about wildlife occurring outside of the standardized bird survey areas that may be affected by the proposed wind-energy facility. Observations of big game species were also conducted during the fixed-point bird use surveys. Elk (*Cervis elaphus*), mule deer (*Odocoileus hemionus*), and white-tailed deer (*Odocoileus virginianus*), are known to occur on or near the LSRWRA. Observations of these species were plotted on data sheet maps and the number of individuals in each group recorded. Incidental wildlife observations were made while observers were within the study area conducting the various surveys. All sightings of raptors, unusual or unique birds, sensitive species, mammals, reptiles, and amphibians were recorded. These observations were recorded in a similar fashion to those recorded during the standardized surveys. The observation number, date, time, species, number of individuals, sex/age class, distance from observer, activity, height above ground (for bird species), habitat, and, in the case of sensitive species, the location by GPS was recorded.

3.5 Land Cover Surveys

The objectives of the land cover surveys were to identify the vegetation types (communities) that may be directly impacted by development of the LSRWRA and characterize the vegetation suitability of the study area for federal or state listed and non-listed sensitive-status species, including the possible occurrence of rare plants. A vegetation map was developed by delineating general vegetation types (e.g. cultivated and non-cultivated areas) on digital orthoquads (DOQ). Recent US Department of Agriculture (USDA) aerial imagery (USDA NAIP 2007), common land unit (CLU) boundaries, and CRP enrollment data were mapped and then ground-truthed to separate out native habitats from CRP grasslands, and to map other features such as trees and waterbodies. The mapped boundaries of each vegetation type were then digitized using ArcView™. This general vegetation map may also be used for wildlife habitat classification and/or support as a GIS base layer for calculating permanent or temporary impacts from a finalized facility layout. This information may be used for quantifying direct and indirect loss of potential wildlife habitat if mitigation measures are being pursued for habitat loss.

3.6 Statistical Analysis

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 their 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 in all steps were made.

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 analysis. All data forms, field notebooks, and electronic data files were retained for reference.

3.6.1 Fixed-Point Bird Use Surveys

A list of all bird species observed during all surveys types was generated for the LSRWRA. The total number of unique species and the mean number of species observed per survey (i.e., number of species/plot/20-min survey) were calculated to illustrate and compare differences between seasons and locations (fixed-point survey plots).

Species lists, with the number of observations and the number of groups, were generated by season, including all observations of birds detected regardless of their distance from the observer. For the standardized fixed-point bird use estimates, only observations of birds detected within the 800-meter radius plot were used. Estimates of bird use (i.e., number of birds/plot/20-min survey) were used to compare differences between bird types, seasons, project areas, and other wind-energy facilities.

The frequency of occurrence by species was calculated as the percent of surveys in which a particular species was observed. Species composition is represented by the mean use for a species divided by the total use for all species. Percent composition provides a relative estimate of the proportion of overall bird use attributable to each species and frequency of occurrence provides information on how often a species occurs in the study area. For example, a particular species might have high use estimates for the study area based on just a few observations of large flocks; however, the frequency of occurrence would indicate that it only occurred during a few of the surveys, therefore making it less likely to be affected by the wind-energy facility.

To calculate potential risk to bird species, the first flight height recorded was used to estimate the percentages of birds flying within the "likely zone of risk" for typical turbines. Since the type of turbines that will be used at the WSWRA is currently unknown, the likely zone of risk was defined as a flight height of between 82 to 410 feet (~25 to 125 m), which is the approximate rotor swept area of typical turbines that could be used at the LSRWRA.

A relative index to 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* (observations within 800 m of observer) averaged across all surveys, P_f equals 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 proportion of all initial flight height observations of species *i* within the likely zone of risk. This index does not account for differences in behavior other than flight heights and percent of birds observed flying.

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. Data were analyzed by comparing use among survey stations and association to topographic features. This information could be used to aid in turbine layout design or adjustments of individual turbines by micro-siting.

3.6.2 Acoustic Bat Surveys

The units of activity were number of bat passes (Hayes 1997). A pass was defined as a continuous series of two or more call notes produced by an individual bat with no pauses between call notes of less than one second (Gannon et al. 2003; White and Gehrt 2001). In this report, the terms bat pass and bat call are used interchangeably. The number of bat passes was determined by downloading the data files to a computer and tallying the number of echolocation passes recorded. Total number of passes was corrected for effort by dividing by the number of detector nights. Bat calls were classified as either high-frequency calls (≥35 kHz) that are generally given by small bats (e.g. *Myotis* sp., western pipistrelle [*Parastrellus hesperus*]) or low-frequency (<35 kHz) that are generally given by larger bats (e.g. silver-haired bat [*Lasionycteris noctivagans*], big brown bat [*Eptesicus fuscus*], hoary bat [*Lasiurus cinereus*], pallid bat [*Antrozous pallidus*], Townsend's big-eared bat [*Corynorhinus townsendii*], spotted bat [*Euderma maculatum*], fringed bat [*Myotis thysanodes*]). Data determined to be noise (produced by a source other than a bat) or call notes that did not meet the pre-specified criteria to be termed a pass were removed from the analysis. To establish which species may have produced the high- and low-frequency calls recorded, a list of species expected to occur in the study area was compiled from range maps (BCI website; Harvey et al. 1999).

The total number of bat passes per detector night was used as an index for bat use in the LSRWRA. Bat pass data represented levels of bat activity rather than the numbers of individuals present because individuals could not be differentiated by their calls. To predict potential for bat mortality (i.e. low, moderate, high), the mean number of bat passes per detector night (averaged across monitoring stations) was compared to existing data from wind-energy facilities where both bat activity and mortality levels have been measured.

Figure 3.1. Study area map and Anabat sampling locations at the Lower Snake River Wind Resource Area.

4.0 RESULTS - LOWER SNAKE RIVER WIND RESOUCE AREA (OVERALL)

Eighty-nine bird species were identified during fixed-point bird use surveys at the LSRWRA between April 9, 2007 and January 14, 2009. One additional species was observed during raptor nest surveys, and all birds observed incidentally were also observed during fixed-point surveys, resulting in 90 unique bird species observed at the LSRWRA. Seven mammal species were also observed incidentally. Results of the fixed-point surveys, raptor nest surveys, and incidental wildlife observations, as well as the specific numbers of unique species for each survey type, are discussed in the sections and chapters below.

4.1 Fixed-Point Bird Use Surveys

A total of 1,655 20-minute fixed-point bird use surveys were conducted between April 9, 2007 and January 14, 2009 within the LSRWRA (Table 4.1).

4.1.1 Bird Diversity and Species Richness

Eighty-nine unique species were observed over the course of all fixed-point bird use surveys, with a mean number of species observed per survey of 1.78 (Table 4.1). A total of 17,608 individual bird observations within 5,164 separate groups were recorded during the fixed-point surveys (Table 4.2). Cumulatively, three species (3.4% of all species) comprised 52.4% of the observations: horned lark (*Eremophila alpestris*), European starling (*Sturnus vulgaris*), and common raven (*Corvus corax)*. All other species comprised 5% or less of the observations individually (Table 4.3).

A total of 1,516 individual raptors were observed within the study area, comprising 15 species (Table 4.2). The most frequently observed raptors in the LSWRA were red-tailed hawk (*Buteo jamaicensis*; 52.0% of all raptor observations), American kestrel (*Falco sparverius*; 12.3%), and northern harrier (*Circus cyaneus*; 12.1%), which were all observed in similar numbers in each season. Accipiters were seldom observed (26 observations), and most observations were of sharp-shinned hawk (*Accipter striatus*; 20); most sharp-shinned hawk were observed in the fall (13). Buteos were the raptor subtype most often observed at the LSRWRA, comprising 68.4% of all raptor observations; red-tailed hawk (789 observations) and Swainson’s hawk (117) were the most frequently observed species. Northern harriers and falcons were seen in lower numbers than buteos (184 and 200 observations, respectively); most falcon observations were of American kestrel (187). Eagle observations consisted of bald eagle (*Haliaeetus leucocephalus*; three observations), golden eagle (*Aquila chrysaetos*; 41), and unidentified eagle (one). Owls and other raptors were infrequently observed (five and 19 observations, respectively); other raptor observations consisted of unidentified raptors (15) and osprey (*Pandion haliaetus*; four).

Most accipiters (73.1%) were observed at the Tucannon (10 observations) and the Oliphant (nine) areas. Buteos were observed across the LSRWRA, with most observations at the Tucannon (433 observations), followed by Kuhl Ridge (303), Oliphant (226) and Dutch Flats (75) areas. Northern harriers were also observed across the LSRWRA, with most observations at the Tucannon and Kuhl Ridge (60 observations at both) areas, followed by Oilphant (44) and Dutch Flats (20). Most (71.1% of all eagle observations) were recorded at the Oliphant (44 observations) area. More than half (54.5%) of all falcons were recorded at the Oliphant area (109 observations), followed by Tucannon (49), the Kuhl Ridge (24), and Dutch Flats (18). Most owls also were observed at the Oliphant (three observations), with one observation each at Tucannon and Dutch Flats; owls were not observed at the Kuhl Ridge area.

4.1.2 Bird Use, Composition, and Frequency of Occurrence by Season

Mean bird use, percent composition, and frequency of occurrence for all species and bird types were calculated by season (Table 5.3). The highest overall bird use occurred in the winter (7.00 birds/plot/20-min survey), compared to fall (6.47), summer (5.72), and spring (5.68).

Waterfowl

Water fowl were only recorded in the winter (0.16 birds/plot/20-min survey), and spring (<0.01; Table 5.3). Waterfowl accounted for 2.3% of all birds during the winter, and accounted for only 1% or less of all surveys.

Raptors

Raptors had the highest use in spring (0.91 birds/plot/20-min survey), followed by summer (0.79), fall (0.76), and winter (0.56; Table 5.3). Of the raptors, red-tailed hawk had the highest use across all seasons, with 0.50 in the spring, 0.41 in the fall, 0.40 in summer, and 0.21 in winter. Raptors comprised 16.1% of the overall bird use in the spring, 13.9% in the summer, 11.8% in the fall, and 8.0% in the winter. Raptors were consistently observed throughout the year, ranging from 34.4% of surveys in the winter to 48.9% in the spring (Table 5.3).

Accipiters had a relatively low use, ranging from 0.01 birds/plot/20-min survey in the winter and summer and 0.03 in the spring and fall (Table 5.3). Most use in all seasons was due to sharp-shinned hawk (<0.01 to 0.03 birds/plot/20-min survey). Accipiters comprised less than 1% of the overall bird use during each season and were observed during less than 2% of all surveys.

Buteos had the highest use of the raptor subtypes in all seasons (Table 5.3). Use by buteos was lowest in the winter (0.33 birds/plot/20-min survey), but higher in the fall (0.48), summer (0.54) and spring (0.55), and more than half the use by buteos in each season was due to use by red-tailed hawk. Buteos comprised between 9.6% and 4.7% of the overall bird use during each season and were observed during 23.4% of winter, 31.9% of spring, 30.2% of summer, and 25.7% of fall surveys.

Use by northern harriers was highest in the spring (0.18 birds/plot/20-min survey), but was similar in the winter, summer, and fall (0.07 to 0.09; Table 5.3). Northern harriers comprised less than 5% of the overall bird use during each season and were observed during 7.1% of winter, 16.7% of spring, 6.7% of summer, and 6.2% of fall surveys.

Eagles had a relatively low use, ranging from 0.06 birds/plot/20-min survey in the winter to 0.01 in the summer (Table 5.3). Most use in all seasons was due to golden eagle (0.01 to 0.05 birds/plot/20-min survey). Eagles comprised less than 1% of the overall bird use during each season and were observed during less than 5% of all surveys.

Use by falcons was lowest in the winter (0.06 birds/plot/20-min survey), but higher in the spring (0.14), summer (0.16) and fall (0.14); most of the use by falcons in each season was due to use by American kestrel (Table 5.3). Falcons comprised less than 5% of the overall bird use during each season and were observed during 10% or less of all surveys.

Owls had low use in the LSRWRA, being observed in only the winter and summer (0.01 birds/plot/20-min survey in both seasons; Table 5.3). Owls comprised less than 1% of the overall bird use during each season and were observed during less than 1% of all surveys.

Upland Gamebirds

Upland gamebirds had the highest use in spring (0.30 birds/plot/20-min survey), compared to summer (0.26), winter (0.14), and fall (0.12; Table 5.3). Upland gamebirds comprised 5% or less of all bird use across all seasons. Upland gamebirds were recorded during 24.7% of spring surveys, 17.4% of summer surveys, 5.1% of fall surveys, and 3.7% of winter surveys (Table 5.3).

Passerines

Passerines had the highest use by any bird type during all four seasons (Table 5.3). Passerine use was higher in winter (5.57 birds/plot/20-min survey) compared to summer (3.89), spring (3.85) and fall (3.36). Horned lark had the highest seasonal use in across all seasons, ranging from 1.57 in the fall to 2.82 in the winter. Passerines made up 52.0% of all bird composition in the fall, and more than 65% of all bird composition across all seasons. Passerines were recorded during the majority of surveys during all seasons, ranging from 57.2% in the winter to 82.8% in the spring (Table 5.3).

4.1.3 Bird Flight Height and Behavior

Flight height characteristics were estimated for both individual bird species and bird types (Tables 5.4 and 5.5). Percentages of observations below, within, and above the likely zone of risk (ZOR) of 82 to 410 feet (~25 to 125 m) above ground level (AGL) were reported. Forty-nine species were observed flying within the likely ZOR, with seven species (snow goose, bald eagle, white-throated swift, ferruginous hawk, cedar waxwing, unidentified raptor, and turkey vulture) observed flying within the likely ZOR for 100% of the observations. Observations for those species were uncommon and consisted of only one, two, or three groups of flying birds for all seasons. Twenty-two species were observed flying in the likely ZOR for at least 50% or greater of the observations. The remaining twenty-one species were observed flying in the likely ZOR for less than 50% of the observations (Table 5.4).

Overall, 18.7% of the bird types observed flying were recorded within the ZOR, 80.3% were below the ZOR, and 1.0% were flying above the ZOR (Table 5.5). More than half (59.6%) of flying raptor observations were of individuals below the ZOR, 35.9% were within the ZOR, and 4.5% were observed raptors flying above the ZOR. The majority of flying waterfowl (74.0%) were recorded within the ZOR, while most waterbirds, shorebirds, vultures, upland gamebirds, doves/pigeons, passerines, and other birds were typically recorded below the estimated ZOR (Table 5.5).

4.1.4 Bird Exposure Index

A relative exposure index (bird use multiplied by proportion of flying observations within the ZOR) was calculated for each species (Table 5.4). This index is only based on initial flight height observations and relative abundance and does not account for other possible collision risk factors such as foraging, courtship, or avoidance behavior. Twelve bird species had an exposure index greater than 0.1, with red-tailed hawk having the highest probability of turbine exposure (0.12; Table 5.4). The only other raptor species with a relatively high exposure index were Swainson's hawk (0.02) and golden eagle (0.02).

4.1.5 Spatial Use

Flight paths for were digitized and mapped for the LSRWRA (Appendices A-D). No obvious flyways or concentration areas were observed for any species. The available data do not indicate that any portions of the study area warrant being excluded from development due to very high bird use.

Table 4.1. Summary of bird use, species richness, and sample size by season and overall during the fixed-point bird use surveys at the Lower Snake River Wind Resource Area, January 24, 2008 – January 14, 2009.

Season	Number of Visits	Mean Use	# Species/ Survey	# Species	# Surveys Conducted
Winter	17	7.00	1.36	45	487
Spring	14	5.68	2.40	60	298
Summer	11	5.72	2.23	66	480
Fall	11	6.47	1.61	52	390
Overall	**53**	**6.39**	**1.78**	**89**	**1,655**

Table 4.2. Total number of groups and individuals for each bird type and species by season and overall during fixed-point bird use surveys at the Lower Snake River Wind Resource Area, January 24, 2008 – January 14, 2009.

		Winter		Spring		Summer		Fall		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Waterbirds		**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**1**
great blue heron	*Ardea herodias*	0	0	0	0	1	1	0	0	1	1
Waterfowl		**7**	**115**	**1**	**2**	**0**	**0**	**0**	**0**	**8**	**117**
Canada goose	*Branta canadensis*	5	48	0	0	0	0	0	0	5	48
Mallard	*Anas platyrhynchos*	0	0	1	2	0	0	0	0	1	2
snow goose	*Chen caerulescens*	1	57	0	0	0	0	0	0	1	57
tundra swan	*Cygnus columbianus*	1	10	0	0	0	0	0	0	1	10
Shorebirds		**3**	**4**	**2**	**2**	**1**	**1**	**0**	**0**	**6**	**7**
Killdeer	*Charadrius vociferus*	3	4	2	2	1	1	0	0	6	7
Raptors		**323**	**341**	**277**	**314**	**388**	**453**	**362**	**408**	**1,350**	**1,516**
Accipiters		*4*	*4*	*5*	*5*	*3*	*3*	*13*	*14*	*25*	*26*
Cooper's hawk	*Accipiter cooperii*	1	1	2	2	2	2	1	1	6	6
sharp-shinned hawk	*Accipter striatus*	3	3	3	3	1	1	12	13	19	20
Buteos		*211*	*225*	*184*	*219*	*281*	*330*	*234*	*263*	*910*	*1,037*
ferruginous hawk	*Buteo regalis*	0	0	0	0	1	1	1	1	2	2
red-tailed hawk	*Buteo jamaicensis*	132	142	154	187	202	243	190	217	678	789
rough-legged hawk	*Buteo lagopus*	65	69	7	7	0	0	20	20	92	96
Swainson's hawk	*Buteo swainsoni*	0	0	14	14	77	85	16	18	107	117
unidentified buteo		14	14	9	11	1	1	7	7	31	33
Northern Harrier		*49*	*52*	*48*	*49*	*39*	*40*	*42*	*43*	*178*	*184*
northern harrier	*Circus cyaneus*	49	52	48	49	39	40	42	43	178	184
Eagles		*23*	*23*	*6*	*6*	*5*	*5*	*11*	*11*	*45*	*45*
bald eagle	*Haliaeetus leucocephalus*	3	3	0	0	0	0	0	0	3	3
golden eagle	*Aquila chrysaetos*	19	19	6	6	5	5	11	11	41	41
unidentified eagle		1	1	0	0	0	0	0	0	1	1
Falcons		*24*	*24*	*33*	*34*	*57*	*72*	*55*	*70*	*169*	*200*
American kestrel	*Falco sparverius*	18	18	30	31	55	70	53	68	156	187
Merlin	*Falco columbarius*	1	1	0	0	0	0	2	2	3	3

Table 4.2. Total number of groups and individuals for each bird type and species by season and overall during fixed-point bird use surveys at the Lower Snake River Wind Resource Area, January 24, 2008 – January 14, 2009.

		Winter		Spring		Summer		Fall		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
prairie falcon	*Falco mexicanus*	5	5	3	3	2	2	0	0	10	10
Owls		*3*	*3*	*0*	*0*	*2*	*2*	*0*	*0*	*5*	*5*
great-horned owl	*Bubo virginianus*	1	1	0	0	0	0	0	0	1	1
short-eared owl	*Asio flammeus*	2	2	0	0	2	2	0	0	4	4
Other Raptors		*9*	*10*	*1*	*1*	*1*	*1*	*7*	*7*	*18*	*19*
Osprey	*Pandion haliaetus*	0	0	1	1	0	0	3	3	4	4
unidentified raptor		9	10	0	0	1	1	4	4	14	15
Vultures		**0**	**0**	**2**	**4**	**2**	**2**	**1**	**1**	**5**	**7**
turkey vulture	*Cathartes aura*	0	0	2	4	2	2	1	1	5	7
Upland Gamebirds		**20**	**50**	**85**	**96**	**77**	**109**	**21**	**48**	**203**	**303**
California quail	*Callipepla californica*	3	12	3	3	5	12	5	17	16	44
chukar	*Alectoris chukar*	2	3	2	2	1	1	0	0	5	6
gray partridge	*Perdix perdix*	2	12	3	5	4	8	2	10	11	35
ring-necked pheasant	*Phasianus colchicus*	13	23	77	86	66	85	14	21	170	215
wild turkey	*Meleagris gallopavo*	0	0	0	0	1	3	0	0	1	3
Doves/Pigeons		**37**	**291**	**25**	**135**	**77**	**392**	**48**	**571**	**187**	**1,389**
mourning dove	*Zenaida macroura*	4	31	10	18	35	87	12	56	61	192
rock pigeon	*Columba livia*	33	260	15	117	42	305	36	515	126	1,197
Passerines		**841**	**5,298**	**852**	**2,301**	**1,006**	**2,835**	**667**	**3,750**	**3,366**	**14,184**
American crow	*Corvus brachyrhynchos*	0	0	1	1	3	10	1	2	5	13
American goldfinch	*Carduelis tristis*	29	319	11	85	9	12	29	355	78	771
American pipit	*Anthus rubescens*	0	0	1	30	1	12	0	0	2	42
American robin	*Turdus migratorius*	7	168	13	67	7	7	3	7	30	249
American tree sparrow	*Spizella arborea*	9	33	0	0	0	0	0	0	9	33
bank swallow	*Riparia riparia*	0	0	0	0	24	152	0	0	24	152
barn swallow	*Hirundo rustica*	0	0	4	7	23	36	7	45	34	88
Bewick's wren	*Thryomanes bewickii*	0	0	1	1	0	0	0	0	1	1
black-billed magpie	*Pica pica*	48	106	18	26	29	56	31	76	126	264

Table 4.2. Total number of groups and individuals for each bird type and species by season and overall during fixed-point bird use surveys at the Lower Snake River Wind Resource Area, January 24, 2008 – January 14, 2009.

		Winter		Spring		Summer		Fall		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Brewer's blackbird	*Euphagus cyanocephalus*	1	16	10	30	19	59	3	151	33	256
brown-headed cowbird	*Molothrus ater*	0	0	1	2	5	6	2	3	8	11
Bullock's oriole	*Icterus bullockii*	0	0	1	1	9	14	0	0	10	15
Cassin's finch	*Carpodacus purpureus*	0	0	0	0	2	5	0	0	2	5
cedar waxwing	*Bombycilla cedrorum*	0	0	0	0	0	0	1	1	1	1
cliff swallow	*Petrochelidon pyrrhonota*	0	0	12	42	26	92	1	10	39	144
common raven	*Corvus corax*	175	311	108	178	99	307	150	443	532	1,239
dark-eyed junco	*Junco hyemalis*	23	226	1	5	0	0	3	7	27	238
eastern kingbird	*Tyrannus tyrannus*	0	0	0	0	22	27	2	5	24	32
European starling	*Sturnus vulgaris*	45	1,097	29	286	39	272	47	1,335	160	2,990
grasshopper sparrow	*Ammodramus savannarum*	0	0	12	15	44	55	0	0	56	70
Harris' sparrow	*Zonotrichia querula*	1	4	0	0	0	0	0	0	1	4
horned lark	*Eremophila alpestris*	365	2,203	300	890	306	1,047	209	850	1,180	4,990
house finch	*Carpodacus mexicanus*	19	215	2	16	8	29	11	43	40	303
house sparrow	*Passer domesticus*	11	275	8	50	5	21	3	11	27	357
house wren	*Troglodytes aedon*	0	0	3	3	4	4	1	1	8	8
lark sparrow	*Chondestes grammacus*	0	0	1	1	6	7	0	0	7	8
lazuli bunting	*Passerina amoena*	0	0	1	1	3	4	0	0	4	5
MacGillivray's warbler	*Oporornis tolmiei*	0	0	0	0	2	2	0	0	2	2
marsh wren	*Cistothorus palustris*	0	0	1	1	0	0	0	0	1	1
mountain bluebird	*Sialia currucoides*	6	7	19	27	7	9	9	29	41	72
mountain chickadee	*Poecile gambeli*	0	0	0	0	0	0	1	1	1	1
northern rough-winged swallow	*Stelgidopteryx serripennis*	0	0	2	2	2	3	0	0	4	5
northern shrike	*Lanius excubitor*	14	15	2	2	0	0	9	11	25	28
pine siskin	*Carduelis pinus*	1	15	0	0	0	0	0	0	1	15
red-winged blackbird	*Agelaius phoeniceus*	6	92	9	15	5	32	0	0	20	139
rock wren	*Salpinctes obsoletus*	0	0	2	2	14	17	3	5	19	24

Table 4.2. Total number of groups and individuals for each bird type and species by season and overall during fixed-point bird use surveys at the Lower Snake River Wind Resource Area, January 24, 2008 – January 14, 2009.

		Winter		Spring		Summer		Fall		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
sage thrasher	*Oreoscoptes montanus*	0	0	0	0	0	0	1	1	1	1
savannah sparrow	*Passerculus sandwichensis*	1	1	31	42	34	45	23	36	89	124
Say's phoebe	*Sayornis saya*	2	3	15	17	25	29	5	5	47	54
snow bunting	*Plectrophenax nivalis*	1	20	0	0	0	0	0	0	1	20
song sparrow	*Melospiza melodia*	13	23	7	9	5	8	8	10	33	50
spotted towhee	*Pipilo maculatus*	0	0	1	1	1	1	0	0	2	2
tree swallow	*Tachycineta bicolor*	0	0	10	17	0	0	3	24	13	41
unidentified empidonax		0	0	0	0	2	6	0	0	2	6
unidentified finch		0	0	0	0	1	5	0	0	1	5
unidentified passerine		15	29	8	12	12	12	18	55	53	108
unidentified sparrow		1	1	3	5	1	3	1	1	6	10
unidentified swallow		0	0	4	8	6	44	5	60	15	112
unidentified warbler		0	0	1	1	0	0	0	0	1	1
vesper sparrow	*Pooecetes gramineus*	0	0	7	7	10	14	2	6	19	27
violet-green swallow	*Tachycineta thalassina*	0	0	2	5	1	1	0	0	3	6
western bluebird	*Sialia mexicana*	0	0	2	4	2	6	3	15	7	25
western kingbird	*Tyrannus verticalis*	0	0	14	21	55	125	4	4	73	150
western meadowlark	*Sturnella neglecta*	37	58	156	276	118	227	50	95	361	656
western tanager	*Piranga ludoviciana*	0	0	0	0	3	4	0	0	3	4
white-crowned sparrow	*Zonotrichia leucophrys*	11	61	17	89	2	3	18	47	48	200
willow flycatcher	*Empidonax traillii*	0	0	0	0	1	1	0	0	1	1
yellow-breasted chat	*Icteria virens*	0	0	0	0	1	1	0	0	1	1
yellow-headed blackbird	*Xanthocephalus xanthocephalus*	0	0	0	0	1	1	0	0	1	1
yellow-rumped warbler	*Dendroica coronata*	0	0	1	1	2	2	0	0	3	3

Table 4.2. Total number of groups and individuals for each bird type and species by season and overall during fixed-point bird use surveys at the Lower Snake River Wind Resource Area, January 24, 2008 – January 14, 2009.

		Winter		Spring		Summer		Fall		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Other Birds		**1**	**1**	**6**	**12**	**10**	**17**	**16**	**36**	**33**	**66**
common nighthawk	*Chordeiles minor*	0	0	0	0	5	9	0	0	5	9
downy woodpecker	*Picoides pubescens*	0	0	0	0	0	0	1	1	1	1
northern flicker	*Colaptes auratus*	1	1	3	4	1	1	5	5	10	11
unidentified hummingbird		0	0	0	0	2	2	0	0	2	2
Vaux's swift	*Chaetura vauxi*	0	0	3	8	2	5	9	27	14	40
white-throated swift	*Aeronautes saxatalis*	0	0	0	0	0	0	1	3	1	3
Unidentified Birds		**1**	**1**	**2**	**2**	**1**	**14**	**1**	**1**	**5**	**18**
unidentified bird		1	1	2	2	1	14	1	1	5	18
Overall		**1,233**	**6,101**	**1,252**	**2,868**	**1,563**	**3,824**	**1,116**	**4,815**	**5,164**	**17,608**

Table 4.3. Mean bird use (number/plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each bird type and species by season during the fixed-point bird use surveys at Lower Snake River Wind Resource Area, January 24, 2008 – January 14, 2009.

	Use				% Composition				% Frequency			
Species/Type	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**
Waterbirds	**0**	**0**	**<0.01**	**0**	**0**	**0**	**<0.1**	**0**	**0**	**0**	**0.2**	**0**
great blue heron	0	0	<0.01	0	0	0	<0.1	0	0	0	0.2	0
Waterfowl	**0.16**	**<0.01**	**0**	**0**	**2.3**	**0.1**	**0**	**0**	**1.0**	**0.2**	**0**	**0**
Canada goose	0.09	0	0	0	1.3	0	0	0	0.9	0	0	0
mallard	0	<0.01	0	0	0	0.1	0	0	0	0.2	0	0
snow goose	0.07	0	0	0	1.1	0	0	0	0.1	0	0	0
Shorebirds	**0.01**	**<0.01**	**<0.01**	**0**	**0.1**	**0.1**	**<0.1**	**0**	**0.7**	**0.3**	**0.2**	**0**
killdeer	0.01	<0.01	<0.01	0	0.1	0.1	<0.1	0	0.7	0.3	0.2	0
Raptors	**0.56**	**0.91**	**0.79**	**0.76**	**8.0**	**16.1**	**13.9**	**11.8**	**34.4**	**48.9**	**41.4**	**38.6**
Accipiters	*0.01*	*0.03*	*0.01*	*0.03*	*0.1*	*0.4*	*0.1*	*0.5*	*1.0*	*1.9*	*0.5*	*2.9*
Cooper's hawk	<0.01	0.01	<0.01	<0.01	<0.1	0.2	0.1	<0.1	0.2	1.2	0.4	0.2
sharp-shinned hawk	0.01	0.01	<0.01	0.03	0.1	0.2	<0.1	0.5	0.8	1.3	0.2	2.7
Buteos	*0.33*	*0.55*	*0.54*	*0.48*	*4.7*	*9.6*	*9.4*	*7.4*	*23.4*	*31.9*	*30.2*	*25.7*
ferruginous hawk	0	0	<0.01	<0.01	0	0	<0.1	<0.1	0	0	0.2	0.2
red-tailed hawk	0.21	0.50	0.40	0.41	3.0	8.8	7.0	6.3	15.0	30.4	25.6	23.3
rough-legged hawk	0.11	0.01	0	0.03	1.6	0.2	0	0.5	9.3	1.3	0	3.2
Swainson's hawk	0	0.03	0.14	0.04	0	0.5	2.4	0.6	0	2.8	8.9	3.0
unidentified buteo	0.01	0.01	0	0	0.2	0.1	0	0	1.3	0.7	0	0
Northern Harrier	*0.09*	*0.18*	*0.07*	*0.08*	*1.2*	*3.2*	*1.2*	*1.2*	*7.1*	*16.7*	*6.7*	*6.2*
northern harrier	0.09	0.18	0.07	0.08	1.2	3.2	1.2	1.2	7.1	16.7	6.7	6.2
Eagles	*0.06*	*0.02*	*0.01*	*0.03*	*0.9*	*0.3*	*0.3*	*0.5*	*5.3*	*1.8*	*1.4*	*2.7*
bald eagle	0.01	0	0	0	0.2	0	0	0	1.1	0	0	0
golden eagle	0.05	0.02	0.01	0.03	0.7	0.3	0.3	0.5	4.2	1.8	1.4	2.7
Falcons	*0.06*	*0.14*	*0.16*	*0.14*	*0.9*	*2.4*	*2.8*	*2.2*	*5.3*	*10.0*	*9.9*	*9.9*
American kestrel	0.06	0.13	0.15	0.14	0.8	2.3	2.7	2.1	4.6	9.6	9.8	9.6
merlin	<0.01	0	0	<0.01	<0.1	0	0	<0.1	0.1	0	0	0.3
prairie falcon	0.01	<0.01	<0.01	0	0.1	0.1	0.1	0	0.6	0.5	0.3	0

Table 4.3. Mean bird use (number/plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each bird type and species by season during the fixed-point bird use surveys at Lower Snake River Wind Resource Area, January 24, 2008 – January 14, 2009.

	Use				% Composition				% Frequency			
Species/Type	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**
Owls	*0.01*	*0*	*0.01*	*0*	*0.1*	*0*	*0.2*	*0*	*0.8*	*0*	*0.9*	*0*
great-horned owl	<0.01	0	0	0	<0.1	0	0	0	0.2	0	0	0
short-eared owl	0.01	0	0.01	0	0.1	0	0.2	0	0.7	0	0.9	0
Other Raptors	*<0.01*	*<0.01*	*0*	*0.01*	*<0.1*	*<0.1*	*0*	*0.1*	*0.1*	*0.2*	*0*	*0.6*
osprey	0	<0.01	0	0.01	0	<0.1	0	0.1	0	0.2	0	0.6
unidentified raptor	<0.01	0	0	0	<0.1	0	0	0	0.1	0	0	0
Vultures	**0**	**0.01**	**<0.01**	**<0.01**	**0**	**0.1**	**0.1**	**<0.1**	**0**	**0.3**	**0.3**	**0.2**
turkey vulture	0	0.01	<0.01	<0.01	0	0.1	0.1	<0.1	0	0.3	0.3	0.2
Upland Gamebirds	**0.14**	**0.30**	**0.26**	**0.12**	**2.0**	**5.3**	**4.6**	**1.8**	**3.7**	**24.7**	**17.4**	**5.1**
California quail	0.02	0.01	0.02	0.02	0.2	0.2	0.3	0.4	0.5	1.4	0.8	0.6
chukar	0.01	<0.01	<0.01	0	0.2	0.1	<0.1	0	0.6	0.3	0.2	0
gray partridge	0.05	0.02	0.03	0.02	0.7	0.4	0.4	0.2	0.6	1.1	1.9	0.3
ring-necked pheasant	0.06	0.26	0.21	0.08	0.9	4.6	3.7	1.2	2.5	22.5	15.0	4.5
wild turkey	0	0	<0.01	0	0	0	0.1	0	0	0	0.2	0
Doves/Pigeons	**0.55**	**0.54**	**0.71**	**2.14**	**7.9**	**9.6**	**12.4**	**33.1**	**7.6**	**7.2**	**13.3**	**11.3**
mourning dove	0.07	0.06	0.17	0.12	1.0	1.1	3.0	1.8	1.1	2.6	6.6	2.8
rock pigeon	0.48	0.48	0.54	2.02	6.9	8.4	9.5	31.3	7.3	4.6	7.2	8.5
Passerines	**5.57**	**3.85**	**3.89**	**3.36**	**79.5**	**67.9**	**68.0**	**52.0**	**57.2**	**82.8**	**75.8**	**60.6**
American crow	0	0	<0.01	0	0	0	<0.1	0	0	0	0.2	0
American goldfinch	0.43	0.20	0.02	0.50	6.1	3.6	0.3	7.8	4.3	3.1	1.2	8.0
American pipit	0	0	0.02	0	0	0	0.3	0	0	0	0.2	0
American robin	0.06	0.02	0.01	0.01	0.9	0.4	0.2	0.1	0.3	1.2	1.0	0.8
American tree sparrow	0.11	0	0	0	1.6	0	0	0	3.0	0	0	0
bank swallow	0	0	0.24	0	0	0	4.3	0	0	0	3.7	0
barn swallow	0	0.02	0.06	0.05	0	0.3	1.1	0.8	0	1.3	3.7	1.1
Bewick's wren	0	<0.01	0	0	0	<0.1	0	0	0	0.1	0	0
black-billed magpie	0.03	0.01	0.03	0.03	0.4	0.2	0.6	0.4	1.3	0.8	2.5	0.6

Table 4.3. Mean bird use (number/plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each bird type and species by season during the fixed-point bird use surveys at Lower Snake River Wind Resource Area, January 24, 2008 – January 14, 2009.

	Use				% Composition				% Frequency			
Species/Type	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**
Brewer's blackbird	0.02	0.02	0.09	0.03	0.2	0.3	1.6	0.5	0.1	0.9	3.8	0.1
brown-headed cowbird	0	<0.01	0.01	<0.01	0	0.1	0.1	0.1	0	0.2	0.6	0.3
Bullock's oriole	0	0	0.02	0	0	0	0.3	0	0	0	1.0	0
Cassin's finch	0	0	0.01	0	0	0	0.1	0	0	0	0.3	0
cedar waxwing	0	0	0	<0.01	0	0	0	<0.1	0	0	0	0.3
cliff swallow	0	0.07	0.11	0	0	1.3	1.9	0	0	2.1	3.4	0
common raven	0.11	0.03	0.04	0.07	1.5	0.6	0.8	1.2	3.6	2.6	2.2	4.2
dark-eyed junco	0.31	0.01	0	0.02	4.5	0.1	0	0.4	4.8	0.1	0	0.8
eastern kingbird	0	0	0.03	0.01	0	0	0.5	0.1	0	0	2.6	0.2
European starling	0.79	0.21	0.12	0.41	11.3	3.6	2.1	6.3	1.9	2.4	2.4	2.5
grasshopper sparrow	0	0.08	0.14	0	0	1.4	2.4	0	0	5.5	8.9	0
Harris' sparrow	0.01	0	0	0	0.1	0	0	0	0.2	0	0	0
horned lark	2.82	2.18	2.04	1.57	40.3	38.4	35.7	24.3	43.7	61.1	49.5	37.3
house finch	0.26	0	0.05	0.12	3.7	0	0.8	1.8	2.3	0	1.3	2.5
house sparrow	0.22	0.08	0.03	0	3.2	1.4	0.6	0	0.5	0.6	1.2	0
house wren	0	0	<0.01	<0.01	0	0	0.1	<0.1	0	0	0.5	0.2
lark sparrow	0	0	0.01	0	0	0	0.2	0	0	0	1.0	0
lazuli bunting	0	<0.01	0.01	0	0	<0.1	0.1	0	0	0.2	0.5	0
MacGillivray's warbler	0	0	<0.01	0	0	0	<0.1	0	0	0	0.2	0
mountain bluebird	0.01	0.06	0.01	0.09	0.2	1.1	0.2	1.4	1.3	4.8	0.9	3.5
mountain chickadee	0	0	0	<0.01	0	0	0	<0.1	0	0	0	0.2
northern rough-winged swallow	0	0.01	0.01	0	0	0.1	0.1	0	0	0.8	0.4	0
northern shrike	0.01	<0.01	0	0.03	0.1	<0.1	0	0.5	0.6	0.1	0	2.1
pine siskin	0.03	0	0	0	0.4	0	0	0	0.2	0	0	0
red-winged blackbird	0.15	0.02	0.05	0	2.2	0.4	0.8	0	0.8	1.3	0.6	0

Table 4.3. Mean bird use (number/plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each bird type and species by season during the fixed-point bird use surveys at Lower Snake River Wind Resource Area, January 24, 2008 – January 14, 2009.

	Use				% Composition				% Frequency			
Species/Type	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**
rock wren	0	0.01	0.03	0.01	0	0.2	0.4	0.2	0	1.2	1.9	0.7
sage thrasher	0	0	0	<0.01	0	0	0	<0.1	0	0	0	0.2
savannah sparrow	<0.01	0.15	0.12	0.06	<0.1	2.6	2.1	0.9	0.3	10.9	8.3	3.4
Say's phoebe	<0.01	0.04	0.05	0.01	<0.1	0.6	0.8	0.1	0.1	2.9	3.9	0.9
snow bunting	0.03	0	0	0	0.5	0	0	0	0.2	0	0	0
song sparrow	0.04	0.04	0.01	0.04	0.6	0.7	0.2	0.5	2.3	3.1	0.7	3.2
spotted towhee	0	0.01	0	0	0	0.1	0	0	0	0.6	0	0
tree swallow	0	0.04	0	0.03	0	0.7	0	0.5	0	2.6	0	0.4
unidentified empidonax	0	0	0.02	0	0	0	0.3	0	0	0	0.9	0
unidentified finch	0	0	0.01	0	0	0	0.1	0	0	0	0.2	0
unidentified passerine	<0.01	0.01	<0.01	0.03	<0.1	0.2	0.1	0.5	0.2	0.6	0.3	1.7
unidentified sparrow	<0.01	0.03	0	0.01	0.1	0.5	0	0.1	0.5	1.8	0	0.8
unidentified warbler	0	0.01	0	0	0	0.1	0	0	0	0.6	0	0
vesper sparrow	0	0.02	0.02	0.01	0	0.3	0.4	0.2	0	1.6	1.4	0.4
violet-green swallow	0	0.01	<0.01	0	0	0.1	<0.1	0	0	0.3	0.2	0
western bluebird	0	0.01	0.01	0.02	0	0.1	0.2	0.4	0	0.3	0.3	0.5
western kingbird	0	0.03	0.12	0.01	0	0.6	2.2	0.1	0	2.6	6.4	0.6
western meadowlark	0.04	0.22	0.32	0.08	0.6	3.9	5.7	1.2	2.3	12.7	13.9	4.0
western tanager	0	0	0.01	0	0	0	0.1	0	0	0	0.5	0
white-crowned sparrow	0.08	0.21	0.01	0.11	1.1	3.7	0.2	1.7	1.4	5.1	0.9	4.0
yellow-breasted chat	0	0	<0.01	0	0	0	<0.1	0	0	0	0.2	0
yellow-headed blackbird	0	0	<0.01	0	0	0	<0.1	0	0	0	0.2	0
yellow-rumped warbler	0	0.01	0	0	0	0.1	0	0	0	0.6	0	0

Table 4.3. Mean bird use (number/plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each bird type and species by season during the fixed-point bird use surveys at Lower Snake River Wind Resource Area, January 24, 2008 – January 14, 2009.

	Use				% Composition				% Frequency			
Species/Type	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**
Other Birds	**<0.01**	**0.04**	**0.03**	**0.08**	**<0.1**	**0.7**	**0.6**	**1.2**	**0.1**	**1.8**	**2.0**	**2.5**
common nighthawk	0	0	0.01	0	0	0	0.3	0	0	0	0.8	0
downy woodpecker	0	0	0	<0.01	0	0	0	<0.1	0	0	0	0.2
northern flicker	<0.01	0.01	<0.01	0.01	<0.1	0.1	<0.1	0.1	0.1	0.4	0.2	0.7
unidentified hummingbird	0	0	0.01	0	0	0	0.2	0	0	0	0.9	0
Vaux's swift	0	0.03	0.01	0.06	0	0.6	0.1	1.0	0	1.3	0.2	1.5
white-throated swift	0	0	0	0.01	0	0	0	0.1	0	0	0	0.2
Unidentified Birds	**<0.01**	**0.01**	**0.02**	**<0.01**	**0.1**	**0.2**	**0.4**	**<0.1**	**0.5**	**1.2**	**0.2**	**0.2**
unidentified bird	<0.01	0.01	0.02	<0.01	0.1	0.2	0.4	<0.1	0.5	1.2	0.2	0.2
Overall	**7.00**	**5.68**	**5.72**	**6.47**	**100**	**100**	**100**	**100**				

Table 4.4. Relative exposure index and flight characteristics by species during the fixed-point bird use surveys at the Lower Snake River Wind Resource Area, January 24, 2008 – January 14, 2009.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within ZOR based on initial obs	Exposure Index	% Within Rotary Height at anytime
red-tailed hawk	474	0.34	77.7	46.3	0.12	75.6
American goldfinch	60	0.32	89.2	34.0	0.10	55.4
horned lark	594	2.30	52.0	7.0	0.08	18.0
rock pigeon	100	0.79	73.4	8.0	0.05	37.1
snow goose	1	0.03	100	100	0.03	100
European starling	99	0.48	52.6	10.1	0.03	43.2
common raven	418	0.07	87.1	35.9	0.02	62.6
Brewer's blackbird	27	0.03	94.5	69.8	0.02	71.5
Swainson's hawk	100	0.04	93.2	45.9	0.02	87.2
American robin	16	0.03	69.5	69.4	0.02	72.8
Canada goose	3	0.04	100	44.4	0.02	44.4
golden eagle	33	0.03	91.7	51.5	0.02	78.8
rough-legged hawk	67	0.06	78.0	29.6	0.01	57.7
northern harrier	165	0.10	93.4	11.2	0.01	19.4
Vaux's swift	14	0.02	100	45.0	0.01	75.0
American kestrel	111	0.11	65.6	11.7	0.01	40.8
tree swallow	13	0.01	100	31.7	<0.01	68.3
unidentified passerine	46	0.01	91.7	42.4	<0.01	55.6
sharp-shinned hawk	17	0.01	94.7	33.3	<0.01	55.6
mountain bluebird	26	0.04	72.2	13.5	<0.01	36.5
unidentified buteo	5	0.01	83.3	60.0	<0.01	80.0
house finch	23	0.14	77.9	3.0	<0.01	3.0
bald eagle	3	<0.01	100	66.7	<0.01	100
dark-eyed junco	6	0.14	11.3	14.8	<0.01	14.8
cliff swallow	35	0.03	96.5	6.5	<0.01	26.6
Cooper's hawk	6	<0.01	100	33.3	<0.01	50.0
house sparrow	18	0.11	49.0	2.3	<0.01	42.9

Table 4.4. Relative exposure index and flight characteristics by species during the fixed-point bird use surveys at the Lower Snake River Wind Resource Area, January 24, 2008 – January 14, 2009.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within ZOR based on initial obs	Exposure Index	% Within Rotary Height at anytime
white-throated swift	1	<0.01	100	100	<0.01	100
unidentified bird	5	0.01	100	11.1	<0.01	11.1
ferruginous hawk	2	<0.01	100	100	<0.01	100
osprey	4	<0.01	100	50.0	<0.01	75.0
western kingbird	53	0.03	59.3	3.4	<0.01	5.6
red-winged blackbird	7	0.08	61.9	1.2	<0.01	1.2
cedar waxwing	1	<0.01	100	100	<0.01	100
unidentified raptor	1	<0.01	100	100	<0.01	100
prairie falcon	10	<0.01	100	10.0	<0.01	10.0
merlin	3	<0.01	100	33.3	<0.01	66.7
turkey vulture	3	<0.01	42.9	33.3	<0.01	100
barn swallow	31	0.02	95.5	1.2	<0.01	47.6
eastern kingbird	17	<0.01	68.8	4.5	<0.01	9.1
black-billed magpie	79	0.03	61.6	0.6	<0.01	4.3
western meadowlark	71	0.14	22.1	0	0	4.8
ring-necked pheasant	16	0.13	11.7	0	0	0
mourning dove	27	0.10	44.8	0	0	0
white-crowned sparrow	15	0.10	53.0	0	0	0
savannah sparrow	22	0.06	25.8	0	0	0
bank swallow	23	0.05	99.3	0	0	17.2
American tree sparrow	2	0.05	9.1	0	0	0
grasshopper sparrow	6	0.04	10.0	0	0	0
song sparrow	5	0.03	16.0	0	0	0
gray partridge	6	0.03	68.6	0	0	0
Say's phoebe	18	0.02	38.9	0	0	0
California quail	0	0.02	0.0	0	0	0
snow bunting	1	0.01	100	0	0	0
pine siskin	1	0.01	100	0	0	0

Table 4.4. Relative exposure index and flight characteristics by species during the fixed-point bird use surveys at the Lower Snake River Wind Resource Area, January 24, 2008 – January 14, 2009.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within ZOR based on initial obs	Exposure Index	% Within Rotary Height at anytime
unidentified sparrow	4	0.01	80.0	0	0	0
rock wren	2	0.01	16.7	0	0	0
vesper sparrow	7	0.01	55.6	0	0	0
northern shrike	14	0.01	57.1	0	0	0
western bluebird	6	0.01	96.0	0	0	12.5
chukar	2	0.01	50.0	0	0	0
short-eared owl	3	<0.01	75.0	0	0	0
killdeer	3	<0.01	57.1	0	0	0
American pipit	2	<0.01	100	0	0	71.4
Bullock's oriole	4	<0.01	46.7	0	0	0
northern flicker	6	<0.01	54.5	0	0	0
unidentified empidonax	1	<0.01	83.3	0	0	0
brown-headed cowbird	5	<0.01	63.6	0	0	0
Harris' sparrow	0	<0.01	0	0	0	0
common nighthawk	5	<0.01	100	0	0	88.9
northern rough-winged swallow	4	<0.01	100	0	0	0
lark sparrow	2	<0.01	37.5	0	0	0
violet-green swallow	3	<0.01	100	0	0	50.0
unidentified hummingbird	2	<0.01	100	0	0	50.0
lazuli bunting	0	<0.01	0	0	0	0
Cassin's finch	1	<0.01	80.0	0	0	0
unidentified finch	1	<0.01	100	0	0	0
house wren	0	<0.01	0	0	0	0
spotted towhee	0	<0.01	0	0	0	0
western tanager	0	<0.01	0	0	0	0
unidentified warbler	0	<0.01	0	0	0	0
yellow-rumped warbler	2	<0.01	66.7	0	0	0
wild turkey	0	<0.01	0	0	0	0

Table 4.4. Relative exposure index and flight characteristics by species during the fixed-point bird use surveys at the Lower Snake River Wind Resource Area, January 24, 2008 – January 14, 2009.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within ZOR based on initial obs	Exposure Index	% Within Rotary Height at anytime
great-horned owl	0	<0.01	0	0	0	0
mallard	1	<0.01	100	0	0	0
sage thrasher	1	<0.01	100	0	0	0
downy woodpecker	1	<0.01	100	0	0	0
mountain chickadee	1	<0.01	100	0	0	0
American crow	2	<0.01	69.2	0	0	0
great blue heron	1	<0.01	100	0	0	0
MacGillivray's warbler	2	<0.01	100	0	0	0
yellow-breasted chat	0	<0.01	0	0	0	0
yellow-headed blackbird	1	<0.01	100	0	0	0
Bewick's wren	0	<0.01	0	0	0	0
willow flycatcher	0	0.00	0	0	0	0
marsh wren	0	0.00	0	0	0	0
tundra swan	0	0.00	0	0	0	0
unidentified eagle	0	0.00	0	0	0	0
unidentified swallow	15	0.00	100	73.2	0	96.4

Table 4.5. Flight height characteristics by bird type during the fixed-point bird use surveys at the Lower Snake River Wind Resource Area, January 24, 2008 – January 14, 2009.

Type	# Obs Flying	# Groups Flying	Mean Flight Height	% Obs Flying	% within Flight Height Categories 0-82 ft	82-410 ft	> 410 ft
Waterbirds	1	1	20.00	100	100	0	0
Waterfowl	5	104	244.00	100	1.9	74.0	24.0
Shorebirds	3	4	10.00	57.1	100	0	0
Raptors	1,004	1,124	41.80	80.5	59.6	35.9	4.5
Accipiters	*23*	*24*	*55.04*	*96.0*	*54.2*	*33.3*	*12.5*
Buteos	*648*	*753*	*48.73*	*79.8*	*50.1*	*44.9*	*5.0*
Northern Harrier	*165*	*170*	*16.44*	*93.4*	*87.6*	*11.2*	*1.2*
Eagles	*36*	*36*	*93.89*	*92.3*	*33.3*	*52.8*	*13.9*
Falcons	*124*	*133*	*19.57*	*67.9*	*87.2*	*12.0*	*0.8*
Owls	*3*	*3*	*0.00*	*60.0*	*100*	*0*	*0*
Other Raptors	*5*	*5*	*121.00*	*100*	*0*	*60.0*	*40.0*
Vultures	3	3	43.33	42.9	66.7	33.3	0
Upland Gamebirds	24	52	2.46	17.2	100	0	0
Doves/Pigeons	127	965	15.96	69.5	92.7	7.3	0
Passerines	1,813	8,319	16.71	58.8	82.6	17.0	0.4
Other Birds	29	61	24.59	92.4	65.6	34.4	0
Unidentified Birds	5	18	25.00	100	88.9	11.1	0
Overall	**3,014**	**10,651**	**25.41**	**61.1**	**80.3**	**18.7**	**1.0**

Figure 4.1 Fixed-point bird use survey points at the Lower Snake River Wind Resource Area.

4.2 Raptor Nest Surveys

One-hundred-two active red-tailed hawk nests, 18 active great-horned owl nests, five Swainson's hawk nests, two golden eagle nests, one barn owl (*Tyto alba*), and one prairie falcon (*Falco mexicanus*) nest were within the study area and one-mile buffer of the study area (Figure 4.2), resulting in an active raptor nest density of 0.40 nests/mi^2. When considering the nests within the boundaries of the LSRWRA alone, 50 active red-tailed hawk nests, 10 active great-horned owl nests, three Swainson's hawk nests, and the burrowing owl nest were within the study area (Figure 4.2), resulting in an active raptor nest density of 0.32 nests/mi^2 (Table 4.6).

One-hundred-eighty inactive nests were within the study area and one-mile buffer of the study area (Table 4.6; Figure 4.2). Two of the inactive nests were historic nests of ferruginous hawks, one of which lies within the boundaries of the LSRWRA. Most of the remaining inactive nests were likely those of red-tailed hawk, based on the number of active nests and abundance of red-tailed hawk in the LSRWRA; however, these nests could also potentially be used by other raptor species, such as great-horned owl or Swainson's hawk.

Table 4.6 Nesting raptor species and nest density for the Lower Snake River Wind Resource Area and the study area, based on raptor nest surveys.

Species	Scientific name	# of nests within LSRWRA	# of nests within 1-mi buffer of LSRWRA	Density	
				LSRWRA (# of nests/mi^2)	1-mi buffer of LSRWRA (#nests/mi^2)
red-tailed hawk	*Buteo jamaicensis*	50	102	0.25	0.32
great-horned owl	*Bubo virginianus*	10	18	0.05	0.06
Swainson's hawk	*Buteo swainsoni*	3	5	0.01	0.02
golden eagle	*Aquila chrysaetos*	0	2	0	0.01
burrowing owl	*Athene cunicularia*	1	1	<0.01	<0.01
prairie falcon	*Falco mexicanus*	0	1	0	<0.01
inactive		63	180	0.31	0.56
Total		**128**	**309**	**0.64**	**0.96**

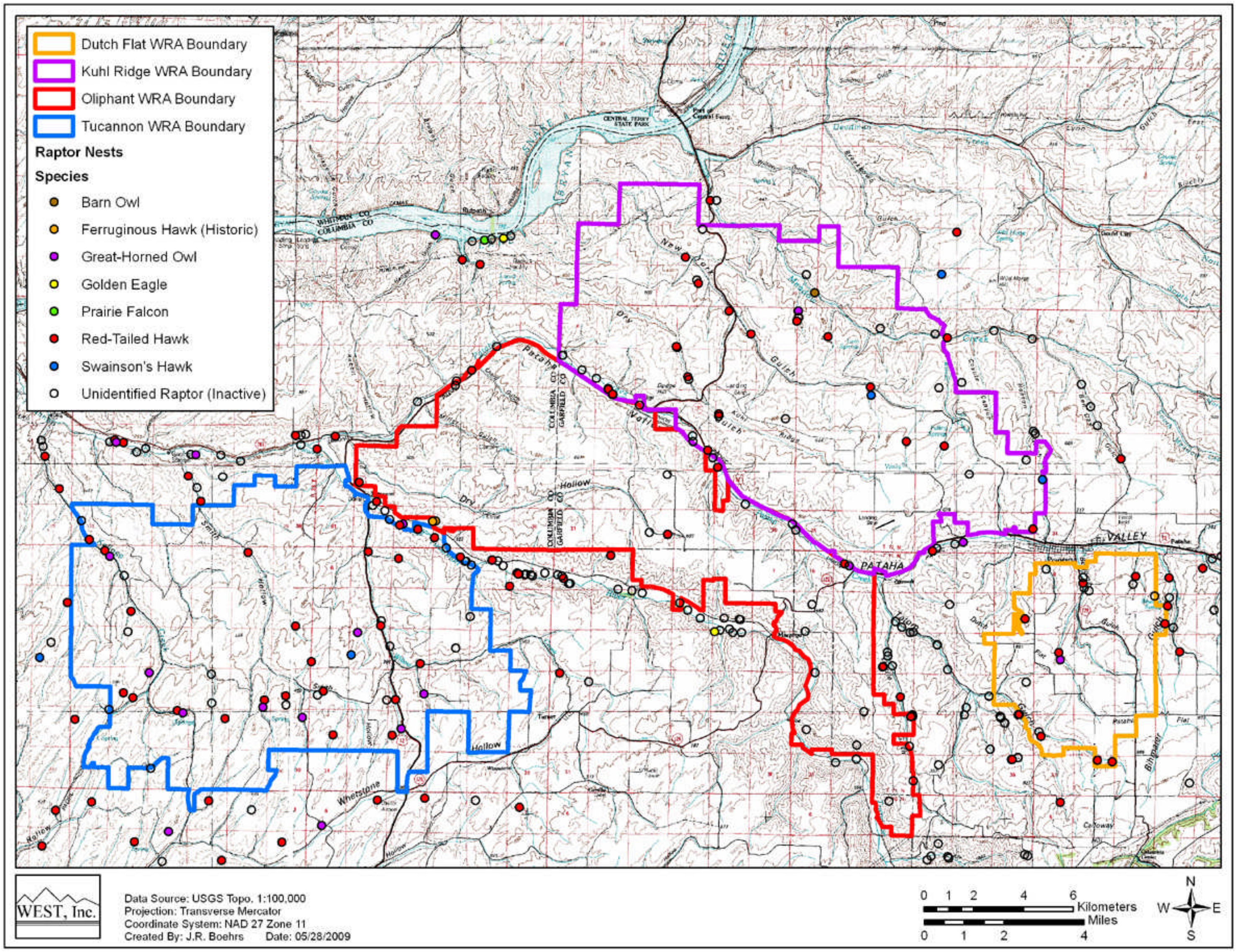


Figure 4.2 Raptor nest locations at the Lower Snake River Wind Resource Area.

4.3 Acoustic Bat Survey Results

Acoustic bat surveys were conducted using two detectors at each of the four wind resource areas within the LSRWRA. A total of fourteen different bat species could be expected within the Lower Snake river Wind Resource Area (Table 4.7).

Bat activity was monitored at eight sampling locations on a total of 185 nights during the period April 30 to October 31, 2008 (Figure 4.3). Anabat units were operable for 94.9% of the sampling period (Figure 4.4), recording 1,472 bat passes on 1,219 detector-nights (Table 4.8). Levels of wind and insect noise were high on some nights (Figure 4.5), and may have interfered with bat detection. Averaging bat passes per detector-night across locations, we detected a mean of 1.21 bat passes per detector-night.

4.3.1 Spatial Variation

Bat activity was highest at Station OL2, which recorded 5.13 bat passes per detector night (64.5% of all bat passes). Bat activity was similar at the other stations, ranging from 0.33 bat passes per detector night at Station TU1 to 0.62 at Station DF1 (Figure 5.6). Patterns of nightly activity were similar among stations, (Figure 4.7), although Station OL2 recorded far more bat passes than other stations.

4.3.2 Temporal Variation

Bat activity was relatively high from early-June through late-August, then abruptly decreased to lower levels through September and October (Figure 4.8). Peaks of activity occurred on July 24. Temporal patterns were largely consistent among stations, although Station OL2 recorded more calls per night. Bat activity levels were much lower from the beginning of the study period through May. There was a second, smaller peak of activity in September (Figure 4.8).

4.3.3 Species Composition

Overall, passes by high-frequency bats (HF; 66.0%) outnumbered passes by low-frequency bats (LF; 44.0%). However, the proportion of HF and LF bat passes was similar among Anabat ground stations (Figures 4.9 and 4.10). HF passes outnumbered LF passes for the majority of the study period, but LF activity was higher than HF activity in late-September (Figures 4.9 and 4.10). LF bat passes were more frequent in September and October when overall activity was much lower.

Species identification for specific passes was possible for the hoary bat; therefore, passes by this species could be separated from passes by other low-frequency bats. Hoary bats comprised 2.2% of total passes detected within the study area. Hoary bat activity was similar among Anabat stations (Figure 4.11). Patterns of hoary bat activity were congruent with the overall trend (Figure 4.7), peaking in mid- to late-August.

Table 4.7 Bat species determined from range-maps (BCI website; Harvey et al. 1999) as likely to occur within the Lower Snake River Wind Resource Area, sorted by call frequency.

Common Name	Scientific Name
High-frequency (> 35 kHz)	
California bat	*Myotis californicus*
western small-footed bat	*Myotis ciliolabrum*
western long-eared bat	*Myotis evotis*
little brown bat[3]	*Myotis lucifugus*
long-legged bat	*Myotis volans*
Yuma bat	*Myotis yumanensis*
western pipistrelle[2,3]	*Parastrellus hesperus*
Low-frequency (< 35 kHz)	
pallid bat	*Antrozous pallidus*
Townsend's big-eared bat	*Corynorhinus townsendii*
big brown bat[3]	*Eptesicus fuscus*
spotted bat[2]	*Euderma maculatum*
silver-haired bat[1,3]	*Lasionycteris noctivagans*
hoary bat[1,3]	*Lasiurus cinereus*
fringed bat	*Myotis thysanodes*

1 = long-distance migrant; 2 = species distribution on edge or just outside project area; 3 = known casualty from wind turbines.

Table 4.8 Results of acoustic bat surveys conducted at the Lower Snake River Wind Resource Area, April 30 - October 31, 2008.

Anabat Location	# of HF Bat Passes	# of LF Bat Passes	# of Hoary Bat Passes*	Total Bat Passes	Detector-Nights	Bat Passes/ Night
DF1	5	105	7	110	177	0.62
DF2	17	59	4	76	88	0.86
KR1	0	73	3	73	178	0.41
KR2	8	1	0	9	57	0.16
OL1	64	58	2	122	185	0.66
OL2	820	129	11	949	185	5.13
TU1	30	31	3	61	184	0.33
TU2	27	45	2	72	165	0.44
Total	**971**	**501**	**32**	**1,472**	**1,219**	**1.08**

*Passes by hoary bats included in low-frequency (LF) numbers.

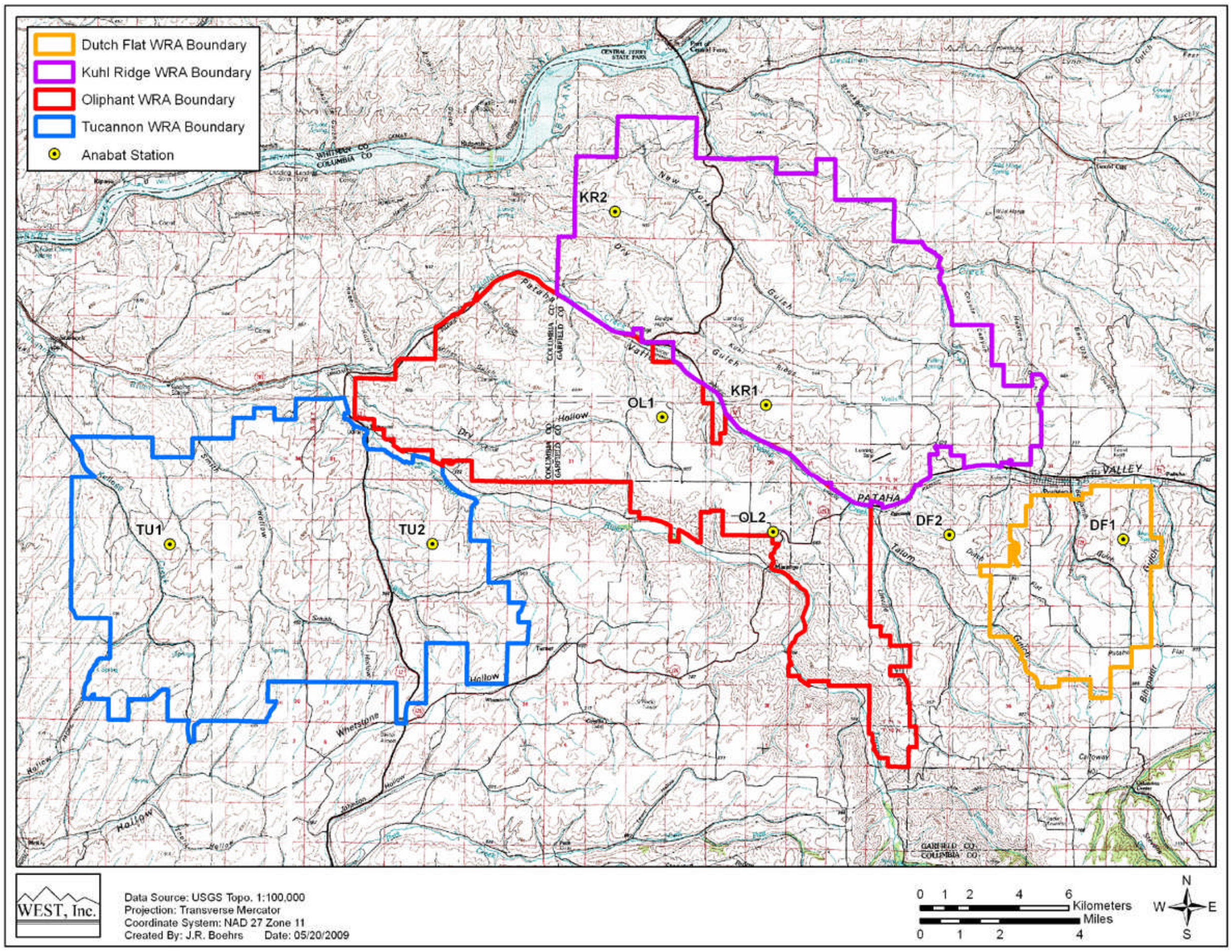


Figure 4.3 Anabat sampling locations within the Lower Snake River Wind Resource Area.

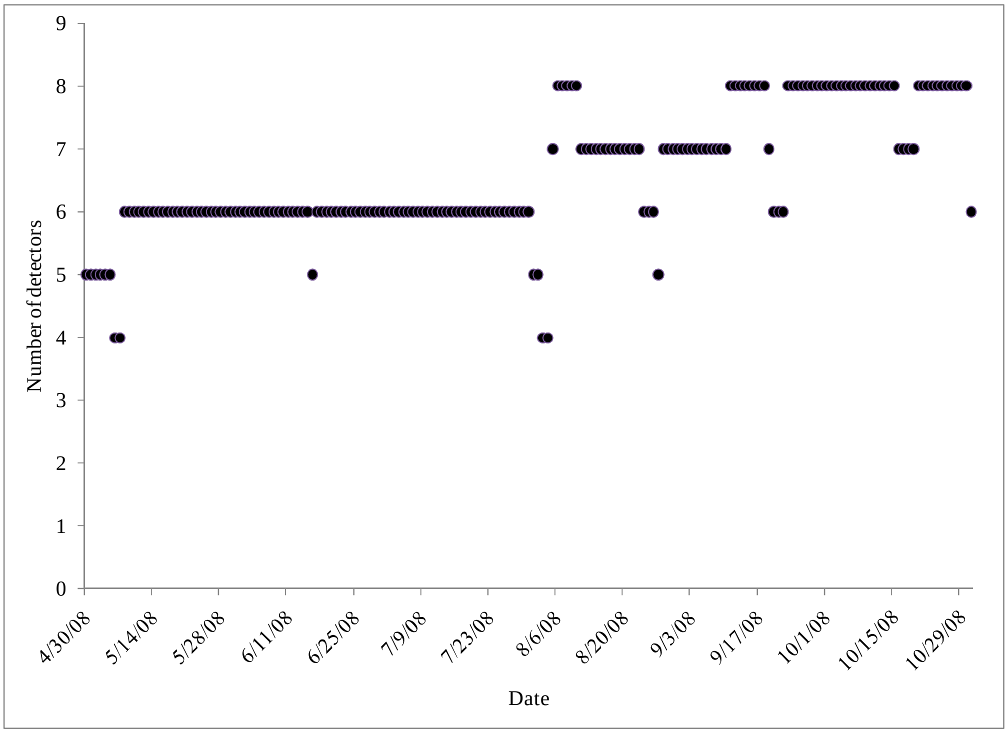


Figure 4.4 Number of Anabat detectors (n = 8) at the Lower Snake River Wind Resource Area operating during each night of the study period April 30 – October 31, 2008.

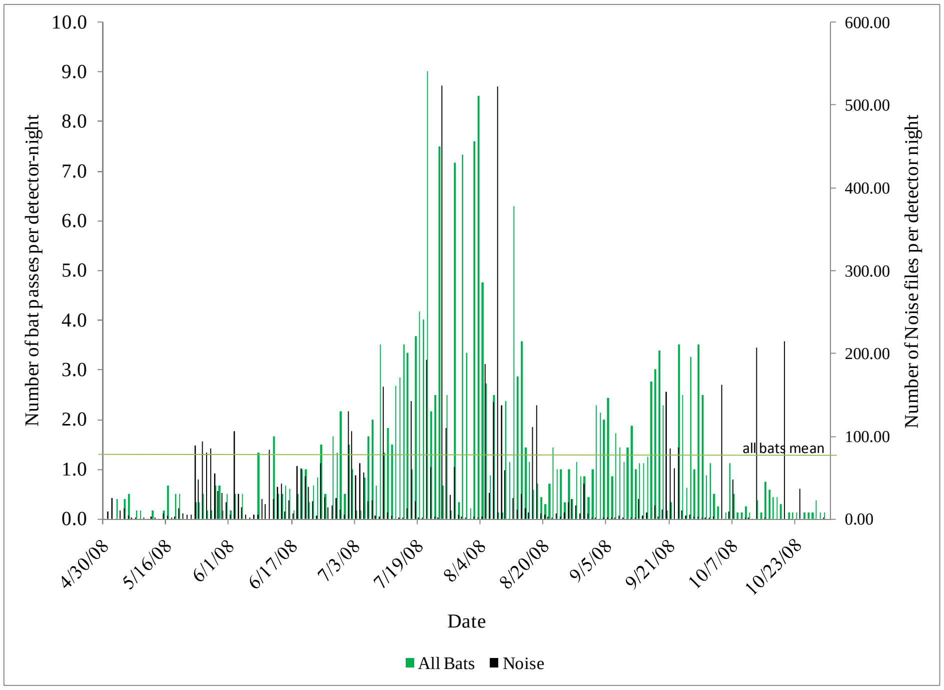


Figure 4.5 Number of bat passes and noise files detected per detector-night at the Lower Snake River Wind Resource Area for the study period April 30 – October 31, 2008, presented nightly. Noise files are indicated on the second axis.

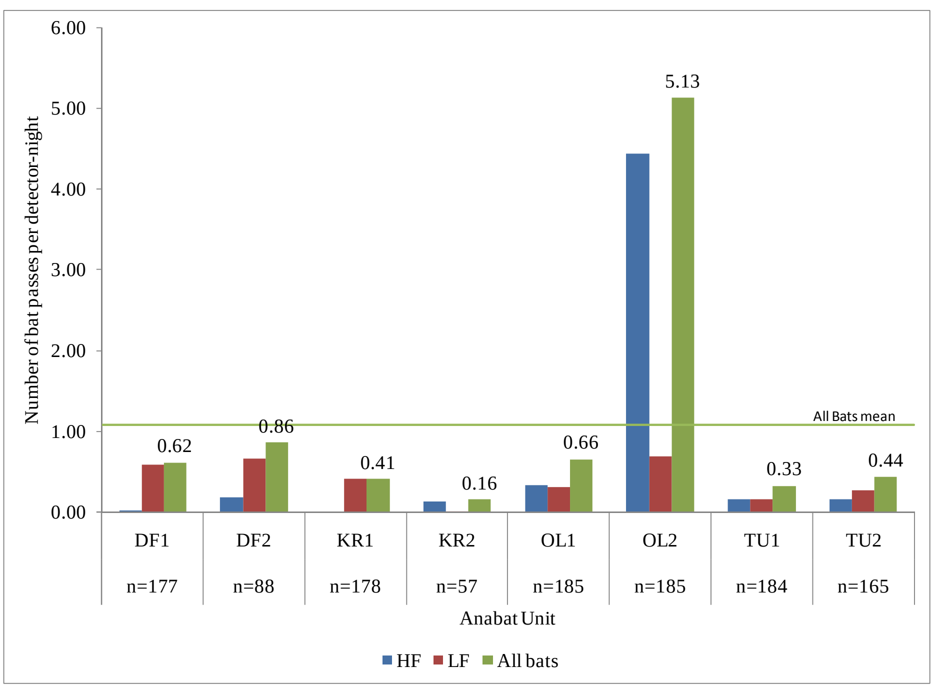


Figure 4.6 Number of bat passes per detector-night by Anabat location at the Lower Snake River Wind Resource Area for the study period April 30 – October 31, 2008.

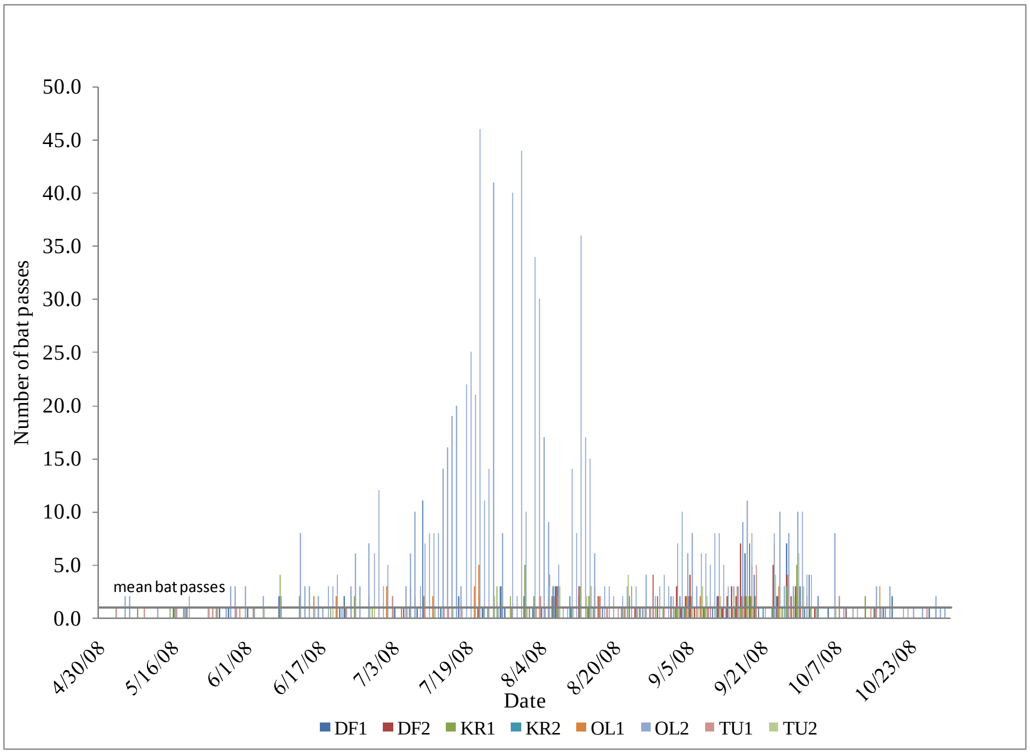


Figure 4.7 Number of nightly bat passes, grouped by Anabat location at the Lower Snake River Wind Resource Area for the for the study period April 30 – October 31, 2008. Station OL2 recorded far more activity than other stations through the end of August.

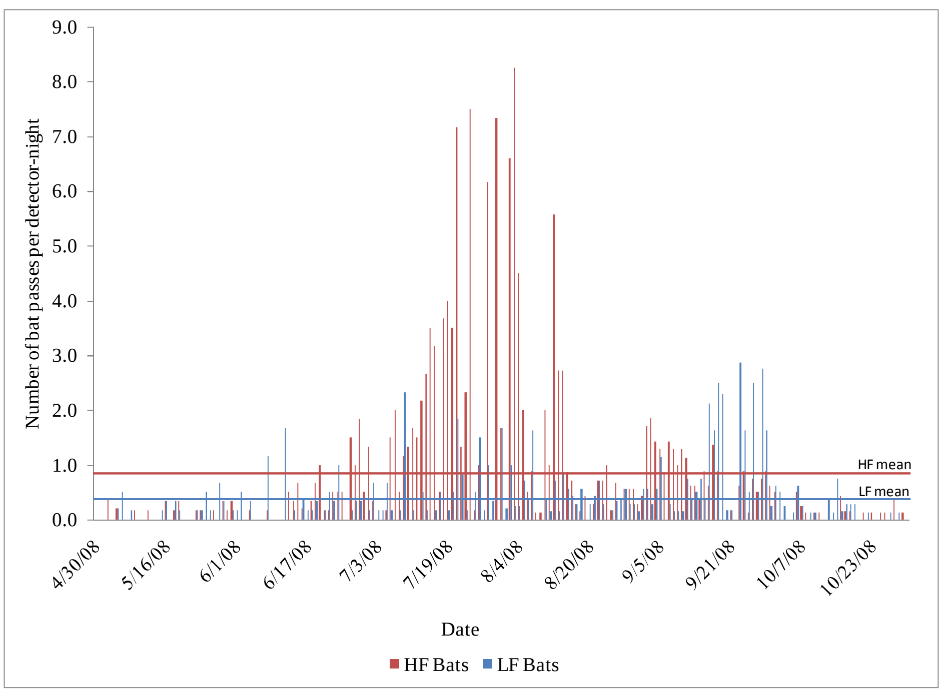


Figure 4.8 Nightly activity by high-frequency (HF) and low-frequency (LF) bats at the Lower Snake River Wind Resource Area for the study period April 30 – October 30, 2008.

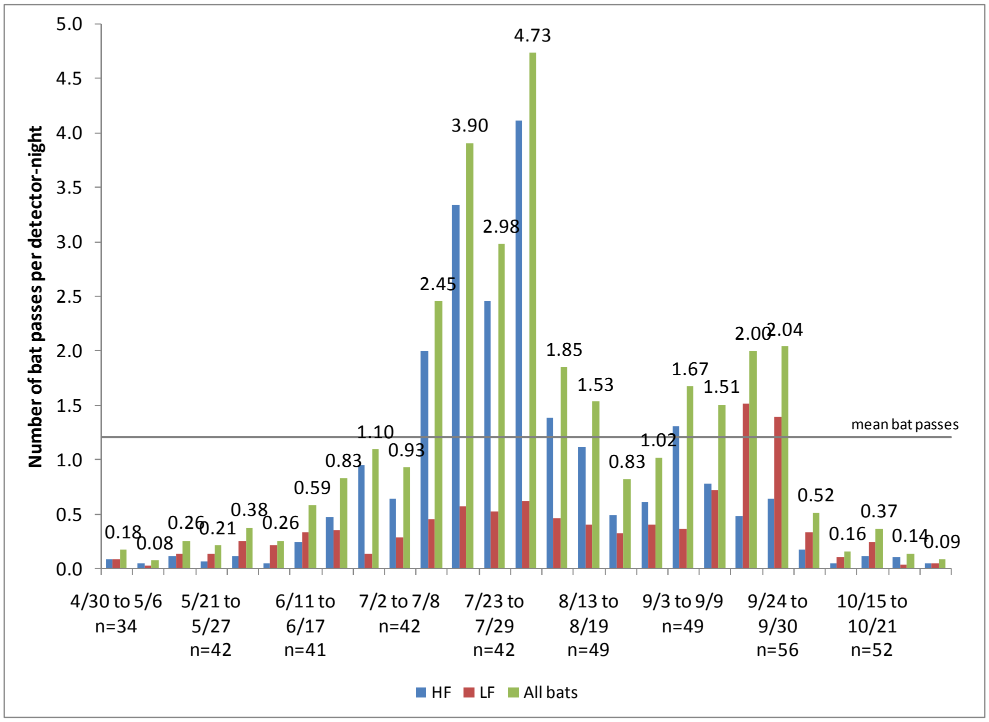


Figure 4.9 Weekly activity by high-frequency (HF) and low-frequency (LF) bats at the Lower Snake River Wind Resource Area for the study period April 30 – October 31, 2008.

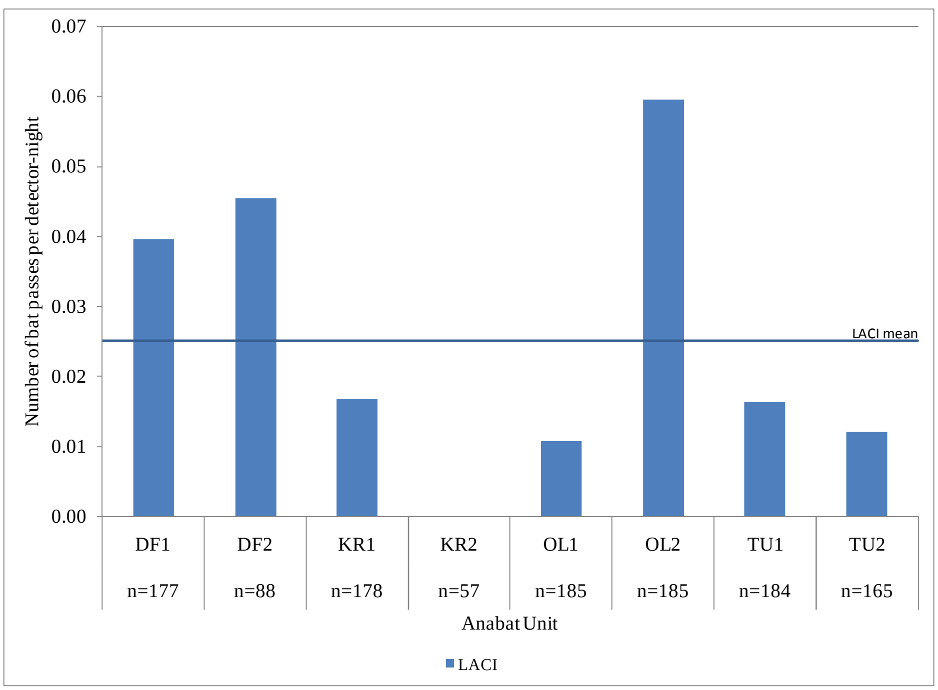


Figure 4.10 Number of passes per detector–night by hoary bats, by Anabat station at the Lower Snake River Wind Resource Area, for the study period April 30 – October 31, 2008.

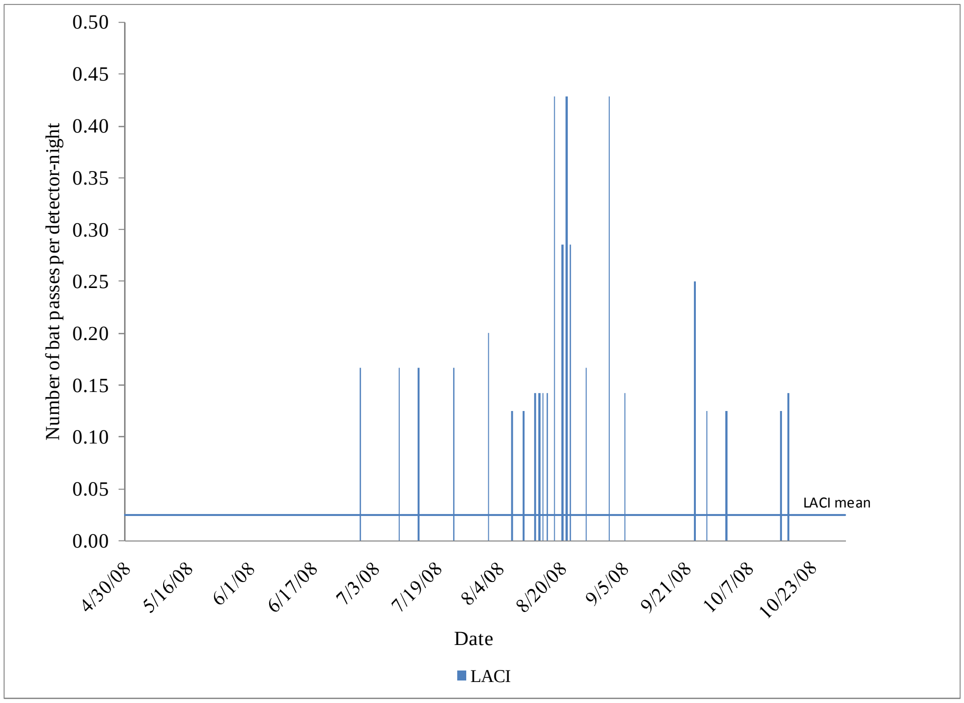


Figure 4.11 Number of passes per detector–night by hoary bats at the Lower Snake River Wind Resource Area, presented nightly for the study period April 30 – October 31.

4.4 Incidental Wildlife and Sensitive Species Observations

A total of 1,333 birds within 904 groups of 22 species were observed incidentally in the LSRWRA (Table 4.9). Seven mammal species were also observed incidentally at the LSRWRA.

The most abundant bird species recorded as an incidental wildlife observation were red-tailed hawk (735 observations) and northern harrier (102), followed by common raven (*Corvus corax*; 87), Swainson's hawk (87), and rough-legged hawk (*Buteo lagopus*; 70; Table 4.9). The most abundant mammal species recorded incidentally were elk (*Cervus elephus*; 68 observations) and mule deer (*Odocoileus hemionius*; 45), followed by coyote (*Canis latrans*; 87), and white-tailed deer (*Odocoileus virginianus*; 14; Table 4.9).

No federal- or state-listed threatened, endangered, or candidate species were observed in the LSRWRA (ECOS 2009). The Washington Department of Fish and Wildlife (WDFW) maintains a list of State and Federal threatened, endangered, candidate, and sensitive species, as well as species of concern. Additionally, the WDFW also maintains a list of State monitored species. These monitored species are not considered species of concern by the WDFW, but are managed as required to prevent these species from being listed as endangered, threatened, or sensitive (WDFW 2008; WDNR 2008).

Eight State sensitive species were observed during fixed-point surveys, raptor nest surveys, or incidentally at the LSRWRA, totaling 138 observations in 104 groups (Table 4.10). Washington species of concern included golden eagle (52 observations), Vaux's swift (*Chaetura vauxi*; 40), vesper sparrow (*Pooecetes gramineus*; 27), merlin (six), burrowing owl (one), and sage thrasher (*Oreoscoptes montanus*; one). Bald eagle, a State sensitive species, was also observed (seven observations), as well as ferruginous hawk (four), a State threatened species. Most sensitive species observations (84.8%) were recorded during fixed-point bird use surveys, mostly due to 41 observations of golden eagle and 40 observations of Vaux's swift which comprised 29.7% and 29.0%, respectively, of all sensitive species observed in the LSRWRA during all surveys. One species, the burrowing owl, was only recorded during raptor nest surveys and was not observed during fixed-point surveys or incidentally; all other sensitive species were observed during the fixed-point surveys.

During fixed-point surveys only at the LSRWRA, seven State sensitive species were observed, totaling 117 observations in 83 groups (Table 4.11). Washington species of concern included golden eagle (41 observations), Vaux's swift (*Chaetura vauxi*; 40), vesper sparrow (*Pooecetes gramineus*; 27), merlin (three), and sage thrasher (*Oreoscoptes montanus*; one). Bald eagle, a State sensitive species, was also observed (three observations), as well as ferruginous hawk (two), a State threatened species. Most sensitive species observations (70.9%) were recorded in the Oliphant project area, mostly due to 28 observations of golden eagle and 35 observations of Vaux's swift.

Seven monitored species were observed during fixed-point surveys, raptor nest surveys, or incidentally at the LSRWRA, totaling 348 observations in 258 groups (Table 4.10). The most common monitored species observed at the LSRWRA was Swainson's hawk (189 observations), followed by grasshopper sparrow (*Ammodramus savannarum*; 72). Most monitored species observations (67.2%) were recorded during fixed-point bird use surveys, mostly due to 117 observations of Swainson's hawk, which comprised 33.6% of all monitored species observed in the LSRWRA during all surveys.

All seven monitored species were observed during fixed-point bird use surveys, totaling 234 birds in 190 groups (Table 4.11). The most common monitored species observed at the LSRWRA was Swainson's hawk (117 observations), followed by grasshopper sparrow (70). Most monitored species observations (44.9%) were recorded in the Tucannon project area mostly due to 69 observations of Swainson's hawk.

Table 4.9 Incidental wildlife observed during surveys at the Lower Snake River Wind Resource Area.

Species	Scientific Name	# Grps	# Obs
red-tailed hawk	*Buteo jamaicensis*	522	735
northern harrier	*Circus cyaneus*	92	102
common raven	*Corvus corax*	13	87
American kestrel	*Falco sparverius*	71	87
Swainson's hawk	*Buteo swainsoni*	55	72
rough-legged hawk	*Buteo lagopus*	64	70
snow bunting	*Plectrophenax nivalis*	1	40
great-horned owl	*Bubo virginianus*	30	38
great blue heron	*Ardea herodias*	4	31
sharp-shinned hawk	*Accipter striatus*	11	13
wild turkey	*Meleagris gallopavo*	1	12
golden eagle	*Aquila chrysaetos*	10	10
prairie falcon	*Falco mexicanus*	8	9
bald eagle	*Haliaeetus leucocephalus*	4	4
Cooper's hawk	*Accipiter cooperii*	2	3
merlin	*Falco columbarius*	3	3
unidentified buteo		1	3
short-eared owl	*Asio flammeus*	2	2
ferruginous hawk	*Buteo regalis*	2	2
grasshopper sparrow	*Ammodramus savannarum*	1	2
killdeer	*Charadrius vociferus*	1	2
burrowing owl	*Athene cunicularia*	1	1
northern shrike	*Lanius excubitor*	1	1
ring-necked pheasant	*Phasianus colchicus*	1	1
Say's phoebe	*Sayornis saya*	1	1
spotted towhee	*Pipilo maculatus*	1	1
unidentified grouse		1	1
Bird Subtotal	**22 species**	**904**	**1,333**
elk	*Cervus elephus*	6	68
mule deer	*Odocoileus hemionius*	3	45
coyote	*Canis latrans*	15	23
white-tailed deer	*Odocoileus virginianus*	2	14
porcupine	*Erethizon dorsatum*	7	7
badger	*Taxidea taxus*	1	1
red fox	*Vulpes vulpes*	1	1
unidentified ground squirrel		1	1
Mammal Subtotal	**7 species**	**36**	**160**
Total		**940**	**1,493**

Table 4.10 Summary of sensitive and monitored species observed during fixed-point bird use surveys, raptor nest surveys, and incidentally at the Lower Snake River Wind Resource Area.

			Fixed-Point Bird Use Surveys		Raptor Nest Surveys		Incidental Observations		Total	
Species	**Scientific Name**	**Status**	**grp**	**obs**	**grp**	**obs**	**grp**	**obs**	**grp**	**obs**
golden eagle	*Aquila chrysaetos*	SC	41	41	3	3	8	8	52	52
Vaux's swift	*Chaetura vauxi*	SC	14	40	0	0	0	0	14	40
vesper sparrow	*Pooecetes gramineus*	SC	19	27	0	0	0	0	19	27
bald eagle	*Haliaeetus leucocephalus*	SS	3	3	0	0	4	4	7	7
merlin	*Falco columbarius*	SC	3	3	0	0	3	3	6	6
ferruginous hawk	*Buteo regalis*	ST	2	2	0	0	2	2	4	4
burrowing owl	*Athene cunicularia*	SC	0	0	1	1	0	0	1	1
sage thrasher	*Oreoscoptes montanus*	SC	1	1	0	0	0	0	1	1
State Sensitive Species Subtotal			**83**	**117**	**4**	**4**	**17**	**17**	**104**	**138**
Swainson's hawk	*Buteo swainsoni*	SM	107	117	0	0	55	72	162	189
grasshopper sparrow	*Ammodramus savannarum*	SM	56	70	0	0	1	2	57	72
great blue heron	*Ardea herodias*	SM	1	1	4	31	0	0	5	32
western bluebird	*Sialia mexicana*	SM	7	25	0	0	0	0	7	25
prairie falcon	*Falco mexicanus*	SM	10	10	1	2	7	7	18	19
turkey vulture	*Cathartes aura*	SM	5	7	0	0	0	0	5	7
osprey	*Pandion haliaetus*	SM	4	4	0	0	0	0	4	4
Monitored Species Subtotal			**190**	**234**	**5**	**33**	**63**	**81**	**258**	**348**
Total			**273**	**351**	**9**	**37**	**80**	**98**	**362**	**486**

ST = State threatened; SS = State sensitive; SC = State species of concern; SM = State monitored species.

Table 4.11 Sensitive and monitored species observed during fixed-point surveys in the Tucannon, Oliphant, Kuhl Ridge, Dutch Flats areas, and for the Lower Snake River Wind Resource Area as a whole.

			TWRA		OWRA		KRWRA		DFWRA		LSRWRA (Total)	
Species	**Scientific Name**	**Status**	**grp**	**obs**	**grp**	**obs**	**grp**	**obs**	**grp**	**obs**	**grp**	**obs**
golden eagle	*Aquila chrysaetos*	SC	8	8	28	28	1	1	4	4	41	41
Vaux's swift	*Chaetura vauxi*	SC	2	5	12	35	0	0	0	0	14	40
vesper sparrow	*Pooecetes gramineus*	SC	1	4	13	17	1	1	4	5	19	27
bald eagle	*Haliaeetus leucocephalus*	SS	0	0	3	3	0	0	0	0	3	3
merlin	*Falco columbarius*	SC	1	1	0	0	2	2	0	0	3	3
ferruginous hawk	*Buteo regalis*	ST	0	0	0	0	2	2	0	0	2	2
sage thrasher	*Oreoscoptes montanus*	SC	1	1	0	0	0	0	0	0	1	1
State Sensitive Species Subtotal			**13**	**19**	**56**	**83**	**6**	**6**	**8**	**9**	**83**	**117**
Swainson's hawk	*Buteo swainsoni*	SM	63	69	2	2	39	43	3	3	107	117
grasshopper sparrow	*Ammodramus savannarum*	SM	11	16	30	34	11	15	4	5	56	70
western bluebird	*Sialia mexicana*	SM	3	11	0	0	1	3	3	11	7	25
prairie falcon	*Falco mexicanus*	SM	0	0	0	0	7	7	3	3	10	10
turkey vulture	*Cathartes aura*	SM	4	6	0	0	0	0	1	1	5	7
osprey	*Pandion haliaetus*	SM	2	2	0	0	2	2	0	0	4	4
great blue heron	*Ardea herodias*	SM	1	1	0	0	0	0	0	0	1	1
Monitored Species Subtotal			**84**	**105**	**32**	**36**	**60**	**70**	**14**	**23**	**190**	**234**
Total			**97**	**124**	**88**	**119**	**66**	**76**	**22**	**32**	**273**	**351**

ST = State threatened; SS = State sensitive; SC = State species of concern; SM = State monitored species.

5.0 DISCUSSION AND IMPACT ASSESSMENT

5.1 Fixed Point Bird Use Surveys

The primary objectives of the study included providing site specific data on bird use of the LSRWRA that could be helpful in estimating potential impacts from the proposed wind-energy facility and in project planning to minimize risk and potential impacts to bird and bat resources. The proposed LSRWRA encompassed a wide variety of terrain from broad flat plateau topographic features primarily used for agriculture that are interspersed with steep drainages tributary to larger creeks and rivers (e.g., Tucannon River, Snake River). These areas create distinct physiographic features that could influence bird use in the study area and therefore provide variable spatial density or abundance of birds and bats across the study area. The surveys were designed so that comparable results to numerous other studies conducted at wind facilties across the west and in particular the CPE where numerous post construction monitoring studies have been conducted.

5.1.1 Raptor Use and Exposure Risk

Although high numbers of raptor fatalities have been documented at some wind-energy facilities (e.g., Altamont Pass Wind Resource Area), and thus a reason raptors are a concern with wind development, a review of studies at newer-generation wind-energy facilities across the United States indicated that approximately 3.2% of casualties were raptors (Erickson et al. 2001, 2002; Kerlinger et al. 2005). Within the Pacific Northwest and CPE the percent of avian fatalities being raptors was higher at approximately 8.6% (Johnson and Erickson 2008). 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). Overall the data set is still relatively 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.

The annual mean raptor use at the LSRWRA was compared with other wind-energy facilities that implemented similar protocols and had data for three or four seasons. The annual mean raptor use at other wind-energy facilities ranged from 0.085 to 2.34 birds/20-min survey (Figure 5.1). Mean raptor use at the LSRWRA, 0.71 was near the mid-level compared to the other sites.

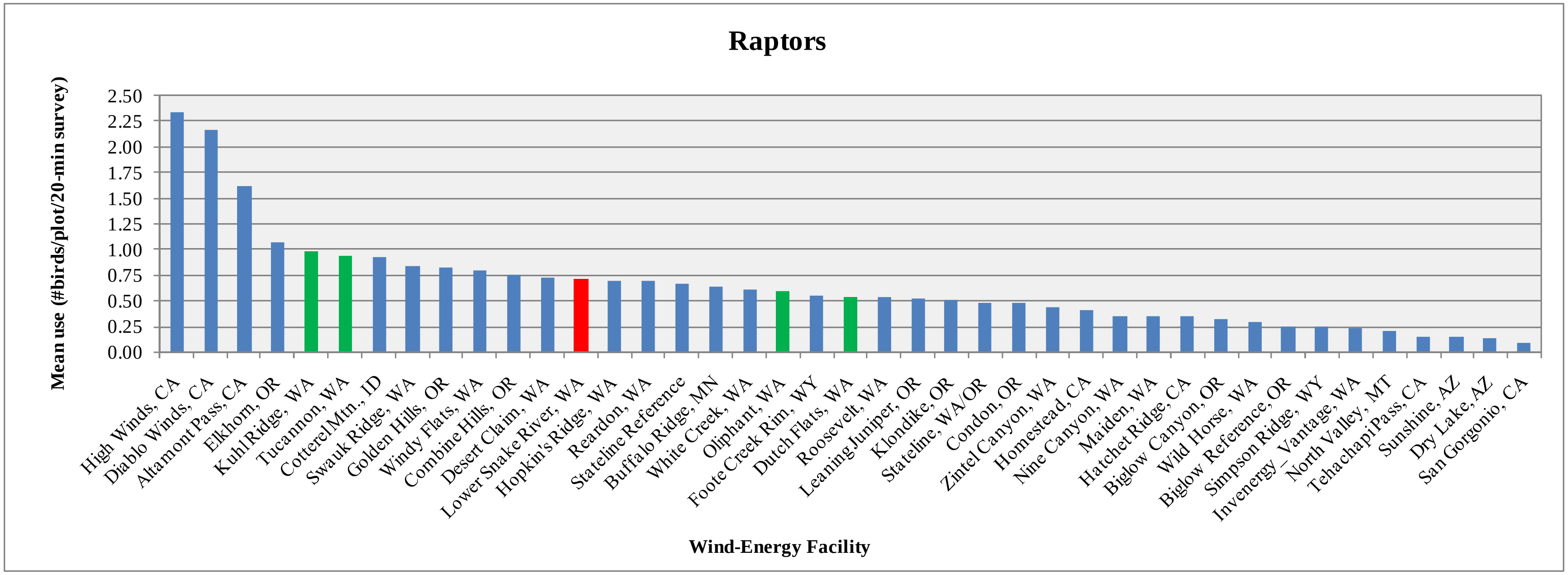


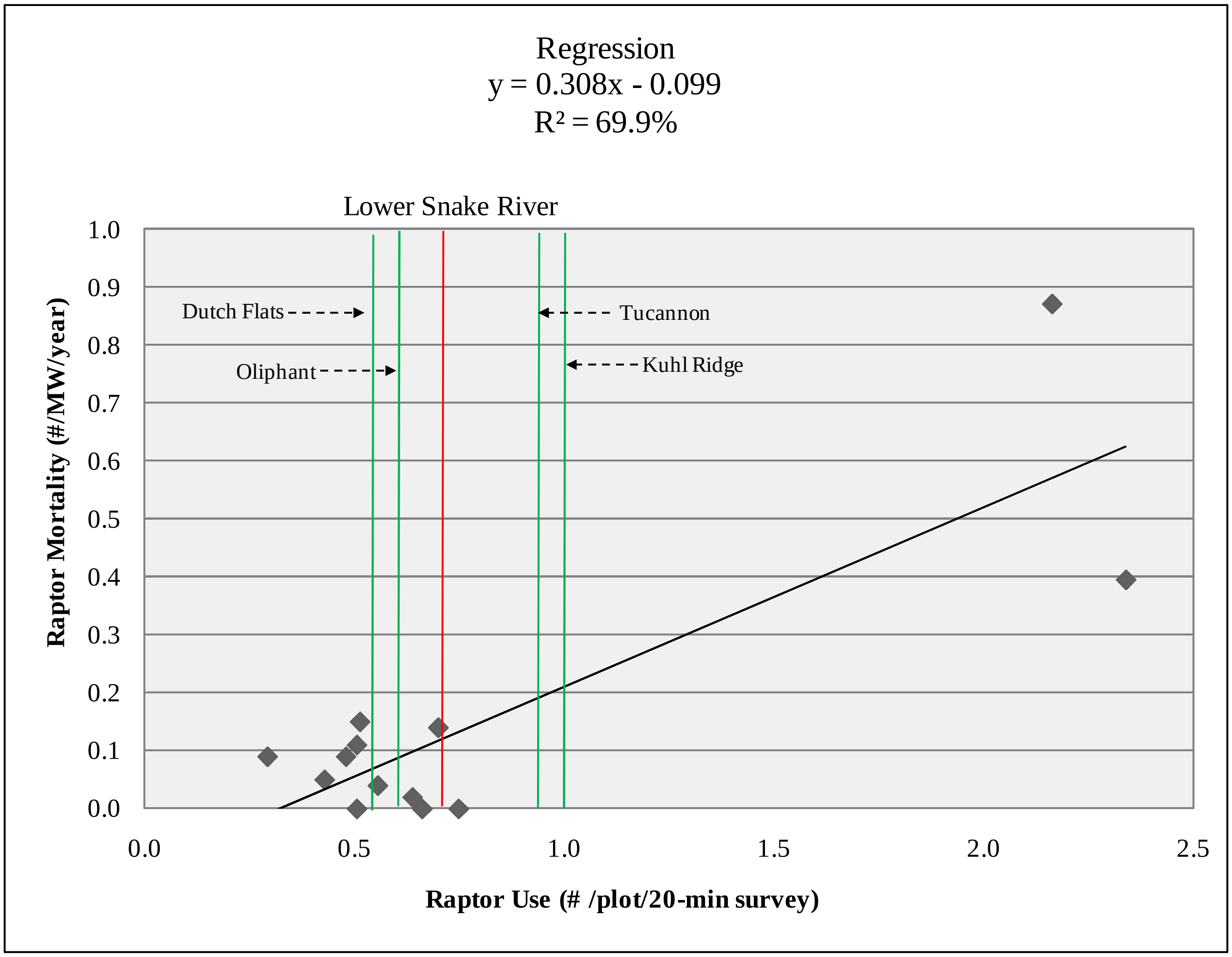
Figure 5.1. Comparison of overall raptor use between the Lower Snake River Wind Resource Area and other US wind-energy facilities.

Data from the following sources:

Lower Snake River, OR	This study.				
High Winds, CA	Kerlinger et al. 2005	Stateline Reference	URS et al. 2001	Maiden, WA	Erickson et al. 2002b
Diablo Winds, CA	WEST 2006a	Buffalo Ridge, MN	Erickson et al. 2002b	Hatchet Ridge, CA	Young et al. 2007c
Altamont Pass, CA	Erickson et al. 2002b	White Creek, WA	NWC and WEST 2005a	Biglow Canyon, OR	WEST 2005c
Elkhorn, OR	WEST 2005a	Foote Creek Rim, WY	Erickson et al. 2002b	Wild Horse, WA	Erickson et al. 2003c
Cotterel Mtn., ID	Cooper et al. 2004	Roosevelt, WA	NWC and WEST 2004	Biglow Reference, OR	WEST 2005c
Swauk Ridge, WA	Erickson et al. 2003a	Leaning Juniper, OR	NWC and WEST 2005b	Simpson Ridge, WY	Johnson et al. 2000
Golden Hills, OR	Jeffrey et al. 2008	Klondike, OR	Johnson et al. 2002	Invenergy_Vantage, WA	WEST 2007
Windy Flats, WA	Johnson et al. 2007	Stateline, WA/OR	Erickson et al. 2002b	North Valley, MT	WEST 2006b
Combine Hills, OR	Young et al. 2003c	Condon, OR	Erickson et al. 2002b	Tehachapi Pass, CA	Erickson et al. 2002b
Desert Claim, WA	Young et al. 2003b	Zintel Canyon, WA	Erickson et al. 2002a	Sunshine, AZ	WEST and the CPRS 2006
Hopkin's Ridge, WA	Young et al. 2003a	Homestead, CA	WEST et al. 2007	Dry Lake, AZ	Young et al. 2007d
Reardon, WA	WEST 2005b	Nine Canyon, WA	Erickson et al. 2001	San Gorgonio, CA	Erickson et al. 2002b

A regression analysis of raptor use and mortality for 13 modern 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 = 69.9%; Figure 5.2). Using this regression to predict raptor collision mortality at the LSRWRA, based on an adjusted mean raptor use of 0.71 birds/20-min survey, yields an estimated fatality rate of 0.09 raptors/MW/year, or nine raptor fatalities per year for a 100-MW wind-energy facility. A 90% prediction interval around this estimate is 0 to 0.23 raptors/MW/year. Raptor fatalities at wind-energy facilities near the LSRWRA fall within this range: Combine Hills wind project (0.0/MW/year; Young et al. 2005), Nine Canyon wind project (0.05/MW/year; Erickson et al. 2003b), Stateline wind project (0.09/MW/year; Erickson et al. 2004), and the Hopkins Ridge wind project (0.14/MW/year; Young et al. 2007a) which is less than two miles south of LSRWRA. The Hopkins Ridge project had a similar pre-project raptor use estimate (0.64 birds/20-min survey) as LSRWRA, further supporting the predicted raptor mortality range, which is relatively low.

Exposure indices analysis may also 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 observations flying, and proportion of flight height of each species within the ZOR for turbines likely to be used at the wind-energy facility. This analysis is based on observations of birds during the daylight period and does not take into consideration flight behavior (e.g. during foraging or courtship) or abundance of nocturnal migrants. It also does not take into consideration habitat selection, the varying ability among species to detect and avoid turbines, and other factors that may vary among species and influence likelihood for turbine collision. For these reasons, the actual risk for some species may be lower or higher than indicated by these data. For example, at the Altamont Pass Wind Resource Area, American kestrels, red-tailed hawks, and golden eagles were killed more often, and turkey vultures and common ravens were killed less often than predicted, based on abundance (Orloff and Flannery 1992). At the LSRWRA, the raptor species with the highest exposure indices were red-tailed hawk which was influenced by the relatively high use estimates by this species. Swainson’s hawk, golden eagle, and rough legged hawk (a winter resident) ranked much lower due again, primarily to the lower use estimates for these species. Based on the results of other studies (see Johnson and Erickson 2008 for a summary of CPE projects) and the results of the baseline studies at LSRWRA, red-tailed hawk is the raptor species most likely affected by the project through direct impacts.



Overall Raptor Use 0.71
Predicted Fatality Rate 0.09/MW/year
90.0% Prediction Interval (0, 0.23)

Figure 5.2 Regression analysis comparing raptor use estimations versus estimated raptor mortality at the Lower Snake River Wind Resource Area.

Data from the following sources:

Study Site and Location	Raptor Use	Source	Raptor Mortality	Source
Buffalo Ridge, MN	0.64	Erickson et al. 2002b	0.02	Erickson et al. 2002b
Combine Hills, OR	0.75	Young et al. 2003c	0.00	Young et al. 2005
Diablo Winds, CA	2.16	WEST 2006a	0.87	WEST 2006a
Foote Creek Rim, WY	0.55	Erickson et al. 2002b	0.04	Erickson et al. 2002b
High Winds, CA	2.34	Kerlinger et al. 2005	0.39	Kerlinger et al. 2006
Hopkins Ridge, WA	0.70	Young et al. 2003a	0.14	Young et al. 2007b
Klondike II, OR	0.50	Johnson 2004	0.11	NWC and WEST 2007
Klondike, OR	0.50	Johnson et al. 2002	0.00	Johnson et al. 2003
Stateline, WA/OR	0.48	Erickson et al. 2002b	0.09	Erickson et al. 2002b
Vansycle, OR	0.66	WCIA and WEST 1997	0.00	Erickson et al. 2002b
Wild Horse, WA	0.29	Erickson et al. 2003c	0.09	Erickson et al. 2008
Zintel, WA	0.43	Erickson et al. 2002a	0.05	Erickson et al. 2002b
Bighorn, WA	0.51	Johnson and Erickson 2004	0.15	Kronner et al. 2008

5.1.2 Non-raptor Avian Use and Exposure Risk

Of the non-raptor avian groups, passerines have been the most abundant avian fatality at newer generation wind facilities, often comprising more than 80% of the avian fatalities (Erickson et al. 2001, Johnson and Erickson 2008). Both migrant and resident passerine fatalities have been observed. Based on species and date information, in some studies up to 70% of fatalities found were believed to be migrants (Howe et al. 2002); however, the estimates are highly variable and range from 0 to 70%. In general, the number of migrant fatalities is higher in wind projects in the eastern United States (see Erickson et al. 2002b). The overall national average for passerine fatalities at wind projects has been approximately 2.2 birds/turbine/year (Erickson et al. 2002b).

The LSRWRA also does not appear to provide important stopover habitat for migrant songbirds based on the results of the fixed point bird use surveys. The primary land use, agriculture, like does not provide attractive stopover habitat and the site is not unique compared to surrounding areas. The project area appears to receive very little use by waterfowl, waterbirds, or shorebirds and these species are unlikely to be affected by the project either directly or indirectly. Passerines, doves, and upland gamebirds were the most abundant non-raptor bird groups observed. While upland gamebird and dove use estimates were relatively low compared to passerines, results from monitoring studies in the CPE, and including the nearby Hopkins Ridge wind project, indicate that these species will likely sustain some direct mortality impacts. Most of the gamebird species are introduced species and impacts are not likely to be significant. Also, the most common dove species was rock pigeon, also an introduced and non-protected species.

Exposure indices of passerines indicate that the vast majority of species recorded during the surveys tend not to fly within the rotor swept zone and are relatively uncommon in the study area. While use was variable across seasons, a few common open grassland species; horned lark, western meadowlark, common raven, European starling, made up the vast majority of passerine use in the study area. Provided that relative abundance is related to exposure and risk of collision, these species would be the most likely affected by the project through direct impacts. Results of other monitoring studies corroborate this as horned lark, European starling, and western meadowlark are three of the most commonly found passerine fatalities at CPE wind projects (Johnson and Erickson 2008). Population estimates for horned lark and western meadowlark in the CPE are very high. Results of USGS BBS surveys suggest that the CPE population for these species is well over 100,000 breeding birds (Saur et al. 2008). Potential mortality impacts to these species from the project will be insignificant. European starling, as with rock pigeon, in an introduced non-protected species and there is no concern over impacts to this species. Despite relatively high use and exposure, common ravens are rarely reported as fatalities according to monitoring studies at other wind-energy facilities (Erickson et al. 2001a; 2002b, Young and Poulton 2007, Johnson and Erickson 2008) and no common raven fatalities were recorded during two year of monitoring at the Nearby Hopkins Ridge project (Young et al. 2007, 2009). No impacts to common ravens are expected from the project.

Predicting numbers of fatalities is difficult, however, the results of monitoring studies within the CPE provide a basis for estimating mortality (Table 5.1). Estimates of mortality for all birds have ranged from approximately 1.0 to 3.2 birds/MW for CPE wind project. Using this as a basis for the proposed LSR project, it is expected that between approximately 100 and 300 bird fatalities would occur per year for each 100 MW constructed. The majority of these fatalities would be passerines as upto 80% of fatalities recorded at CPE projects are passerines (Young and Poulton 2007, Johnson and Erickson 2008). Due to the overall low numbers of non-raptor fatalities expected and the high population sizes for the species most likely affected, is unlikely that non-raptor populations will be adversely affected by direct mortality from the operation of the wind-energy facility.

Table 5.1 Raptor, all bird, and bat mortality estimates at existing wind energy projects in the Columbia Plateau Ecoregion.

	Fatality Rate (#/MW/year)			
Project	**Raptors**	**All birds**	**Bats**	**Source**
Wild Horse, WA	0.09	1.6	0.4	Erickson et al. 2008
Bighorn I, WA	0.15	2.6	1.9	Kronner et al. 2008
Combine Hills, OR	0.00	2.6	1.9	Young et al. 2005a
Hopkins Ridge I, WA, 2006	0.14	1.2	0.6	Young et al. 2007
Hopkins Ridge I, WA, 2008	0.07	3.0	1.4	Young et al. 2009
Klondike I, OR	0.00	0.9	0.8	Johnson et al. 2003
Klondike II, OR	0.11	3.1	0.4	NWC and WEST 2007
Leaning Juniper, OR	0.06	3.2	0.9	Kronner et al. 2007
Nine Canyon, WA	0.05	2.8	2.5	Erickson et al. 2001
Stateline, WA/OR	0.10	2.4	1.7	Erickson et al. 2004a, 2007
Vansycle, OR	0.00	1.0	1.1	Erickson et al. 2000
Condon, OR	0.02[a]	0.05[a]	NA[a]	Fishman 2003
Mean	**0.06**	**2.3**	**1.2**	

[a] not adjusted for searcher efficiency or scavenger removal; study methods differed from other projects and were not as rigorous; therefore estimate should be regarded as a minimum mortality estimate and is not included in the overall mean calculation.

5.2 Raptor Nesting

The total study area surveyed for raptor nests was approximately 255 square miles (~660 km^2). Nest density for all raptors in this area was approximately 0.40 nest/mi^2. *Buteos* (red-tailed hawk, Swainson's hawk) accounted for approximately 83% of the nests and red-tailed hawk was by far the most common nesting raptor accounting for approximately 79% of all active raptor nests found. This index of raptor nest density is similar to other nearby wind plants that have been studied in the Oregon/Washington region. For example, raptor nest density within a 2-mile buffer around the Hopkins Ridge wind project to the south was 0.43 nest/mi^2, the Stateline Wind Plant (WA/OR) was 0.20 nest/mi^2 (URS and WEST 2001), and at the Combine Hills wind plant (Umatilla County, Oregon) was 0.24 nest/mi^2 (Young *et al.* 2002b).

The raptor nest density in the LSRWRA appears to be influenced by the proximity of several tributaries to the Snake River (e.g., the Tucannon River, Pataha Creek), which have good raptor nesting habitat in the form of large cottonwood trees and rocky cliffs lining the valley (see Figure

4.2). There are also some raptor nests in isolated trees located in the steep draws leading from the flat agriculture areas on top of the ridges down to the rivers.

Potential impacts to nesting raptors include direct loss of nests, if habitat where nests are located is disturbed by construction, and potential disturbance or displacement effects if construction or facilities occur in close proximity to nests. Due to the location of the majority of nests in the LSRWRA being in the riparian corridors or drainages and proposed facilities being on top of the ridges in the agricultural areas, there is little potential for direct take of a raptor nest. In addition, the raptor nest location file will be used in project planning and design to avoid direct loss of nests.

The nests higher on the ridges or in isolated trees near the flat agricultural areas will be in closer proximity to the proposed turbines and more likely affected through disturbance or displacement. In general, raptor nests are believed to be at greater risk of disturbance (indirect) effects during the construction phases than during project operation. There have been few studies that have addressed nesting raptor displacement at wind-energy facilities, however, the studies that are available suggest that indirect effects are negligible (Howell and Noone 1992; Johnson et al. 2000b; Johnson et al. 2003a; Madders and Whitfield 2006). A Swainson's hawk (*Buteo swainsonii*) was reported nesting within 0.25 mile (0.8 km) of a turbine string at the Klondike facility in Oregon, suggesting little disturbance or habituation to the turbines by this species (Johnson et al. 2003a). At the Foote Creek Rim wind-energy facility in southern Wyoming, one pair of red-tailed hawks nested within 0.3 mile (0.48 km) of the turbine strings, and seven red-tailed hawk, one great horned owl, and one golden eagle nests located within one mile (1.61 km) of the facility successfully fledged young (Johnson et al. 2000b). The golden eagle pair successfully nested 0.5 mile (800 m) from the wind-energy facility for three different years after it became operational. Studies at the Stateline wind-energy facility in Oregon and Washington have not shown any measurable short-term effects to nesting raptors (Erickson et al. 2004).

These observations suggest that there will be limited displacement of nesting raptors at the LSRWRA. Also, as evidenced by the raptor nest survey results, there are numerous active nests in close proximity to the existing Hopkins Ridge and Marengo facilities. Nesting raptors appear to become habituated to the wind facilities once construction is complete and no disturbance or displacement effects are expected from wind project operation.

Red-tailed hawk and great-horned owl, as the most abundant nesting raptors in the study area, are the species at highest risk to disturbance or displacement effects from construction activity. Red-tailed hawk is likely the most common *Buteo* species and great-horned owl likely the most common owl species in North America and both species are nearly ubiquitous across the U.S. and Canada (Preston et al. 2009; Houston et al. 1998). Generally less concern is raised over these species than other species with far smaller populations. Of the nesting raptors recorded, golden eagle is a Washington State Candidate species and scrutiny over potential impacts to this species is expected to be higher. The two golden eagle nests located during the survey are unlikely to be affected by the project construction or operation as they were both located in the buffer zone for the survey and greater than ½ mile from the proposed project areas (see Figure 4.2). No impacts to nesting golden eagles are expected from the LSR wind projects.

5.3 Acoustic Bat Survey

Assessing the potential impacts of wind energy development to bats at the LSRWRA is complicated by a current lack of understanding of why bats die at wind turbines (Kunz et al. 2007b; Baerwald et al. 2008), combined with the inherent difficulties of monitoring elusive, night-flying animals (O'Shea et al. 2003). To date, monitoring studies of wind-energy facilities suggest that (a) migratory tree-roosting species (eastern red [*Lasiurus borealis*], hoary, and silver-haired bats) comprise almost 75% of reported bats killed, (b) the majority of fatalities occur during the post-breeding dispersal or fall migration season (roughly August and September), and (c) the highest reported fatalities occur at wind facilities located along forested ridge tops in the eastern US (Arnett et al. 2008, Gruver 2002, Johnson et al. 2003, Kunz et al. 2007b), although recent studies in agricultural regions of Iowa and Alberta, Canada, report relatively high fatalities as well (Jain 2005, Baerwald 2006).

Some studies of wind projects have recorded both Anabat detections per night and bat mortality (Table 5.2). The number of bat calls per night as determined from bat detectors shows a rough correlation with bat mortality, but may be misleading because effort, timing of sampling, species recorded, and detector settings (equipment and locations) varied among studies (Kunz et al. 2007*b*). The best available estimate of mortality levels at a proposed wind-energy facility often involves evaluation of on-site bat acoustic data in terms of activity levels, seasonal variation, species composition, and topographic features of the project area in conjunction with results of regional monitoring studies.

Table 5.2 Wind projects in the U.S. with both AnaBat sampling data and mortality data for all bat species.

Project Area	Study Period	Bat activity (#/detector/night)	Mortality (#/turbine/yr)	Reference
Lower Snake River, WA	Apr 30-Oct 31, 2008	1.1	na	This study
Foote Creek Rim, WY	Jun 15-Sep 1, 2000-01	2.2	1.3	Gruver 2002
Buffalo Ridge, MN	Jun 15-Sep 1, 2001	2.1	2.2	Johnson et al. 2003
Buffalo Mountain, TN	Apr 1-Sep 30, 2001-02	23.7	20.8	Fieldler 2004
Top of Iowa, IA	May 26-Sep 24, 2004	34.9	10.2	Koford et al. 2005
Mount Storm, WV	July 17-Oct 17, 2008	35.2	24.2	Young et al. 2009
Mountaineer, WV	Aug 1-Sep 14, 2004	38.3	38.0	Arnett 2005

Influence of Activity

Bat activity within the LSRWRA (mean of 1.1 bat passes per detector-night) was fairly low and lower than activity observed at facilities in Minnesota and Wyoming, where bat mortality was low, and was much lower than activity recorded at sites in West Virginia, Iowa and Tennessee, where bat mortality rates were high (Table 5.2). Thus, based on the presumed relationship between bat activity as measured by anabat detectors and post-construction fatalities, bat mortality rates at LSRWRA are expected to be low and likely similar to the average for other wind projects within the CPE (Table 5.1).

Spatial Variation

Bat activity was variable across the sampling stations but the highest activity recorded, 5.1 bat detections/detector night, was still much lower than sites where bat mortality has been high. The proposed wind-energy facility is not located near any known bat colonies or other features that are likely to attract large numbers of bats, but it is expected that areas within the LSRWRA, such as the riparian corridors, likely receive higher bat use than the areas where turbines will be constructed. The LSRWRA does not appear to contain topographic features that may funnel migrating bats, and is lacking forest cover, such as present at the high-mortality sites in the eastern U.S. However, the larger numbers of bat fatalities have been reported in northern Iowa (Jain 2005) and southwestern Alberta (Baerwald 2006) and indicate that an open landscape is no guarantee of low mortality.

Temporal Variation

Bat activity at the site was relatively consistent from June to August and likely represented foraging by resident bats and the fall migration period for bats (August). Overall activity dropped off in September, which is likely an indication that most migrant bats have moved through by this time and resident bats have retreated to areas around hibernacula.

Fatality studies of bats at wind-energy facilities in the US have shown a peak in mortality in August and September and generally lower mortality earlier in the summer (Johnson 2005; Arnett et al. 2008). While the survey effort varies among the different studies, the studies that combine Anabat surveys and fatality surveys show a general association between the timing of increased bat call rates and timing of mortality, with both call rates and mortality peaking during the fall (Kunz et al. 2007*b*). These findings are supported by monitoring studies from CPE wind projects (see for example Young et al. 2007, 2009). Based on the available data, it is expected that bat mortality at the LSRWRA will be highest in August with little to no mortality in the spring and early summer.

Species Composition

Of the 14 species of bat with potential to occur in the study area, five are known fatalities at wind-energy facilities (see Table 4.7). Bat acoustic surveys were unable to determine all bat species present in the study area, but they were able to distinguish high-frequency (HF) from low-frequency (LF) species and hoary bats. Roughly two-thirds of passes were by high-frequency bats, suggesting higher relative abundance of species such as western pipistrelle and *Myotis* sp. High frequency bats do not appear to be as at high a risk of turbine collision as low frequency bats. Despite the higher relative abundance of high frequency bats, CPE monitoring studies are consistent with the finding that high frequency bats are at lower risk (Young and Poulton 2007, Johnson and Erickson 2008). In general, high frequency bats were more common than low frequency bats during the summer months and low frequency bats were more common in the fall, which likely represents when the low frequency bats migrated through the area.

Overall, the Anabat survey results do not suggest that bat mortality impacts from the LSR would be different than other CPE wind projects. Mortality is likely to be primarily of hoary bats and silver-haired bats and be highest during the months of August and September. Minor impacts are expected to other species, little brown and big brown bats and during the spring and early summer.

6.0 CONCLUSION AND RECOMMENDATIONS

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