Portland General Electric
Biglow Canyon Wind Farm Phase I
Post-Construction Avian and Bat Monitoring
First Annual Report
Sherman County, Oregon

January, 2008 – December, 2008

Prepared for:

Portland General Electric Company
121 SW Salmon Street
Portland, OR 97204

Prepared by:

Jay D. Jeffrey, Kimberly Bay, Wallace Erickson, Michelle Sonnenberg,
Jerry Baker, Matt Kesterke, JR Boehrs, and Andrea Palochak

Western **E**co**S**ystems **T**echnology, Inc.
2003 Central Avenue
Cheyenne, Wyoming
&
5 W. Alder St. Suite 234
Walla Walla, Washington

WEST, Inc.

April 29, 2009

1.0 EXECUTIVE SUMMARY

The Biglow Canyon Wind Farm is located in the Columbia Plateau Ecoregion (CPE) of the Pacific Northwest. The facility is located in the rolling hills near the town of Wasco, 140 miles east of Portland, Oregon. The John Day River corridor borders the project to the east and the Columbia River gorge borders the north. Phase I of the wind project consists of 76 1.65-MW wind turbines for a total nameplate capacity of 125.4 MW. As part of conditions under the Biglow Canyon Wind Farm Site Certificate with the State of Oregon Energy Facility Siting Council (EFSC), the certificate holder, Portland General Electric (PGE) is required to implement a two-year (24-month) operational (post-construction) monitoring study for each phase of the facility to evaluate impacts to bird and bat species. Data were collected according to a monitoring protocol developed in collaboration with the Oregon Department of Fish and Wildlife (ODFW). The protocol for this monitoring study includes bird and bat carcass surveys at turbines (Fatality Monitoring) as well as bird use surveys (Avian Use and Behavior). The first year of monitoring surveys was conducted on the site between January and December 2008.

Fatality Monitoring

The primary objective of the Fatality Monitoring study was to estimate the number of avian and bat casualties attributable to collisions with wind turbines for the entire project on an annual basis. The monitoring study consists of five components: (1) standardized carcass searches of selected turbines or turbine strings; (2) searcher efficiency trials to estimate the percentage of carcasses found by searchers; (3) carcass removal trials to estimate the length of time that a carcass remains in the field for possible detection; (4) adjusted fatality estimates for bird and bat species calculated using the results from searcher efficiency trials and carcass removal trials to estimate the total number of avian and bat fatalities within the wind resource area; and 5) a Wildlife Incident Reporting and Handling System for wind project personnel to handle and report casualties found in the project incidentally to the study.

Carcass searching surveys took place at 50 Phase I turbines during 2008. As per protocols, standardized scheduled searches of all selected 50 turbines were searched once every four-week (28-day) period during the winter and summer seasons, and approximately twice per month during the spring and fall seasons. Square or rectangular search plots were a minimum of 110 m from turbines within the plot to the side of the study plot (141 m from turbine to plot corner). Surveyors walked parallel transects within the search plot spaced approximately 6 m apart while scanning the ground for fatalities or injured birds or bats. A total of 850 turbine searches were conducted over the one year monitoring study period (January-December 2008).

A total of 17 search periods of all study plots were conducted throughout the year covering four seasons. Forty-two bird fatalities comprising 20 identified species and 50 bat fatalities comprising two identifiable species were found during standard carcass surveys and incidentally. No Federal or State Threatened or Endangered species, or State Sensitive species, were found during the study. Bird fatalities were found near 22 different turbines; bat fatalities were found near 29 different turbines. The average distance of bird casualties to the nearest turbine was 79 meters; the average distance of bat casualties to the nearest turbine was 29 meters.

The most common bird species found included 12 horned larks (28.6% of fatalities) and 7 ring-necked pheasants (16.7%). All other bird species comprised less than five percent of total bird

fatalities found. Two raptors were found, one rough-legged hawk and one red-tailed hawk.

Fatalities were found throughout the year, but rates were slightly higher in the spring (33%) and fall (38%), followed by the summer (21%), and lowest in winter (0.7%). There was no strong concentration of avian fatalities within the search plots. One turbine (T17) had four fatalities and four turbines (T15, T47, T64, and T67) had three fatalities; often including horned lark and gamebird fatalities. Most turbine searches produced no fatalities.

Fifty bat fatalities were found during the 2008 fatality study. Except for one hoary bat and three silver-haired bats found between April 29 and June 23, all bat fatalities were observed between August 19 and October 16, 2008; considered the fall migration season for bats. Hoary bats comprised 50% (25 fatalities) and silver-haired bat comprised 50% (25 fatalities) of the bat fatalities. There did not appear to be any strong concentrations of bat fatalities within the search plots. Bat fatalities were distributed throughout the study area and were not concentrated within particular search plots. The maximum number of bats found at any one turbine was four (T36: two silver-haired bats and two hoary bats; all individuals found independently over 4 different survey intervals). Bat fatalities at other turbines ranged from zero to two per turbine.

Overall fatality estimates were calculated by adjusting for carcass removal and observer detection bias. The estimated number of all bird fatalities per turbine per year for the first year of study was 2.90 (1.76 per MW per year). The estimated number of all bird fatalities excluding the introduced species, ring-necked pheasant, gray partridge, chukar, and rock pigeon, was 2.53 per turbine per year (1.53 per MW per year). The estimated number of small bird fatalities per turbine per year was 2.55 (1.54 per MW per year) and the estimated number of large bird fatalities per turbine per year was 0.35 (0.21 per MW per year). The estimated number of nocturnal migrant fatalities per turbine per year was 0.72 (0.44 per MW per year). For raptors the number of fatalities per turbine per year was estimated to be 0.06 (0.03 per MW per year).

Adjustments for carcass removal and observer detection bias for bats were made using the estimates for small birds. The estimated number of bat fatalities per turbine per year for the second year of study was 3.29 (1.99 per MW per year).

Fatality estimates for birds and bats from the study are similar to other wind projects in the Columbia Plateau Ecoregion of the Pacific Northwest. All fatalities found were assumed to be wind project related so the estimate of avian mortality is an over-estimate of actual wind project mortality. In order to compare Biglow Canyon to other wind projects with different turbines, the fatality rates were standardized on a per MW capacity basis.

For Biglow Canyon the estimate was 1.76 birds per MW per year. This estimate was higher than nearby Klondike I (0.9 bird fatalities/MW/year) but lower than Klondike II (3.1 birds per MW), Bighorn I (2.6 birds per MW), Leaning Juniper I (3.2 birds per MW), and the overall average for new generation wind projects in the USA of 3.05 fatalities per MW (Erickson et al. 2004b). The Biglow Canyon bat fatality rate of 1.99 bats per MW per year is higher than Klondike I (0.77 bats/MW/year), Klondike II (0.41 per MW), Leaning Juniper I (0.86 per MW), and similar to Bighorn I (1.90 per MW), and below the average rate for new generation wind projects in the west and Midwest of 2.10 per MW per year.

Raptor mortality during the first Biglow Canyon monitoring year (0.03 per MW) was lower than Klondike II (0.11), Leaning Juniper I (0.06), and the Bighorn I wind project (0.15) on a per MW basis (Klondike I recorded no raptor fatalities). The pre-project raptor use for Biglow Canyon (0.30 raptors observations/survey) was lower than Klondike I and II (0.47), Leaning Juniper I (0.52), and Bighorn I (0.90). The John Day Canyon bird use study (see below) raptor use estimate for this 2008 monitoring year was 0.45. Using this estimate in a regression analysis comparing raptor use estimates and raptor mortality estimates at existing wind facilities provides a predicted fatality rate for Biglow Canyon of 0.04 raptors per MW. Currently the highest raptor mortality rate (0.15 per MW) documented in the CPE region of the Pacific Northwest has a raptor use estimate of 0.90 (Bighorn I project). In addition to these comparisons, raptor mortality at Biglow Canyon is in the lower range of other wind projects studied in the CPE region of the Pacific Northwest.

Species composition for bird and bat fatalities was similar to composition at other wind projects in the Pacific Northwest with horned lark making up the majority of fatalities for native avian species and silver-haired bat and hoary bat the making up the bat fatalities. When grouped together, upland gamebirds were also common fatalities. For the first year of monitoring at Biglow Canyon, no significant statistical differences were found between bird or bat fatalities at lit or unlit turbines, suggesting that lighting did not appear to influence mortality. Similar results have been found at other CPE projects

Avian Use and Behavior

The principle objectives of the post-construction avian use and behavior study were to (1) document bird use and abundance near the John Day Canyon rim relative to the wind project, and (2) document bird use and abundance near the Biglow Canyon Phase I wind turbines. Methods for the John Day Canyon (JDC) surveys were the same as pre-construction surveys in order to make before/after comparisons, and methods for the project wind turbines (PWT) were designed to establish general post-construction bird utilization of the wind-energy facility. The JDC 800-m fixed-point 30-minute bird use surveys were conducted at four points during 68 visits along the John Day Canyon rim from January 17 through December 18, 2008. A total of 271 surveys were conducted during this period. The PWT 400-m fixed-point 5-minute bird use surveys were conducted at 50 Phase I wind turbines in the Biglow Canyon project area during 17 visits from January 10 through December 12, 2008. A total of 850 surveys were conducted during this period.

During the JDC surveys, a total of 12,127 individual bird observations within 1,785 separate groups were recorded. Fifty-eight unique species were observed. Two species (3.4% of all species) composed approximately 78.8% of all observations: Canada goose (7,834 observations) and horned lark (1,722 observations). All other species comprised less than 5% of observations. A total of 388 individual raptors were recorded within JDC during the 800-m fixed-point surveys, representing 13 species. Highest overall bird use occurred in fall (19.90 birds/30-min survey), followed by winter (12.70), spring (6.99), and summer (5.08). Passerines were the most abundant bird type during the spring and summer, while waterfowl were the most common during the fall and winter. Passerines had the highest use of any bird type during the spring and summer study seasons (5.14 birds/survey and 3.48, respectively). The most abundant passerine species was horned lark (49% of all passerine observations), followed by western meadowlark (14%), European starling (12%), and common raven (0.01%). Waterfowl had the highest use of any bird type in fall (9.68 birds/survey) and winter (8.43). High waterfowl use in fall was due to several large groups of Canada geese that composed 48.2% of fall bird observations. Upland gamebird use among seasons ranged from 0.43-0.78 birds/survey. Upland gamebird species included chukar, ring-necked pheasant, gray partridge, and California quail.

Raptor use was similar across all seasons during JDC bird surveys, with highest use occurring in spring (0.83 raptors/survey), followed by summer (0.75), winter (0.64), and fall (0.52). Raptors composed 14.8% of summer bird use, 11.9% in spring, 5.1% in the winter, and 2.6% in the fall. The most abundant raptor species was red-tailed hawk (43% of all raptor observations), followed by American kestrel (16%), rough-legged hawk (14%), and northern harrier (11%). Two individual adult peregrine falcon observations were made during one survey in the fall season. Prairie falcons (14 observations) were documented during all seasons. Bald eagles (8) were infrequently seen primarily in winter and spring. Golden eagles (16) were observed during spring, summer, and fall. One adult ferruginous hawk was observed during summer.

During the PWT surveys, a total of 3,471 individual bird observations within 1,610 separate groups were recorded. Thirty-three unique species were observed. Two species (6.1% of all species) composed 69.5% of the individual observations. These were horned lark (1,518 observations) and common raven (894 observations). Other species composed roughly ten percent or less of all observations. Highest overall bird use occurred in winter (21.36 birds/survey), followed by fall (3.55), spring (3.09), and summer (1.78). Passerines were the most abundant bird type during all seasons. Passerine use was highest during winter (21.28 birds/5-min survey), and much lower during spring (2.83), fall (2.41), and summer (1.69). Passerines composed 67.8% of all observations in the fall, and over 90% of observations during other seasons. The most abundant passerine species was horned lark (51% of all passerine observations), followed by common raven (30%), and western meadowlark (12%). Waterbird/waterfowl use was highest in fall (1.05 birds/plot/5-min survey), followed by spring (0.10), summer (0.01), and winter (0). Waterbird/waterfowl composed 29.6% of bird observations in fall, and were recorded during 2.7% of fall surveys. Waterbirds/waterfowl composed less than 4% of observations during all other seasons and were seen in less than 1% of surveys during spring, summer, and winter. Canada geese comprised 96% of all waterbird/waterfowl observations. Upland gamebird use was highest in spring (0.07 birds/survey) and ranged 0-0.03 during other seasons. Upland gamebirds accounted for less than 3% of all bird observations, and were seen in 7% or less of all surveys. Upland gamebird species observed during PWT surveys included ring-necked pheasant and California quail.

Raptor use during PWT bird use surveys was consistent among spring, fall, and winter (0.08 raptors/plot/5-min survey), and only slightly lower in summer (0.06). Raptors accounted for roughly 3% or less of all bird observations throughout the year, and were seen in 8% or less of all surveys. The most abundant raptor species was red-tailed hawk (43%), followed by northern harrier (21%), rough-legged hawk (12%), and American kestrel (11%). Two bald eagles and one golden eagle were observed.

For JDC bird surveys, mean bird use was highest at point A6 (23.2 birds/survey). Bird use at other points ranged from 6.28 to 8.60. The high mean use estimate for point A6 was largely due to high waterfowl use (15.3). Waterfowl use ranged from 0-2.57 at other points. Raptor use was similar among stations and ranged from 0.35 to 0.96 birds/survey; highest at point A6. Raptor use was primarily of buteos and falcons. Passerine use was highest at point I (6.91), and ranged from 3.60 to 5.63 at other points.

Flight paths for waterbirds, waterfowl, shorebirds, raptors, and vultures were digitized and mapped for JDC bird use surveys. Flight paths illustrate raptor use as widespread and relatively consistent among points. Many of the raptor groups, buteos in particular, showed some affinity toward flying over John Day River tributary canyons and side-canyon slopes, although use of open ridge tops was also exhibited to some degree. Similar pre-project flight patterns were documented by raptors, especially buteos. Waterfowl flight paths also showed concentrated flight paths over John Day River tributary canyons and canyon-slopes, yet appeared to primarily fly near the eastern region of the JDC study area where highest use was documented (primarily by Canada geese). Pre-project surveys also showed higher waterfowl (Canada geese) use in this region. Otherwise, no obvious flyways or concentration areas were observed for other bird groups or species. Additional before/after comparisons will be made after 2009 data collection.

For PWT bird surveys, mean use for all bird species combined was highest at turbine 41 (50.6 birds/survey) and turbine 57 (14.7). Bird use for the other points ranged from 1.24-5.44 birds/survey. High use at point 41 was due to passerines of several different passerine subtypes including high numbers of corvids (i.e., common raven). Passerine use ranged from 1.18-4.53 at the other points. Turbines 44 and 40 also showed higher use for some bird types (e.g., American robins as thrush passerine subtype; double-crested cormorant as waterbird). High use at turbine 57 was primarily due to high waterfowl use which was all Canada geese. All these wind turbines are located closer to the John Day River than other facility turbines, yet no bird fatalities were documented at these locations during the 2008 monitoring study. Mean use by grassland songbirds and sparrows was relatively consistent among turbines. Further assessment of potential avian attraction or avoidance of Biglow Canyon wind turbines will be conducted after 2009 data collection.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

STUDY PARTICIPANTS

Western EcoSystems Technology

Jay Jeffrey	Project Manager, Research Biologist
Wallace Erickson	Consulting Statistician
Kimberly Bay	Data Supervisor and Statistician
Victoria Poulton	GIS Technician
JR Boehrs	GIS Technician
Andrea Palochak	Report Formatting
Jamey P. Eddy	Data Technician and Trial Bird Provider
Jerry Baker	Field Supervisor
Christopher Baum	Field Technician
Tara Graham	Field Technician
Patrick Migas	Field Technician

REPORT REFERENCE

Jeffrey, J.D., W.P. Erickson, K. Bay, M. Sonneberg, J. Baker, M. Kesterke, JR. Boehrs, and A. Palochak. 2009. Portland General Electric, Biglow Canyon Wind Farm Phase I, Post-Construction Avian and Bat Monitoring, First Annual Report, January-December 2008. Technical report prepared for Portland General Electric, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc., Cheyenne, Wyoming and Walla Walla, Washington.

ACKNOWLEDGEMENTS

A number of individuals from different organizations were instrumental in the completion of the first year of monitoring at the Biglow Canyon Phase I Wind Project. Review of project habitats and selection of study plots was conducted in collaboration with Keith Kohl, Oregon Department of Fish and Wildlife. PGE provided funding for the field studies and access to the Biglow Canyon facility. Greg Concannon and Gary Hackett of PGE served as outstanding project managers administering information and coordination to WEST field staff and guiding communication with other project O&M personnel. Other on-site PGE personnel, Robert Marheine and Christy Brown were helpful in additional safety instruction, access, storage, and other logistical considerations for the study. All the landowners in the Biglow Canyon project deserve recognition for their support and cooperation in allowing safe, secure, and trouble-free property access.

2.0 INTRODUCTION

The Biglow Canyon Wind Farm (Biglow Canyon) is located in Sherman County, Oregon, approximately 140 miles east of Portland near the towns of Moro, Wasco, and Rufus (Figure 1). Biglow Canyon Phase I consists of 76 V82 1.65-megatwatt (MW) Vestas wind turbines, for a total nameplate capacity of 125.4 MW, each mounted on 262-foot (ft; 80-meter [m]) tall towers with blades 131-ft (39-m) long (Biglow Canyon website; PGE 2009). Maximum height with the blade fully extended is 396 ft (121 m) and the turbines have a rotor diameter of 269 ft (90 m) with rotors turning at 14.4 rpm. Turbines begin producing electricity at wind speeds of nine mph, and shut down at constant wind speeds of 44 mph (PGE 2009).

As part of conditions under the Biglow Canyon Wind Farm Site Certificate (SC) with the State of Oregon Energy Facility Siting Council (EFSC), the certificate holder, Portland General Electric (PGE) is required to implement a two-year (24-month) operational (post-construction) monitoring study for each phase of the facility to evaluate impacts to bird and bat species. Data were collected according to a detailed monitoring protocol developed in collaboration with the Oregon Department of Fish and Wildlife (ODFW). The protocol for this monitoring study includes bird and bat carcass surveys at turbines (Fatality Monitoring) as well as bird use surveys (Avian Use and Behavior) which follow details in the Wildlife Monitoring and Mitigation Plan (DOE 2007). The first year of monitoring surveys was conducted on the site between January and December 2008.

The overall objective of the fatality monitoring study is to estimate the annual number of avian and bat casualties (fatalities and injured birds/bats) attributable to collisions with wind turbines for the entire project. The study consists of four components:

1) Standardized carcass searches of selected turbines or turbine strings in a rectangular plot centered on the turbine;
2) Searcher efficiency trials to estimate the percentage of carcasses found by searchers;
3) Carcass removal trials to estimate the length of time that a carcass remains in the field for possible detection; and
4) A Wildlife Incident Reporting and Handling System (WIRHS) for wind project personnel to handle and report casualties incidentally found in the project area.

The overall objective of the avian use and behavior study, coupled with the fatality monitoring results, is to aid in the understanding of direct and indirect impacts of the wind facility on raptors, waterfowl, and other avian species. This includes assessment as to whether operation of the facility may reduce bird use and abundance in the wind project area. Specific study objectives include:

1) Estimate post-construction seasonal, spatial, and temporal use of the John Day canyon rim project area by birds, particularly raptors, to be used in before/after comparison analysis with pre-construction data;
2) Document general post-construction avian utilization of the Biglow Canyon Wind Farm at turbines sampled during the fatality monitoring; estimate seasonal and temporal use of facility turbines within the Phase I area;

3) Document incidental avian and other wildlife observations while traveling between avian observation stations as well as while conducting carcass searches and/or associated travel.

The ability to estimate potential bird mortality at proposed wind-energy facilities is greatly enhanced by operational monitoring data collected at existing facilities. For several wind-energy facilities, standardized data on fixed-point surveys have been collected in association with standardized post-construction (operational) monitoring, allowing comparisons of bird use with bird mortality. Where possible, comparisons with regional and local studies were made. During the course of all surveys, observers recorded any federal and state threatened, endangered, proposed, candidate, or sensitive-status wildlife.

This report presents results of the first year fatality monitoring study, John Day Canyon 800-m fixed-point bird use surveys and project wind turbine 400-m fixed-point bird use surveys, and incidental wildlife observations conducted at Biglow Canyon from January 10, 2008 through December 28, 2008.

3.0 STUDY AREA

The Phase I Biglow Canyon Wind Farm is located on 25,000 acres (39 mi^2; 101 km^2) near the town of Wasco, 140 miles (225 km) east of Portland (Figure 1). The Biglow Canyon Wind Farm area is located in the northern section of Sherman County, Oregon; the project area is approximately 5 miles southeast of Rufus and approximately 4 miles northeast of Wasco. The general project area and adjacent lands range in elevation from approximately 250 feet above sea level near the mouth of the John Day River to 1600 feet (Figure 2). The project is sited in a region that is comprised primarily of cultivated agriculture (approximately 76%), with some areas of Conservation Reserve Program grassland (CRP), native shrub-steppe and grassland habitat, intermittent streams, and occasional scattered upland trees (Table 1; Figure 3 and 4). The John Day River corridor borders the project to the east and the Columbia River gorge borders the north.

Currently, most wind energy development in northern Oregon and southern Washington has been within the Columbia Plateau Level III Ecoregion (Thorson et al. 2003; Figure 5). The Columbia Plateau was historically characterized by open, arid shrub-steppe and grassland-steppe habitats. The current predominant land use of the Ecoregion is dryland agriculture, land enrolled in the Conservation Reserve Program (CRP), and rangeland. Precipitation through the region is 6 to 12 inches (about 15-30 centimeters) per year (Thorson et al. 2003). Surrounding ecoregions are more mountainous, receive more precipitation, and are more forested than the Columbia Plateau.

During the first year of study, 27 of the Phase I wind turbines were lit with FAA recommended strobe lighting. Turbines located at the end of turbine strings were lit, and roughly every third or fourth turbine within turbine strings that have more than five turbines in the string was also lit. Each warning light is an ORGA/TWT Medium Intensity Red Obstacle Light (Model L350-864-G). Theses lights are not on during the day. Lights are only on during dark hours and flash red (~20 flashes per minute).

4.0 BIRD AND BAT MORTALITY

4.1 Methods

The primary objective of the fatality monitoring study was to estimate the number of bird and bat casualties attributable to collisions with wind turbines for the entire facility on an annual basis. The monitoring study began after Phase I of the wind-energy facility became fully operational and was conducted for one full year: January 10, 2008 through December 12, 2008. The methods for the fatality study are broken into four primary components: 1) standardized carcass surveys of selected turbines; 2) searcher efficiency trials to estimate the percentage of carcasses found by searchers; 3) carcass removal trials to estimate the length of time that a carcass remains in the field for possible detection; and 4) adjusted fatality estimates for bird and bat species calculated using the results from searcher efficiency trials and carcass removal trials to estimate the total number of bird and bat fatalities within Phase I of the wind project.

There are three scenarios under which casualties were found at Biglow Canyon: 1) during the standardized surveys for the study; 2) while observers are on site, but not conducting a standardized search (i.e., an incidental find); and 3) by facility personnel or others on site for other purposes, such as turbine maintenance. Casualties found by study personnel regardless of timing (e.g., during a standard survey or not) are recorded by the methods described below. All casualties found within a search plot, even if outside of the standard survey period, were included in the dataset under the assumption that these casualties would have been found during standardized surveys.

All bird and bat casualties located within the search areas, regardless of species, were recorded and cause of death determined, if possible, based on field inspection of the carcass. The total number of bird and bat carcasses was estimated by adjusting for search frequency, removal bias (length of stay in the field), searcher efficiency bias (percent found), and proportion of the survey plot searched. For carcasses where the cause of death was not apparent, the assumption that the fatality was a wind turbine collision casualty was made for the analysis. This approach likely led to an overestimate of the true number of facility-related fatalities, but most wind-energy facilities have used this conservative approach because of the relative high costs associated with obtaining accurate estimates of natural or reference mortality (see Johnson et al. 2000a).

4.1.1 Search Plots and Sample Size

Approximately 66% of all turbines (50) were sampled during the study. Rectangular plots were established around selected turbines and searched for carcasses (Figure 6). Search plots extended to a minimum of 110 m from the turbine (Figure 6). Studies at wind-energy facilities with other large turbines, such as Klondike in Sherman County, Oregon (Johnson et al. 2003) and Combine Hills in Umatilla County, Oregon (Young et al. 2005) indicate nearly all fatalities are found within the area that is roughly equivalent to the height of the turbine. Standardized searches by trained biologists of all selected plots (50 turbines) were conducted once every four week period (28-day) during non-migration periods (summer and winter). During the spring and fall migration periods[1], the search effort was increased to once every two weeks. The first year of study consisted of 17 search intervals during January – December, 2008.

[1] The spring migration season was defined as March 15 - May 15 and the fall migration season was from August 15-October 31.

4.1.2 Standardized Carcass Surveys

The objective of the standardized carcasses searches was to systematically search the wind project for bird and bat casualties that were attributable to collision with project facilities. Personnel were trained in proper search techniques prior to conducting the carcass searches. Parallel transects were set approximately 6 meters apart in the area to be searched. Orientation of the transects was based on the orientation of the topography surrounding the turbines. A searcher walked at a rate of approximately 45-60 meters per minute along each transect taking approximately 80-120 minutes to search each turbine. As they walked each transect, searchers scanned the area on both sides of the transect out to approximately 5-6 meters for casualties.

The condition of each carcass found was recorded using the following categories:

- Intact - a carcass that is completely intact, is not badly decomposed, and shows no sign of being fed upon by a predator or scavenger.
- Scavenged - an entire carcass, which shows signs of being fed upon by a predator or scavenger, or a portion(s) of a carcass in one location (e.g., wings, skeletal remains, portion of a carcass, etc.), or a carcass that has been heavily infested by insects.
- Feather Spot - 10 or more feathers or two or more primaries at one location indicating predation or scavenging.

All carcasses were labeled with a unique number and were bagged and frozen for future reference and possible necropsy. A copy of the data sheet for each carcass was maintained, bagged, and frozen with the carcass at all times. For all casualties found, data recorded included species, sex and age when possible, date and time collected, GPS location, condition (intact, scavenged, feather spot), and any comments that may indicate cause of death. All casualties were photographed as found and plotted on a detailed map of the study plot and nearest wind turbine.

Casualties found outside the formal search area by carcass search technicians were treated following the above protocol as closely as possible. Casualties observed in non-search areas (e.g., near a turbine not included in the search area), or observed within search areas but outside of the standard search period, were coded as incidental discoveries and were documented in a similar fashion as those found during standard searches.

4.1.3 Searcher Efficiency Trials

The objective of the searcher efficiency trials was to estimate the percentage of casualties found by searchers. Searcher efficiency trials were conducted in the same areas as carcass searches. Searcher efficiency was estimated by major habitat type (grassland and agriculture), size of carcass, and season. Estimates of searcher efficiency were used to adjust the total number of carcasses found for those missed by searchers, correcting for detection bias.

Searcher efficiency trials began in February, after the carcass search surveys began. Personnel conducting standardized carcass searches did not know when trials were being conducted or the location of the searcher efficiency carcasses. During each season and within two major habitat types (grassland and agriculture), approximately 40 bird carcasses of two different size classes[2] were placed within the search plots. A total of 163 searcher efficiency trial carcasses were placed in 2008 on 14 different dates.

All searcher efficiency trial carcasses were placed at random locations before dawn within the search area prior to that day's scheduled carcass search. Carcasses were placed in a variety of postures to simulate a range of fatality conditions. For example, birds were: 1) placed in an exposed posture (tossed randomly to one side); 2) partially hidden; or 3) mostly hidden in denser habitat (e.g., placed beneath a shrub or bunch grass) to vary the visibility conditions associated with carcasses.

Each trial carcass was discreetly marked so that it could be identified as a study carcass after it was found. The number and location of the searcher efficiency carcasses found during the carcass search was recorded. The number of carcasses available for detection during each trial was determined immediately after the trial by the person responsible for distributing the carcasses.

4.1.4 Carcass Removal Trials

The objective of carcass removal trials was to estimate the average length of time a carcass remains in the study area and is available to be detected. Carcass removal includes removal by predation or scavenging, or other means such as being plowed into a field. Carcass removal trials were conducted during each season near the carcass search plots (e.g., near a turbine that was not included in the standard search plots) and within two major habitat types (cultivated agriculture and grassland). Approximately 40 carcasses of birds of two different size classes[3] were placed in the field each season, for a total of approximately 160 removal trial carcasses for the entire year. Removal trials were spread throughout the year to incorporate the effects of varying weather, climatic conditions, farming practices, and scavenger densities.

Removal trial birds were not placed in the standardized search plots to minimize the chance of confusing a trial bird with a true casualty. Turbines not included in the standardized searches were selected for the removal trials and trial carcasses were randomly located in a similar size plot to the search plots around the turbine. Trial carcasses were placed in a variety of postures to simulate a turbine fatality. For example, birds were: 1) placed in an exposed posture (tossed randomly to one side), 2) partially hidden, or 3) mostly hidden to simulate a carcass in denser habitat (e.g., placed beneath a shrub or bunch grass). Personnel conducting carcass searches monitored the trial birds over a 40 day period. In general carcasses were checked every day for

---

[2] Carcasses used for searcher efficiency trials included a mix of native and non-native/non-protected and commercially available species. Native species were off-project fully intact casualties salvaged by permit from roads or buildings. Small carcasses were house sparrows (*Passer domesticus*), hatchling mallards (*Anas platyrhynchos*), hatchling pheasants (*Phasianus* spp.), *Coturnix* quail, European starlings (*Sturnus vulgaris*), American robin (*Turdus migratorius*), American goldfinch (*Carduelis tristis*), dark-eyed junco (*Junco hyemalis*), white-crowned sparrow (*Zonotrichia leucophrys*), mourning dove (*Zenaida macroura*), northern flicker (*Colaptes auratus*), California quail (*Callipepla californica*); hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*); Medium - Large carcasses were hen ring-necked pheasants (*Phasianus colchicus*), rock pigeons, hen mallards, barn owl (*Tyto alba*), great horned owl (*Bubo virginianus*), and ruffed grouse (*Bonasa umbellus*).

[3] Carcasses used for scavenger removal trials were primarily non-native/non-protected and commercially available species. Small carcasses were house sparrows, hatchling mallards, hatchling pheasants, *Coturnix* quail; medium - large carcasses were rock pigeons, hen mallards, and hen pheasants.

the first 4 days, and then on day 7, day 10, day 14, day 20, day 30 and day 40. Trial carcasses were marked discreetly for recognition by searchers and other personnel. Experimental carcasses were left at the location until the end of the 40-day period and any evidence of the carcasses remaining was removed.

Carcass removal was estimated by major habitat type (cultivated agriculture and grassland), carcass size (small and large), and season. Estimates of carcass removal were used to adjust the total number of carcasses found for those removed from the study area, correcting for removal bias.

4.1.5 Statistical Methods

Estimates of facility-related fatalities are based on:

(1) Observed number of carcasses found during standardized searches for which the cause of death is either unknown or is probably facility-related.

(2) Non-removal rates expressed as the estimated average probability a carcass is expected to remain in the study area and be available for detection by the searchers during removal trials

(3) Searcher efficiency expressed as the proportion of planted carcasses found by searchers during searcher efficiency trials.

On an annual basis, estimates of fatalities are calculated for seven categories: 1) all birds, 2) small birds, 3) large birds, 4) raptors 5) target grassland/shrub-steppe birds, 6) likely nocturnal migrants, and 7) bats. The number of bird and bat fatalities attributed to operation of the facility is based on the number of bird and bat fatalities found at the facility. Total number of bird and bat carcasses is estimated by adjusting for removal and searcher efficiency bias.

Definition of Variables

The following variables are used in the equations below:

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

n the number of search plots

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

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

s the number of carcasses used in removal trials

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

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

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

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

d the total number of carcasses placed in searcher efficiency trials

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

I the average interval between standardized carcass searches, in days

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

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

Observed Number of Carcasses

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

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

Estimation of Carcass Non-Removal Rates

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

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

Estimation of Searcher Efficiency Trials

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

Estimation of Facility-Related Fatality Rates

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

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

where $\hat{\pi}$ includes adjustments for both carcass removal (from scavenging and other means) and searcher efficiency bias. Data for carcass removal and searcher efficiency bias were pooled across the study to estimate $\hat{\pi}$. $\hat{\pi}$ is calculated as follows:

$$\hat{\pi} = \frac{\bar{t} \cdot p}{I} \cdot \left[\frac{\exp\left(I/\bar{t} \right) - 1}{\exp\left(I/\bar{t} \right) - 1 + p} \right]$$ (Shoenfeld 2004) (4)

Separate estimates were obtained for migration seasons and other seasons. Then, final estimates were calculated by a weighted average of these estimates by length of season.

This formula (4) has been independently verified by Shoenfeld (2004). The final reported estimates of *m* and associated standard errors and 90% confidence intervals were calculated using bootstrapping (Manly 1997). Bootstrapping is a computer simulation technique that is useful for calculating point estimates, variances, and confidence intervals for complicated test statistics.

For each bootstrap sample, $\bar{c}$, $\bar{t}$, p, $\hat{\pi}$, and m are calculated. A total of 1,000 bootstrap samples were used. The reported estimates are the mathematical means of the 1,000 bootstrap estimates. The standard deviation of the bootstrap estimates is the estimated standard error. The lower 5th and upper 95th percentiles of the 1,000 bootstrap estimates are estimates of the lower limit and upper limit of 90% confidence intervals.

This formula was used because search effort was concentrated (more frequent) during the migration seasons. During the migration seasons the interval was approximately 14 days between searches, while outside the migration seasons the interval was approximately 28 days. Therefore, separate estimates were calculated for each search effort pattern and a weighted average was used based on the number of days for the seasons. This estimate more accurately reflects the true value since it accounts for the differences between search efforts and better accounts for the variability due to carcass removal.

4.2 Results

Fatality estimates for the first year of fatality monitoring are based on one full year from January 10 to December 12, 2008. A total of 850 turbine searches were conducted during this period, searching fifty wind turbines per survey (Table 2). Forty-two (42) bird fatalities of 20 species and fifty (50) bats representing two species were found during scheduled searches and incidentally (Tables 2 and 3; Appendix A). The vast majority of the plot searches produced no fatalities. During the entire study, the maximum number of bird fatalities found at any one turbine was four (turbine 17; Table 4). The maximum number of bat fatalities found at any one turbine was four (turbine 63; Table 6). The average distance of bird casualties (n=38) to the nearest turbine was 78.6 meters; the average distance of bat casualties (n=41) to the nearest turbine was 29.4 meters. This section describes characteristics of the bird and bat fatalities, and provides fatality estimates adjusted for searcher efficiency and carcass removal biases.

4.2.1 Bird Fatalities

No birds listed as Federal or State Threatened or Endangered species, or State Sensitive species, were documented as fatalities. Bird fatalities found during 2008 were plotted (Figure 7) and summarized in Appendix A. This list includes fatalities observed during standardized plot searches and other fatalities that were not observed during standardized searches (incidental finds). A total of 42 bird fatalities were found, including two raptors (Tables 2 and 3). Of the 42 fatalities, 33 were found during regularly scheduled searches and nine were documented as incidental fatalities (four on non-search plots).

The most common species found included horned lark (12; *Eremophila alpestris*; 28.6% of total fatalities), ring-necked pheasants (7; *Phasianus colchicus*; 16.7%) (Table 3). Two raptors were found, one rough-legged hawk (*Buteo lagopus*) and one red-tailed hawk (*B. jamaicensis*). Based on the date of recovery (season) and species, 9 of the avian fatalities were considered likely nocturnal migrants comprised of 7 passerine species. The remainder of the passerines were either horned larks, which are year-round residents of the project area, or were found during the breeding season and are common summer or year-round residents of the area (e.g., rock pigeon [*Columba livia*], western meadowlark [*Sturnella neglecta*]).

Fatalities were found throughout the year, but rates were slightly higher in the spring (33%) and fall (38%), followed by the summer (21%), and lowest in winter (0.7%) (Table 2; Figure 8). When considering all bird fatalities, there did not appear to be any strong localization in casualties (Table 4; Figure 7). There were some local concentrations comprised of no greater than four fatalities (i.e., Turbine 17). At turbine-17, two horned larks, one orange-crowned warbler (*Vermivora celata*), and one savannah sparrow (*Passerculus sandwichensis*) were found during the fall season. Four other turbines had more than two recorded fatalities, often comprised of horned lark or gamebird species (Turbines 15, 47, 64, and 67). The majority of bird fatalities (90%) were found between 0 m and 120 m from turbines (Table 5; Figure 9). Otherwise, no strong patterns in fatality locations suggests no large differences in mortality by location within the wind project.

In addition to these bird fatalities, two birds were reported in early December, 2007, during the latter stages of project construction prior to the monitoring study; by project operations and maintenance personnel through the PGE Wildlife Incidental Reporting and Handling System. These fatalities consisted of one Canada goose (*Branta canadensis*) near Turbine 28 and one rough-legged hawk near Turbine 69. The rough-legged hawk was found over 500 ft from Turbine 69 on a county road and is thought to be a road collision casualty.

4.2.2 Bat Fatalities

A total of 50 bat fatalities were found, comprising two species (Table 3; Figure 10). Hoary bats (*Lasiurus cinereus*; 25 individuals) and silver-haired bats (*Lasionycteris noctivagans*; 25 individuals) were the only bat fatalities found (Appendix A). Of the 50 bat fatalities, 39 were found during regularly scheduled searches and eleven were found incidentally (Table 3; nine on non-search plots). None of the bats are Federal or State Threatened or Endangered species.

Except for one hoary bat and three silver-haired bats found between April 29 and June 23, all bat fatalities were observed between August 19 and October 16, 2008 (Figure 11; Appendix A). There did not appear to be any strong concentrations of bat fatalities within the facility (see Figure 10). The majority of the bat fatalities (92%) were found during the fall migration period for hoary and silver-haired bats with the greatest number of bat fatalities found in September (Figure 11).

Bat fatalities were distributed throughout the study area and were not concentrated within particular search plots (Table 6 and Figure 10). The maximum number of bats found at any one turbine was four at Turbine 36 (two silver-haired bats and two hoary bats; all individuals found independently over 4 different survey intervals). Bat fatalities at other turbines ranged from zero to two per turbine. The lack of strong patterns in fatality locations suggests no large differences in mortality by location within the wind project. Most bat fatalities (82.0%) were found within 40 m (131 feet) of the turbines (Table 5; Figure 12).

4.2.3 Searcher Efficiency Trials

Searcher efficiency trials were conducted between March 4 and December 10, 2008. A total of 163 carcasses (81 large, 82 small) were placed in the field during 14 searcher efficiency trials. The trial carcasses were placed throughout the year to account for varying weather and habitat conditions. Across all seasons, observers detected 90.0% of large bird carcasses and 36.8% of small bird carcasses (Table 7). In grassland habitats, 86.4% of large bird and 30.0% of small bird carcasses were detected, while 91.2% of large bird and 39.3% of small bird carcasses were detected in agricultural settings (Table 7).

4.2.4 Carcass Removal Trials

The carcass removal trials were initiated between February 11 and November 20, 2008. A total of 80 large bird carcasses and 80 small bird carcasses were placed in the field and monitored over 40-day periods. For large birds the mean removal time was estimated at approximately 17.8 days. The lower and upper 90% confidence limits around this estimate were 15.0 and 20.76 (Table 8). For small birds the mean removal time and 90% confidence limits were 10.1 days (8.1, 12.2) (Table 8). For large birds approximately half of the carcasses remained until day 13, and for small birds one half remained until approximately day 6 of the trial (Figure 13).

4.2.5 Adjusted Fatality Estimates

Fatality estimates, standard errors, and confidence intervals were calculated for: (1) all birds - with and without introduced species, (2) small birds, (3) large birds, (4) raptors, (5) nocturnal migrant birds, (6) grassland songbirds, and (7) bats (Table 8). The fatality estimates are adjusted based on the corrections for carcass removal and observer detection bias. Based on searcher efficiency and the carcass removal rate at the site, the estimated average probability that a small bird casualty would remain in the plot until a scheduled search and would be found during the migration seasons, and the 90% confidence limits around this probability, were 0.25 (0.18, 0.32); Table 8. The estimated average probability a large bird casualty would remain until a scheduled search and would be found during the migration season, and the 90% confidence limits, were 0.72 (0.65, 0.77). For non-migration seasons, the estimated average probability that a large bird and small bird casualty would remain was 0.55 (0.47, 0.61) and 0.14 (0.10, 0.19), respectively.

<u>Large Birds</u>

Eleven (11) large bird fatalities[4] were found during the standardized searches. The estimated number of large bird fatalities per turbine per year and associated 90% confidence limits for the first year of study was 0.35 (0.09, 0.54), or 0.21 fatalities/MW/year (Table 8).

[4] Large birds were considered to be all upland gamebirds, raptors, corvids, waterfowl, and waterbirds.

Small Birds

Twenty-seven (27) small bird fatalities were found during the study. The estimated number of small bird fatalities per turbine per year and associated 90% confidence interval limits was 2.55 (1.48, 4.07), or 1.54 fatalities/MW/year (Table 8).

All Birds

The fatality estimate for all birds was obtained by summing the estimates for small and large birds. The estimated number of all bird fatalities per turbine per year and associated 90% confidence limits was 2.90 (1.83, 4.46), or 1.76 fatalities/MW/year (Table 8).

House sparrows (*Passer domesticus*) are not protected under the Migratory Bird Treaty Act (MBTA 1918), and ring-necked pheasant, chukar (*Alectoris chukar*), rock pigeon (*Columba livia*) and gray partridge (*Perdix perdix*), non-native introduced species, were included in this estimate. By excluding fatalities for these species from the dataset, the estimate is approximately 2.53 (1.46, 4.04) bird fatalities per turbine per year, or 1.53 fatalities/MW/year.

Raptors

Two raptors of two species were found during the study. The estimated number of raptors per turbine per year and associated 90% confidence limits for the first year of study was 0.06 (0.00, 0.12), or 0.03 fatalities/MW/year (Table 8).

Nocturnal Migrants

Based on date of find and species, 9 casualties were found which were considered nocturnal migrants (comprised of seven passerine species). The estimated number of nocturnal migrant fatalities per turbine per year and associated 90% confidence limits for the first year of study was 0.72 (0.29, 1.31), or 0.44 fatalities/MW/year (Table 8).

Grassland Songbirds

The estimated number of grassland songbird fatalities per turbine per year and associated 90% confidence limits for the first year of study was 1.44 (0.73, 2.42), or 0.87 fatalities/MW/year (Table 8). This estimate includes horned larks which are not considered a target grassland species (see DOE 2007). An additional estimate was calculated for target grassland species only, excluding horned lark fatalities from the dataset. For target grassland species only, the estimate is approximately 0.22 (0.00, 0.54) bird fatalities per turbine per year, or 0.13 fatalities/MW/year (0.00, 0.33; Table 8).

Bats

Adjustments for carcass removal and observer detection bias for bats were made using the estimates for small birds. The estimated number of bat fatalities per turbine per year and associated 90% confidence limits for the first year of study was 3.29 (2.27, 4.85), or 1.99 fatalities/MW/year (Table 8).

4.2.6 Turbine Lighting and Location Effects

Of the 50 turbine search plots in this study, 17 were lit with FAA lights and 33 were unlit. The overall low numbers of observed avian nocturnal migrant fatalities (9) made calculating the effect of turbine lights on avian mortality difficult with high levels of confidence. The experimental design and experimental units given the lighting configuration reduced the effective sample size and limited statistical power for detecting differences. For the entire study period, 6 nocturnal migrant bird fatalities were observed at lit turbines and 3 were observed at unlit turbines (Tables 8 & 9). This difference was not statistically significant (difference of means and 90% confidence limits was -0.05 [-0.05, 0.57]) and sample size was very low (n=9); Table 9. The observed number of bat fatalities at lit turbines (13) was lower than unlit turbines (28) and there was no statistical difference between lit and unlit turbines (difference of means and 90% confidence limits was -0.08 [-0.50, 0.33]; Table 10). These results suggest that FAA lighting did not attract nocturnal migrant birds or bats.

5.0 FIXED-POINT BIRD USE SURVEYS

In general, the objectives of the post-construction avian use and behavior study were to (1) document bird use and abundance near the John Day Canyon rim relative to the wind project, and (2) document bird use and abundance near the Biglow Canyon Phase I wind turbines. Methods for the John Day Canyon (JDC) surveys were the same as pre-construction surveys in order to make before/after comparisons, and methods for the project wind turbines (PWT) were designed to establish general post-construction bird utilization of the wind-energy facility. Fixed-point surveys (variable circular plots) were conducted using methods described by Reynolds et al. (1980).

5.1 Methods

5.1.1 Bird Use Survey Plots

Four points established during pre-construction surveys were again used for JDC 800-m fixed-point bird use surveys (Figure 14; WEST 2005a, 2005d, 2007a). The points were selected to survey representative habitats and topography of the study area, while also providing relatively even coverage with minimal overlap of points. Each survey plot was a 800-meter (2,625-ft) radius circle centered on the point. Each survey plot was surveyed for a 30-minute period.

PWT 400-m fixed-point survey stations were established at each of the 50 standardized carcass search plots (Figure 15). Each survey plot was a 400-meter (1,312-ft) radius circle centered on a fixed location near the wind turbine which provided the best viewshed. Each survey plot was surveyed for a 5-minute period by a qualified biologist prior to conducting carcass searches.

5.1.2 Bird Survey Methods

The JDC bird use surveys were conducted to estimate the seasonal, spatial, and temporal use of the study area by birds, particularly raptors. 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) observed within 328 ft (100 m) of the point were recorded, but not mapped. Observations of birds beyond the plot radius were recorded, but were not included in the statistical analyses. A unique observation number was assigned to each observation.

All birds seen during fixed point surveys were recorded. 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 16-ft (5-m) interval. Other information recorded about the observation included whether or not the observation was auditory only and the 10-minute interval of the 30-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 animal observations were recorded in the comments section of the data sheet. Incidental observations of 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; coordinates derived from GPS also were noted for species of concern.

The PWT bird use surveys were conducted to provide information on the species composition and seasonal use of the project wind turbines. Surveys were conducted at various times during daylight hours, prior to each standardized carcass search. Observers recorded birds detected in a 5-minute period, all birds seen during fixed point surveys were recorded. Data collected for each survey and bird observation followed methods for JDC surveys, except flight paths were not mapped.

5.1.3 Observation Schedule

Sampling intensity was designed to document bird use and behavior by habitat and season within the study areas. The JDC bird use surveys were conducted from January 17 through December 18, 2008. JDC stations were intensively sampled, i.e., approximately six times per month (3 morning periods, 3 afternoon/evening periods). This intensity was maintained through all seasons: spring (March 1 to May 31), summer (June 1 to August 15), fall (August 16 to November 30) and winter (December 1 to February 29). Surveys were conducted during daylight hours and A.M. and P.M. survey periods alternated to cover approximately all daylight hours during a season. To the extent practical, each point was surveyed about the same number of times; however, the schedule varied in response to adverse weather conditions (e.g., fog and/or rain), which may have caused delays and/or missed surveys. Stations were also visited at different times during A.M. or P.M. survey periods by rotating the order in which each was selected to begin each survey period.

The PWT bird surveys were conducted January 10 through December 12, 2008, under the same survey schedule as the scheduled carcass searches; plots were surveyed approximately once a month in winter and summer, and twice a month during spring and fall.

5.1.4 Statistical Analysis

<u>Quality Assurance and Quality Control</u>

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

5.1.5 Data Compilation and Storage

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

Bird Diversity and Species Richness

Bird diversity was illustrated by the total number of unique species observed. Species lists, with the number of observations and the number of groups, were generated by season, including all observations of birds detected regardless of their distance from the observer. Species richness was calculated as the mean number of species observed per survey (i.e., number of species/plot/survey). Species diversity and richness were compared between seasons for fixed-point bird use surveys.

Bird Use, Composition, and Frequency of Occurrence

For the standardized fixed-point bird use estimates, only observations of birds detected within the plot were used. Estimates of bird use (i.e., number of birds/plot/survey) were used to compare differences between bird types, seasons, and other wind-energy facilities.

The frequency of occurrence was calculated as the percent of surveys in which a particular species/bird type was observed. Percent composition was calculated as the proportion of the overall mean use for a particular species/bird type. Frequency of occurrence and percent composition provide relative estimates of species exposure to the wind project. For example, a species may have high use estimates for the site based on just a few observations of large groups; however, the frequency of occurrence will indicate that it occurs during very few of the surveys and therefore, may be less likely affected by the project. Data were analyzed by comparing use among plots.

Bird Flight Height and Behavior

To calculate potential risk to bird species, the first flight height recorded during JDC 800-m fixed-point bird use surveys was used to estimate the percentages of birds flying within the likely zone of risk (ZOR) for potential collision with turbine blades for typical turbines. The likely ZOR was 114 to 427 ft (35 to 130 m) above ground level, which is the blade height of typical turbines that could be used at Biglow Canyon.

Bird Exposure Index

A relative index of collision exposure (R) was calculated for bird species observed during the JDC 800-m 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 the plot) averaged across all surveys, P_f equals the proportion of all observations of species *i* where activity was recorded as flying (an index to the approximate percentage of time species *i* spends flying during the daylight period), and P_t equals the proportion of all initial flight height observations of species *i* within the likely ZOR.

Spatial Use

Data from JDC 800-m fixed-point bird use surveys were analyzed by comparing use among plots. Mapped flight paths were qualitatively compared to project area features such as topographic features. The objective of mapping observed bird locations and flight paths was to look for areas of concentrated use by raptors and other large birds and/or consistent flight patterns within the study area. This information can be useful in comparing pre-construction and post-construction spatial flight patterns.

5.2 Results

The JDC 30-minute 800-m fixed-point bird use surveys were conducted at four points during 68 visits along the John Day Canyon rim from January 17 through December 18, 2008. A total of 271 fixed-point surveys were conducted during this period (Table 11). The PWT 5-minute 400-m fixed-point bird use surveys were conducted at 50 wind turbines in the Biglow Canyon Phase I project area during 21 visits from January 10 through December 12, 2008. A total of 850 fixed-point surveys were conducted during this period (Table 12).

5.2.1 Bird Diversity and Species Richness

Fifty-eight unique species were observed during the JDC bird use surveys, with a mean number of species observed per survey of 2.10 (Table 11). More species were observed during spring (38 species), followed by fall (37), summer (33), and winter (29). The mean number of species per survey was higher in spring (2.79 species/survey) compared to summer (1.98), fall (1.85) and winter (1.79). During the JDC surveys, a total of 12,127 individual bird observations within 1,785 separate groups were recorded (Table 13). Cumulatively, two species (3.4% of all species) composed approximately 78.8% of all observations: Canada goose (7,834 observations) and horned lark (1,722 observations). All other species comprised less than 5% of observations. A total of 388 individual raptors were recorded within Biglow Canyon during the 800-m fixed-point surveys, representing 13 species (Table 13).

Thirty-three unique species were identified during the PWT bird use surveys and the mean number of species observed per survey was 1.03 (Table 12). A total of 3,471 individual bird observations within 1,610 separate groups were recorded (Table 14). Cumulatively, two species (6.1% of all species) composed 69.5% of the individual observations. These were horned lark (1,518 observations) and common raven (*Corvus corax*; 894 observations). All other species composed roughly ten percent or less of the observations individually.

5.2.2 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 (Tables 15 and 16).

For the JDC 800-m fixed-point surveys, the highest overall bird use occurred in the fall (19.90 birds/plot/30-min survey), followed by winter (12.70), spring (6.99), and summer (5.08; Table 15). Passerines were the most abundant bird type during the spring and summer, while waterfowl were the most common during the fall and winter.

For the PWT 400-m fixed-point surveys, the highest overall bird use occurred in the winter (21.36 birds/plot/5-min survey), followed by fall (3.55), spring (3.09), and summer (1.78; Table 16). Passerines were the most abundant bird type during all seasons.

Waterbirds/Waterfowl

Waterbirds were only recorded during the fall season during JDC 800-m fixed-point surveys (0.05 birds/plot/survey). Waterbirds, represented by one species, double-crested cormorant (*Phalacrocorax auritus*), composed only 0.3% of all fall bird use, and were only seen during 1.3% of fall surveys (Table 15).

During JDC 800-m fixed-point surveys, waterfowl had the highest use in fall (9.68 birds/plot/30-min survey) and winter (8.43) compared to other times of the year (spring 0.01, and summer 0; Table 15). High waterfowl use in fall was due to several large groups of Canada geese that composed 48.2% of fall bird observations. Waterfowl composed 66.4% of winter and 48.6% of fall bird use, and less than 1% in spring and summer. Waterfowl were most commonly seen in the fall (14.8% of surveys) and winter (8.9%), but were uncommon in the spring (1.4%) and summer (0%).

For the PWT 400-m fixed-point surveys, waterbirds and waterfowl were combined (i.e., Canada goose, double-crested cormorant, unidentified gull). Waterbird/waterfowl use was highest in the fall (1.05 birds/plot/5-min survey), followed by spring (0.10), summer (0.01), and winter (0; Table 16). Waterbird/waterfowl composed 29.6% of bird observations in the fall, and were recorded during 2.7% of fall surveys (Tables 14 and 16). Waterbirds/waterfowl composed less than 4% of observations during all other seasons and were seen in less than 1% of surveys during spring, summer, and winter. Canada geese comprised 96% of all waterbird/waterfowl observations.

Shorebirds

During JDC bird surveys, shorebirds were only recorded during spring (0.07 birds/plot/30-min survey) and winter (0.02). Shorebirds accounted for 1% or less of overall bird use during both spring and winter, and were only recorded during 2.8% of spring surveys and 1.8% of winter surveys (Table 15). Long-billed curlew (5; *Numenius americanus*) and killdeer (1; *Charadrius vociferus*) were the species of shorebirds recorded.

No shorebirds were observed during PWT bird use surveys (Table 16).

Raptors

Raptor use was similar across all seasons during JDC bird use surveys, with highest use occurring in spring (0.83 birds/plot/30-min survey), followed by summer (0.75), winter (0.64), and fall (0.52). Raptors composed 14.8% of summer bird use, 11.9% in spring, 5.1% in the winter, and 2.6% in the fall. Raptors were more frequently observed during spring surveys (51.4%), followed by winter (46.4%), summer (45.3%), and fall (34.8%; Table15). The most abundant raptor species was red-tailed hawk (43% of all raptor observations), followed by American kestrel (*Falco sparverius*; 16%), rough-legged hawk (14%), and northern harrier (*Circus cyaneus*; 11%; Table 13). Two individual adult peregrine falcon (*F. peregrinus*) observations were made during one survey (station I) in the fall season. Prairie falcons (*F.*

mexicanus; 14 observations) were documented during all seasons. Bald eagles (*Haliaeetus leucocephalus*; 8) were infrequently seen primarily in winter and spring. Golden eagles (*Aquila chrysaetos*; 16) were observed during spring, summer, and fall. One adult ferruginous hawk (*Buteo regalis*) was observed during summer.

For PWT bird use surveys, raptor use was consistent during spring, fall, and winter (0.08 birds/plot/5-min survey), and only slightly lower in summer (0.06). Raptors accounted for roughly 3% or less of all bird observations throughout the year, and were seen in 8% or less of all surveys (Table 16). The most abundant raptor species was red-tailed hawk (43%), followed by northern harrier (21%), rough-legged hawk (12%), and American kestrel (11%; Table 14). Two bald eagles and one golden eagle were observed.

Vultures

Vultures, represented by turkey vulture (*Cathartes aura*), were only recorded during spring and summer study seasons during JDC 800-m fixed-point bird use surveys. Spring vulture use was 0.06 birds/plot/30-min survey, while summer use was 0.02. Vultures accounted for 0.8% of all bird observations in the spring and 0.3% in the fall. Vultures were recorded in less than 5% of all surveys (Table 15).

No vultures were observed during PWT 400-m fixed-point bird use surveys (Table 16).

Upland Gamebirds

During JDC bird use surveys, upland gamebird use was highest during the spring (0.78 birds/plot/30-min survey), followed by winter (0.57), summer (0.53), and fall (0.43). Upland gamebirds accounted for 11.1% of spring bird use, 10.5% of summer use, 4.5% of winter use, and 2.1% of fall use. Upland gamebirds were recorded during 47.2% of spring surveys, 26.6% of summer surveys, 17.9% of winter surveys, and 8.8% of fall surveys (Table 15). Upland gamebird species included chukar (80 individuals), ring-necked pheasant (69), gray partridge (4), and California quail (*Callipepla californica*; 3).

Upland gamebird use was highest in the spring (0.07 birds/plot/5-min survey) during PTW 400-m fixed-point bird use surveys, followed by summer (0.03), fall (0.01), and winter (0). Upland gamebirds accounted for less than 3% of all bird observations, and were seen in 7% or less of all surveys (Table 16). Upland gamebird species observed during PWT surveys included ring-necked pheasant (30) and California quail (1).

Passerines

During JDC bird use surveys, passerines had the highest use of any bird type during the spring and summer study seasons (5.14 birds/plot/30-min survey and 3.48, respectively). Passerine use in the fall was 8.92 birds/plot/30-min survey and winter use was 2.93. Passerines accounted for the majority of observations in the spring and summer (73.6% and 68.6%, respectively), and 44.8% of observations in the fall and 23.1% in the winter. Passerines were recorded in 94.4% of spring surveys, and over 67% of surveys during other seasons (Table 15). The most abundant passerine species was horned lark (49% of all passerine observations), followed by western meadowlark (14%), European starling (*Sturnus vulgaris*; 12%), and common raven (0.01%) (Table 13).

Passerines had the highest use across all seasons during the PWT bird use surveys. Passerine use was highest during winter (21.28 birds/plot/5-min survey), and much lower during the spring (2.83), fall (2.41), and summer (1.69). Passerines composed 67.8% of all observations in the fall, and over 90% of observations during other seasons. Passerines were recorded during 60% or more of all surveys at the facility (Table 16). The most abundant passerine species was horned lark (51% of all passerine observations), followed by common raven (30%), western meadowlark (12%), and European starling (0.02%) (Table 14).

5.2.3 Bird Flight Height and Behavior

Flight height characteristics were estimated for both bird types and bird species for 800-m fixed-point bird use surveys. During the study, 810 single birds or groups totaling 3,736 individuals were observed flying during 800-m fixed-point bird use surveys (Table 17). Overall, 24.5% of birds observed flying were recorded within the ZOR, 70.9% were below the ZOR, and 4.5% were flying above the ZOR (Table 17). The majority of flying raptors (64.8%) were observed below the ZOR, 33.5% were within the ZOR, and only 1.7% were above the ZOR. Vultures had the highest percentage of flying birds within the ZOR (60.0%), followed by other birds with 50.0% within the ZOR, and waterbirds with 44.7%. Raptors had the fourth highest percentage of birds within the ZOR, primarily due to 36.4% of buteo observations and 32.1% of falcon observations recorded in this zone. Eagles were recorded within the ZOR in 100% of observations, but this was based on only three observations. Shorebirds, doves/pigeons, upland gamebirds, and passerines were typically observed flying below the ZOR (Table 17).

Six species had at least 30 groups observed flying, though none of these species were observed flying within the likely ZOR in more than 45% of the observations (Table 18). The most common species with more than 30 observations recorded within the ZOR was Canada goose (44.9% within the ZOR). Four species were always seen flying within the likely ZOR; however these were only based on one or two observations.

5.2.4 Bird Exposure Index

A relative exposure index was calculated for each species for JDC 800-m bird use surveys (Table 18). This index is only based on initial flight height observations and relative abundance (defined as the use estimate) and does not account for other possible collision risk factors such as foraging or courtship behavior. Canada goose had an exposure index far higher than any other species with 2.20, compared to less than 0.3 for all other species. The only raptor species with a relatively high exposure index was red-tailed hawk (0.07). Rough-legged hawk and American kestrel had an exposure index of 0.05. All other raptor species had an exposure index of 0.02 or less (Table 18).

5.2.5 Spatial Use

For JDC 800-m fixed-point bird surveys, mean use (birds/30-min survey) was plotted by point for all types and passerine subtypes (Figure 16 a-h). For all bird species combined, use was highest at point A6 (23.2 birds/30-min survey). Bird use at other points ranged from 6.28 to 8.60 (Figure 16a). The high mean use estimate for point A6 was largely due to high waterfowl use at this point (15.3; Figure 16b). Waterfowl use ranged from 0 to 2.57 at other points. Waterbirds were only seen at point H (0.06 birds/30-min survey; Figure 16a). Shorebirds were only seen at point A6 (0.09; Figure 16b). Raptor use was similar among stations and ranged from 0.35 to 0.96 birds/30-min survey; highest at point A6 (Figure 16c). Raptor use was primarily of buteos and falcons (Figure 16c, d, and e). Passerine use was highest at point I (6.91), and ranged from 3.60 to 5.63 at other points (Figure 16g). Upland gamebird use was highest at point A5 (0.93), and ranged from 0.16 to 0.90 bird/30-min survey at other points (Figure 16f). Vulture use was low at all points, ranging from 0 to 0.03 (Figure 16f).

Flight paths for waterbirds, waterfowl, shorebirds, raptors, and vultures were digitized and mapped for JDC 800-m fixed-point bird use surveys (Figure 18a-g). Raptor flight paths illustrate use as widespread and relatively consistent among points (Figure 18c,d,e,f). Many of the raptor groups, buteos in particular (Figure 18c), showed some affinity toward flying over John Day River tributary canyons and side-canyon slopes, although use of open ridge tops was also exhibited to some degree. Waterfowl flight paths also showed concentrated flight paths over John Day River tributary canyons and canyon-slopes, yet appeared to primarily fly near the eastern region of the JDC study area (Figure 18b); where highest use was documented (primarily by Canada geese). Otherwise, no obvious flyways or concentration areas were observed for other bird groups or species.

For PWT 400-m fixed-point bird surveys, mean use (birds/5-min survey) was plotted by point (turbine) for all types and passerine subtypes (Figure 17a-l). For all bird species combined, use was highest at turbine 41 (50.6 birds/5-min survey) and turbine 57 (14.7) (Figure 17a). Bird use for the other points ranged from 1.24 to 5.44 birds/5-min survey. High use at point 41 was due to passerines of several different passerine subtypes including high numbers of corvids (Figure 17f-l). Passerine use ranged from 1.18 to 4.53 at the other points (Figure 17f). Turbines 44 and 40 also showed higher use for some bird types (e.g., American robins [*Turdus migratorius*] as thrush passerine subtype; double-crested cormorant as waterbird). High use at turbine 57 was primarily due to high waterfowl use which was all Canada geese (Figure 17c). Mean use by grassland songbirds and sparrows was relatively consistent among turbines (Figure 17e).

6.0 INCIDENTAL WILDLIFE OBSERVATIONS

6.1 Methods

Incidental wildlife observations were recorded by biologists while conducting carcass searches or traveling between avian fixed point stations and within other areas of the project area (Appendix B). Observations were primarily documented for raptors, big game species, and other bird and wildlife species that are considered either uncommon or a first record for a season or the study year. This information is largely anecdotal, yet provides general occurrence of wildlife within the project area. An observation number, date, time, species, number of individuals, sex/age class, distance from observer, activity, height above ground (for target bird species), habitat, and in the case of special status species, the location was recorded using GPS (e.g., UTM coordinates).

6.2 Results

Twenty-three bird species were incidentally documented (Table 19). Raptors flying within the project area identified by biologists while traveling on-site or during searches include: red-tailed hawk (27 sightings[5]), rough-legged hawk (3), northern harrier (8), prairie falcon (6), golden eagle (2), American kestrel (5), great horned owl (*Bubo virginianus*; 6) sharp-shinned hawk (*Accipiter striatus*; 2), Cooper's hawk (*A. cooperii*; 1), and merlin (*Falco columbarius*; 1). Five mammal species totaling 1,165 individuals were recorded incidentally, with mule deer (*Odocoileus hemionus*; 1,028 individuals) being the most commonly observed (Table 19). Other big game species include elk (*Cervus elephus*; 22 individuals) and pronghorn (*Antilocapra americana*; 23 individuals). For reptiles, three species of snakes were documented (Table 19). One amphibian species, the western toad (*Bufo boreas*) was also documented. Additional notes for all incidental observations are presented in Appendix B and a summary of special/sensitive-status species are presented in Table 21.

[5] This may represent repeated observations of individual birds on different days, but it is unknown.

7.0 DISCUSSION

7.1 Bird and Bat Mortality

The Biglow Canyon Phase I wind project is located in the Columbia Plateau Ecoregion (CPE) of the Pacific Northwest (Thorson et al. 2003; Figure 5). Studies at the Biglow Canyon Wind Farm were designed to provide comparable results with other CPE wind energy facilities (Table 20) and other non-regional wind energy facilities. Post-construction fatality monitoring data are available from 11 regional utility-scale operational wind energy facilities in the CPE region (Table 20). These projects range in maximum capacity from 25 to 300 MW in size. Five of these projects are located within approximately 40 miles of Biglow Canyon (Condon, Bighorn I, Klondike I and II, and Leaning Juniper I; Table 20, Figure 5). With the exception of the Condon wind-energy facility, Gilliam County, Oregon, where no rigorous monitoring was conducted[6], all data sets were collected under the same objectives using similar study components, where observed fatality rates, calculated from standardized carcass searches, were adjusted for searcher efficiency and carcass removal biases. While the methods and statistical analysis for the other regional studies may have varied, the results are considered comparable because the overall objectives and study components for all the studies were the same, and it is generally believed that the statistical analysis methods have improved over time, resulting in more accurate or less variable estimates that are more reflective of true conditions.

7.1.1 Potential Biases in Fatality Rate Estimation

The overall study design incorporates several assumptions or factors that affect the results of the fatality estimates. These factors potentially contribute to both positive and negative biases in estimating fatality rates (Erickson 2006). First, all bird casualties found within the standardized search plots during the study were included in the analysis. If carcasses were found incidentally within a search plot during other activities on-site then it was assumed that these carcasses would have been found during scheduled carcass searches. Second, it was assumed that all carcasses found during the study were due to collision with wind turbines. True cause of death is unknown for most of the fatalities. It is likely that some of the fatalities included in the data pool were caused by predators (e.g., raptors, coyotes), farming or ranching activity, vehicles on county/project roads, or were due to other natural causes (background mortality[7]). The effect of

---

[6] Ad hoc monitoring at the Condon wind project took place for less than one year in 2003 (Fishman 2003). Three bird fatalities, including one rough-legged hawk, and no bats were located during the study. No searcher efficiency or carcass removal trials were conducted.

[7] A few wind project studies have provided information on background mortality. During a four-year study at Buffalo Ridge, Minnesota, 2,482 fatality searches were conducted on study plots without turbines to estimate reference mortality in the study area. Thirty-one (31) avian fatalities comprising 15 species were found (Johnson et al. 2000a). Reference mortality for this study was estimated to average 1.1 fatalities per plot per year.

Some pre-project carcass searches were conducted at a proposed wind project in Montana (Harmata et al. 1998). Three bird fatalities were found during 8 searches of 5 transects, totaling 17.61 km per search. On average, approximately 1.8 km of transect is searched within every 180 m diameter turbine plot. Therefore, the amount of transect searched at the Montana site per search was equivalent to searching approximately 9 turbines at Hopkins Ridge. The background estimate for observed mortality would be approximately 0.33 per turbine plot per year, unadjusted for scavenging and searcher efficiency.

these assumptions is that the analysis provides a conservative estimate (an over estimate) of mortality due to the wind facility.

No adjustments were made for fatalities possibly occurring outside of the rectangular plot boundaries. Plot boundaries were established a minimum distance of 110 m from the turbines. Because the search plots were square or rectangular in shape, the maximum distance to a turbine within a search plot was 141 m at the corners. Also, because observers search both sides of a transect out to 5-6 m, the effective surveyed distance from a turbine is 115 m (110 m plus 5 m on either end). The search plot distance for this study was selected based on results of other studies (Erickson et al. 2004a; Higgins et al. 1996; Kerlinger et al. 2007; Young et al. 2003c, 2005) where a distance equal to approximately the height of the turbines appeared to capture a very large percentage of fatalities. Based on the distribution of fatalities as a function of distance from turbines (Figure 8), a small percentage of bird fatalities possibly fell outside the search plots and may have been missed. This factor would lead to an underestimate of bird fatality rates. However, again it is unknown if the fatalities detected at greater than 110 m were actual turbine collision fatalities. The average distance of bird casualties to nearest turbine was 79 meters. Most bat fatalities were within 40 m of wind turbines (see Table 5; Figure 12). The average distance of bat casualties to nearest turbine was 29 m. Bat casualties have often been documented closer to turbines than birds at other sites (e.g., Erickson et al. 2004a; Kerlinger and Kerns 2004; Kerlinger et al. 2007; Young et al. 2003c). Only two bat casualties were found beyond 60 m from a turbine and it is unlikely that many bats fell outside the effective search area; no bats were found beyond 100 m.

Other potential biases are associated with the experimental carcasses used in searcher efficiency and carcass removal trials and whether or not they are representative of actual carcasses. For example, this may occur if the types of birds used are larger or smaller than the carcasses of fatalities, or are more or less cryptic in color than actual fatalities. For the searcher efficiency study, house sparrows, hatchling and adult hen mallards (*Anas platyrhynchos*), hatchling and adult hen pheasants, *Coturnix* quail, European starlings, rock pigeons, American robin, American goldfinch (*Carduelis tristis*), dark-eyed junco (*Junco hyemalis*), white-crowned sparrow (*Zonotrichia leucophrys*), mourning dove (*Zenaida macroura*), northern flicker (*Colaptes auratus*), California quail, barn owl (*Tyto alba*), great horned owl, and ruffed grouse (*Bonasa umbellus*) were used to represent the range of fatalities expected. For the scavenger removal trial, non-protected/non-native commercially available species were primarily used for which time of death and carcass condition were consistent, including house sparrows, rock pigeons, hatchling and adult mallards, hatchling and adult pheasants, and *Coturnix* quail. We feel this sample of species captures the range of sizes and other characteristics of actual fatalities and should be a reasonable representation of scavenging rates of the birds as a group.

7.1.2 Bird Fatalities

For the first year of post-construction avian and bat fatality monitoring, the overall bird fatality rate (which includes ring-necked pheasants, gray partridge, chukar, rock pigeon and house sparrow) calculated for Biglow Canyon (2.90 per turbine per year) was within the range of

---

The background mortality information from Minnesota and Montana suggest that the estimates of bird mortality include some avian fatalities not related to turbine collision, and this factor alone would lead to an over-estimate of true avian collision mortality for the study.

estimates reported for regional projects such as Vansycle (0.63), Klondike I (1.4), Stateline (1.9), Combine Hills (2.56), Bighorn I (3.8), Klondike II (4.7), and Hopkins Ridge (5.4) (Erickson et al. 2000; Johnson et al. 2003; Erickson et al. 2004a; Young et al. 2005; Kronner et al. 2008; NWC and WEST 2007; Young et al. 2007a; respectively) and is slightly higher than the average bird fatality rates reported for new generation wind projects in the U.S. (2.11 per turbine per year, Erickson et al. 2004b). Despite these estimates, the Biglow Canyon bird fatality rate is lower than approximately half of other regional Columbia Plateau wind projects on a per megawatt (MW) basis (see Table 20).

Fatality estimates on a per turbine basis may be misleading when comparing different wind energy projects since turbine sizes vary among projects. For example, the Vestas V80 turbines at Hopkins Ridge are 1.8 MW turbines with a rotor swept area of approximately 5026 m^2 (Young et al. 2003a). This is quite a bit larger than the Mitsubishi MWT-1000A 1.0 MW turbines at Combine Hills with a rotor swept area of approximately 2961 m^2 (Young et al. 2005) or the Stateline project with Vestas V-47 0.66 kW turbines with a rotor swept area of approximately 1735 m^2 (Erickson et al. 2004a). Fatality estimates for smaller turbines may be less per turbine than for larger turbines, however, it would take more small turbines to generate the same amount of electricity. In an effort to account for differences in turbine size, the fatality rates standardized to a per MW basis can be compared. For Biglow Canyon with 1.65 MW turbines, the estimate for all birds drops to 1.76 bird fatalities per MW per year which is higher than nearby Klondike I (0.9 birds/MW/year) but lower than Klondike II, 3.1 birds/MW/year; Bighorn I, 2.6 fatalities per MW per year; Leaning Juniper I, 3.2 fatalities per MW per year (Table 20); and the overall average for new generation wind projects in the USA of 3.05 fatalities per MW (Erickson et al. 2004b). Non-native avian species were included in the Biglow Canyon analysis so that results would be comparable to other studies of regional wind projects. However, house sparrows, rock pigeon, chukar, partridge, and pheasants, non-native introduced species made up approximately 28% of all avian fatalities found during the carcass searches. Eliminating these from the data pool reduced the overall avian mortality estimate for Biglow Canyon to 1.53/MW/year. Based on these comparisons, bird mortality at Biglow Canyon is similar to other wind projects studied in the CPE region of the Pacific Northwest and USA in general.

Raptor mortality during the first Biglow Canyon monitoring year (0.03 per MW) was lower than Klondike II (0.11), Leaning Juniper I (0.06), and the Bighorn I wind project (0.15) on a per MW basis (Table 20; Klondike I recorded no raptor fatalities). The pre-project raptor use estimate (defined as the number observed per 30-minute survey; WEST 2005d) for Biglow Canyon (0.30) was lower than Klondike I and II (0.47), Leaning Juniper I (0.52), and Bighorn I (0.90). The John Day Canyon raptor use estimate for this 2008 monitoring year was 0.45. Using this estimate in a regression analysis comparing raptor use estimates and raptor mortality estimates at existing wind facilities provides a predicted fatality rate for Biglow Canyon of 0.04 raptors per MW (Figure 19 and Section 7.2 below). Currently the highest raptor mortality rate (0.15 per MW) documented in the CPE region of the Pacific Northwest has a raptor use estimate of 0.90 (Table 20; Kronner et al. 2008). In addition to these comparisons, raptor mortality at Biglow Canyon is in the lower range of wind projects studied in the CPE region of the Pacific Northwest (Table 20).

Species composition at Biglow Canyon during the first post-construction study year for bird casualties was similar to composition at other sites in the CPE region of the Pacific Northwest (Johnson and Erickson 2008), with horned larks comprising the majority of avian fatalities (28.6%). When species were grouped taxonomically, passerines (71.3%) and upland gamebirds (21.5%) were the groups with the most fatalities. For all CPE wind projects, passerines and gamebirds were also bird groups with the most fatalities, 69.5% and 14.5%, respectively (Johnson and Erickson 2008). Raptor fatalities found at CPE wind-energy facilities have composed 8.6% of the total bird mortality. Most of the CPE raptor fatalities have been American kestrels (38.6%), red-tailed hawks (24.6%) and short-eared owls (*Asio flammeus*; 12.3%). Other raptors found as fatalities at CPE wind-energy facilities include four ferruginous hawks, three Swainson's hawks, and one each of the following: rough-legged hawk, Cooper's hawk, northern harrier, great horned owl, long-eared owl (*Asio otus*), barn owl, and unidentified accipiter (Johnson and Erickson 2008).

The 2008 monitoring year at Biglow Canyon documented two raptor fatalities: one red-tailed hawk and one rough-legged hawk. Red-tailed hawks are abundant in the CPE and have been by far the most common hawk fatality observed at CPE wind-energy facilities. Based on breeding bird survey (BBS) long-term average data, approximately 77,000 breeding red-tailed hawks occur in the Columbia Plateau (Blancher et al. 2007). Rough-legged hawks are migratory and occur in the CPE primarily during late fall through early spring. Rough-legged hawk fatalities have been uncommon in the CPE, however this species has been the second most abundant raptor observed at the Biglow Canyon project (WEST 2005a, 2005d, 2007a, and this study).

Golden eagles are known to occur in the vicinity of the project (WEST 2005a, 2005d, 2007a) and were documented in this study during John Day Canyon bird surveys, project wind turbine bird surveys, and incidentally by biotechnicians conducting carcass searches or traveling during the course of the study. To date, no golden eagle fatalities have been documented in the CPE region of the Pacific Northwest (Johnson and Erickson 2008).

7.1.3 Bat Fatalities

The overall bat fatality rate for Biglow Canyon (3.29 per turbine per year) is higher than the per turbine estimate for Klondike I (1.16; Johnson et al. 2003), Klondike II (0.63; NWC and WEST 2007), Leaning Juniper I (1.28; Kronner et al. 2007), and Bighorn I (2.85; Kronner et al. 2008) and the average bat fatality rate reported for western and mid-western wind projects in the U.S. (1.40 per turbine per year; Johnson et al. 2004).

On a per MW basis, the Biglow Canyon estimate (1.99 bats per MW per year) is higher than Klondike I (0.77 bats/MW/year), Klondike II (0.41), Leaning Juniper I (0.86), and similar to Bighorn I (1.90) estimates (Table 20); and below the average rate for new generation wind projects in the west and Midwest of 2.10 per MW per year. There are potential biases in the estimates because we used small cryptic birds as surrogates for the experimental trials; however, the results are consistent with the patterns observed at other Pacific Northwest wind projects. Two other projects sited in predominantly agricultural settings had similar or higher bat mortality estimates: Combine Hills (1.88) and Nine Canyon (2.46) (Table 20). Bat fatality estimates at new projects are more variable than bird estimates, with the highest estimates occurring at sites in the Eastern USA (Arnett 2005; Kerlinger and Kerns 2004; Nicholson 2003). Based on these comparisons, bat mortality at Biglow Canyon is higher or similar to nearby wind projects and similar to other newer generation wind projects studied in the CPE region of the Pacific Northwest, the Midwest, and southwestern states of the USA.

Species composition at Biglow Canyon for bats was also very similar to other Pacific Northwest projects with only two species found: silver-haired bat and hoary bat. These two species have comprised 93.5% of all bat fatalities documented in the CPE region of the Pacific Northwest (Johnson and Erickson 2008). As supported by this study and by numerous other monitoring studies throughout the USA, the majority of bat fatalities are found in the late summer and early fall during the time period when both silver-haired and hoary bats are migrating (Cryan et al. 2004).

7.1.4 Nocturnal Migrants and Lighting

Tall lighted structures are suspected of attracting nocturnal migrating birds, especially during inclement weather (Kerlinger 2000). There has been concern expressed that lighting wind turbines may increase the risk of collision fatalities for birds and bats if they are attracted to the lights. Typically not every turbine in a wind project is lit, however, and to date, results have generally shown no effect from lighting (see Arnett 2005; Erickson et al. 2004a; Young et al. 2005). Lighting at other structures like communication towers is typically different than lighting at wind turbines. Communication towers may have more than one light on a tower and therefore, cumulatively may have a stronger attraction (Kerlinger 2003). Wind turbines have only one location for the light on top of the nacelle.

For the first year of monitoring at Biglow Canyon, no significant statistical differences were found between bird or bat fatalities at lit or unlit turbines, suggesting that lighting did not appear to influence mortality. Similar results have been found at other CPE projects: Stateline wind project (Erickson et al. 2004a), Nine Canyon wind project (Erickson et al. 2003b), Combine Hills project (Young et al. 2006), Hopkins Ridge wind project (Young et al. 2007a), Wild Horse wind project (Erickson et al. 2008), and the Bighorn I project (Kronner et al. 2008). Although local effects of lighting on birds have been noted on some projects, no statistical significance has been shown at the meta-analysis level for projects in the USA, suggesting no large differences in fatality rates at lit and unlit turbines (Erickson 2009). It appears as if FAA required lighting on turbines does not influence the risk of bird or bat mortality associated with wind turbines.

7.2 Avian Use and Behavior

The following discusses bird utilization and bird behavior at the Phase I Biglow Canyon Wind Farm relative to the John Day Canyon (JDC) and project wind turbines (PWT).

7.2.1 JDC Raptor Use and Exposure Risk

Annual mean raptor use at the John Day Canyon (0.45 birds/survey) was compared with other wind-energy facilities that implemented similar protocols and had data for three or four seasons. Similar studies were conducted at 36 other wind-energy facilities. The annual mean raptor use at these wind-energy facilities ranged from 0.09 birds/30-min survey at the San Gorgonio wind-energy facility in California to 2.34 birds/30-min survey at the High Winds facility, also in California (Figure 19). Based on the results from these projects a ranking of seasonal raptor mean use was developed as: low (0 – 0.5 birds/plot/20-min survey); low to moderate (0.5 – 1.0); moderate (1.0 – 2.0); high (2.0 – 3.0); and very high (> 3.0). Under this ranking, mean raptor use at John Day Canyon is considered to be low, ranking twenty-second highest compared to the other wind-energy facilities (Figure 19).

Although high numbers of raptor fatalities have been documented at some wind-energy facilities (e.g. Altamont Pass), a review of studies at wind-energy facilities across the United States reported that only 3.2% of casualties were raptors (Erickson et al. 2001a). Indeed, although raptors occur in most areas with the potential for wind-energy development, individual species appear to differ from one another in their susceptibility to collision (NRC 2007). Results from Altamont Pass in California suggest that mortality for some species is not necessarily related to abundance (Orloff and Flannery 1992). American kestrels, red-tailed hawks, and golden eagles were killed more often, and turkey vultures were killed less often than predicted based on abundance. A recent report from the Buffalo Gap wind-energy facility in Texas, however, suggests that turkey vultures may show higher susceptible to collision at larger wind turbines than previously believed for smaller turbines (Tierney 2007). Thus far, only three northern harrier fatalities at existing wind-energy facilities have been reported in publicly available documents, despite the fact they are commonly observed during point counts at these projects (Erickson et al. 2001a; Whitfield and Madders 2006). In addition, reports from the High Winds Wind-Energy Facility in California document high American kestrel mortality. Relative use by this species is six times that at Altamont Pass (Kerlinger 2005). It is likely that many factors, in addition to abundance, are important in predicting raptor mortality.

An exposure index analysis may also provide insight into what species might be the most likely turbine casualties. The index considers relative probability of exposure based on abundance, proportion of daily activity spent flying, and proportion of flight height of each species within the ZOR for turbines likely to be used at the wind-energy facility. The exposure index 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 ability 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 this index.

A regression analysis of raptor use and mortality for 13 new-generation wind-energy facilities, where similar methods were used to estimate raptor use and mortality, found that there was a significant correlation between use and mortality (R^2 = 69.9%; Figure 20). Using this regression to predict raptor collision mortality at the John Day Canyon area, based on an adjusted mean raptor use of 0.45 birds/20-min survey, yields an estimated fatality rate of 0.04 raptors/MW/year, or four raptor fatalities per year for each 100 MW of wind-energy development. A 90% prediction interval around this estimate is 0.00 to 0.30 raptors/MW/year.

For the John Day Canyon area, the raptor species with the highest exposure index was the red-tailed hawk (ranked fourth of all bird species) followed by rough-legged hawk and American kestrel (both with same exposure index and ranked fifth) (Table 18). Based on the relative abundance of these species throughout the year, and higher exposure indices than other raptor species, there is higher potential for red-tailed hawk, rough-legged hawk, and American kestrel fatalities compared to other species. During the Biglow Canyon 2008 monitoring study, one red-tailed hawk fatality and one rough-legged hawk fatality were documented; no other raptor fatalities were found.

7.2.2 JDC Non-Raptor Use and Exposure Risk

Exposure indices of non-raptors indicated that Canada goose, horned lark, and cliff swallow are most likely to be exposed to potential collision from wind turbines at the John Day Canyon area (Table 18). Most non-raptors had relatively low exposure indices due to the majority of individuals flying below the likely zone of risk. Horned larks were the most common fatality during the Biglow Canyon 2008 monitoring study.

The John Day Canyon study area received high use by waterfowl (i.e., Canada geese) during the fall and winter. This area also documented high waterfowl use during pre-project surveys (WEST 2005a, 2007a). Wind-energy facilities with year-round use by water-dependent species have shown the highest mortality, although levels of waterfowl/waterbird/shorebird mortality appear insignificant compared to the use of the sites by these groups. Of 1,033 bird carcasses collected at US wind-energy facilities, waterbirds composed about 2%, waterfowl composed about 3%, and shorebirds composed less than 1% (Erickson et al. 2002b). At the Klondike facility in Oregon, only two Canada goose fatalities were documented (Johnson et al. 2003) even though 43 flocks totaling 4,845 individual Canada geese were observed during pre-construction surveys (Johnson et al. 2002a). The recently constructed Top of Iowa wind-energy facility is located in cropland between three Wildlife Management Areas (WMAs) with historically high bird use, including migrant and resident waterfowl. During a recent study, approximately one-million goose-use days and 120,000 duck-use days were recorded in the WMAs during the fall and early winter, and no waterfowl fatalities were documented during concurrent and standardized wind-energy facility fatality studies (Jain 2005). Similar findings were observed at the Buffalo Ridge facility in southwestern Minnesota, which is located in an area with relatively high waterfowl/waterbird use and some shorebird use. Snow geese, Canada geese and mallards were the most common waterfowl observed. Three of the 55 fatalities observed during the fatality monitoring studies were waterfowl, including two mallards and one blue-winged teal (*Anas discors*). Two American coots (*Fulica americana*), one grebe, and one shorebird fatality were also found (Johnson et al. 2002b).

No waterfowl fatalities were documented during the 2008 Biglow Canyon study, although one Canada goose fatality was documented in late 2007 by O&M personnel prior to this study. To date, only four other Canada goose fatalities have been documented in the CPE (Johnson and Erickson 2008). Only four other waterfowl species have been documented at CPE wind facilities: mallard (2), American coot (1), bufflehead (*Bucephala albeola*; (1), and western grebe (*Aechmophorus occidentalis*; (1) (Johnson and Erickson 2008). Based on available evidence, waterfowl do not seem especially vulnerable to turbine collisions and significant impacts are not likely.

7.2.3 JDC Sensitive Species Use

Seven state or federal special/sensitive-status bird species were observed during the JDC surveys (Table 21). The bald eagle is state threatened and both the bald and golden eagle are legally protected under the Bald and Golden Eagle Protection Act (BGEPA 1940), while the others are protected under the MBTA (1918). Bald eagle use of the John Day Canyon study area was relatively low, and golden eagle use was low but spread through all seasons. Bald and golden eagles have been documented during baseline surveys at numerous projects in the CPE and no fatalities have been documented to date (Johnson and Erickson 2008). The peregrine falcon is state endangered and known to nest along the Columbia and John Day Rivers. Two adult peregrines were observed during a single survey in September of the fall season. The ferruginous hawk is a state critical sensitive species and federal species of concern. Only one observation of an adult of this species was recorded during July of the summer season. These species were also documented during Biglow Canyon pre-project baseline surveys (WEST 2005a, 2005d, 2007a). The remaining three bird species are special/sensitive status (e.g., vulnerable, critical, undetermined) and do not receive additional special protection.

7.2.4 PWT Raptor Use

During bird surveys at the Biglow Canyon project wind turbines, raptors accounted for 3% or less of all bird observations throughout the year, and were seen in 8% or less of all surveys. The most abundant raptor species was red-tailed hawk, followed by northern harrier, rough-legged hawk, and American kestrel. Only two bald eagles and one golden eagle were observed.

7.2.5 PWT Non-Raptor Use

During bird surveys at the Biglow Canyon project wind turbines, horned lark and common raven comprised 70% of all bird observations. All other species including raptors composed roughly ten percent or less of the observations individually. Passerines composed 68% of all observations in the fall, and over 90% of observations during other seasons. Waterfowl use was highest during fall, comprised primarily of Canada geese, and were seen in less than 1% of surveys in all other seasons. Upland gamebirds accounted for less than 3% of all bird observations, and were seen in 7% or less of all surveys.

A second post-construction monitoring year (2009, on-going) will collect additional bird use information using the same methods providing additional information on bird use near facility wind turbines and nearby vicinity.

7.2.6 JDC Avian Spatial Behavior

For the John Day Canyon study area, bird use was highest at station A6 which is between Emigrant and Draper Canyons. High bird use at this location was primarily due to high numbers of Canada geese. Raptor use was similar among observation points. Passerine use was similar among points but highest at station I, near Biglow Canyon, which has arguably the greatest amount of riparian shrubs and trees in proximity to the observation point. Many of the raptor groups, buteos in particular, showed some affinity toward flying over John Day River tributary canyons and side-canyon slopes, although use of open ridge tops was also exhibited to some degree. Similar pre-project flight patterns by raptors, especially buteos, were documented (see Appendix C). Canada geese also showed concentrated flight paths over John Day River tributary canyons and canyon-slopes but appeared to fly primarily near the southeastern region of the study area. Pre-project surveys also showed higher waterfowl use in this region (e.g., station A5; WEST 2005a, 2007a). Additional before/after comparisons will be made after 2009 data collection.

7.2.7 PWT Avian Spatial Behavior

For Biglow Canyon project wind turbines, bird use was highest at Turbines 41 and 57. Turbine 41 is near Fox Canyon and Turbine 57 is near Biglow Canyon. High bird use at Turbine 41 was due to several different passerine species, but primarily composed of common ravens. High bird use at Turbine 57 was largely due to high numbers of Canada geese. Turbines 44 and 40 also showed higher use for some bird types (e.g., American robins as thrush passerine subtype; double-crested cormorant as waterbird). All these wind turbines are located closer to the John Day River than other facility turbines, yet no bird fatalities were documented here during the 2008 monitoring study. Grassland songbirds were relatively consistent among turbines, likely due to the widespread distribution of common species such as horned larks and western meadowlarks. Further assessment of potential avian attraction or avoidance of Biglow Canyon wind turbines will be conducted after 2009 data collection.

8.0 REFERENCES

Arnett, E. B., technical editor. 2005. Relationships between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Bat Fatality Search Protocols, Patterns of Fatality, and Behavioral Interactions with Wind Turbines. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas. http://www.batcon.org/wind/BWEC2004finalreport.pdf

Bald and Golden Eagle Protection Act (BGEPA). 1940. 16 United States Code § 668-668d. June 8, 1940.

Blancher, P.J., K.V. Rosenberg, A.O. Panjabi, B. Altman, J. Bart, C.J. Beardmore, G.S. Butcher, D. Demarest, R. Dettmers, E.H. Dunn, W. Easton, W.C. Hunter, E.E. Iñigo-Elias, D.N. Pashley, C.J. Ralph, T.D. Rich, C.M. Rustay, J.M. Ruth, and T.C. Will. 2007. Guide to the Partners in Flight Population Estimates Database. Version: North American Landbird Conservation Plan 2004. Partners in Flight Technical Series No 5. http://www.partnersinflight.org/

Cooper, B.A., R.J. Blaha, T.J. Mabee, and J.H. Plissner. 2004. A Radar Study of Nocturnal Bird Migration at the Proposed Cotterel Mountain Wind Energy Facility, Idaho, Fall 2003. Technical report prepared for Windland, Inc., Boise, Idaho, by ABR, Inc., Forest Grove, Oregon. January 2004.

Cryan, P.M., M.A. Bogan, R.O. Rye, G.P. Landis, and C.L. Kester. 2004. Stable Hydrogen Isotope Analysis of Bat Hair as Evidence for Seasonal Molt and Long-Distance Migration. Journal of Mammalogy 85(5): 995-1001.

Department of Energy, (DOE). 2007. Biglow Canyon Wind Farm: Wildlife Monitoring and Mitigation Plan. Prepared by Oregon State Department of Energy, Energy Facility Siting Council. May 10, 2007.

Environmental Conservation Online System (ECOS). 2009. US Fish and Wildlife Service (USFWS) Threatened and Endangered Species System (TESS). USFWS Endangered Species Program Homepage: http://www.fws.gov/endangered/ ECOS: http://ecos.fws.gov/tess_public

Erickson, W.P. 2006. Objectives, Uncertainties and Biases in Mortality Studies at Wind Facilities. Paper presented at the NWCC Research Meeting VI, November 2006. San Antonio, Texas. www.nationalwind.org

Erickson, W.P. 2009. A Summary of Avian and Bat Fatality at Wind Facilities in the US. Proceedings of the NWCC Wind Wildlife Research Meeting VII, Milwaukee, Wisconsin. Prepared for the Wildlife Workgroup of the National Wind Coordinating Collaborative by RESOLVE, Inc., Washington, D.C. S. S. Schwartz, ed. October 28-29, 2008. 116 pp.

Erickson, W.P., J. Jeffrey, K. Kronner, and K. Bay. 2004a. Stateline Wind Project Wildlife Monitoring Final Report: July 2001 - December 2003. Technical report for and peer-reviewed by FPL Energy, Stateline Technical Advisory Committee, and the Oregon Energy Facility Siting Council, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Walla Walla, Washington, and Northwest Wildlife Consultants (NWC), Pendleton, Oregon. December 2004. http://www.west-inc.com

Erickson, W.P., J. Jeffrey, and V.K. Poulton. 2008. Avian and Bat Monitoring: Year 1 Report. Puget Sound Energy Wild Horse Wind Project, Kittitas County, Washington. Prepared for Puget Sound Energy, Ellensburg, Washington, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. January 2008.

Erickson, W.P., J. Jeffrey, D. Young, K. Bay, R. Good, K. Sernka, and K. Kronner. 2003a. Wildlife Baseline Study for the Kittitas Valley Wind Project: Summary of Results from 2002 Wildlife Surveys. Final Report February 2002– November 2002. Prepared for Zilkha Renewable Energy, Portland, Oregon, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. January 2003.

Erickson, W.P., G.D. Johnson, K. Bay, and K. Kronner. 2002a. Ecological Baseline Study for the Zintel Canyon Wind Project. Final Report April 2001 – June 2002. Technical report prepared for Energy Northwest. Prepared for Energy Northwest by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. June 2002.

Erickson, W.P., G.D. Johnson, M.D. Strickland, and K. Kronner. 2000. Avian and Bat Mortality Associated with the Vansycle Wind Project, Umatilla County, Oregon: 1999 Study Year. Technical report prepared by WEST, Inc. for Umatilla County Department of Resource Services and Development, Pendleton, Oregon. 21pp. http://www.west-inc.com/reports/vansyclereportnet.pdf

Erickson, W.P., G.D. Johnson, M.D. Strickland, D.P. Young, Jr., K.J. Sernka, and R.E. Good. 2001a. Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Bird Collision Mortality in the United States. National Wind Coordinating Committee (NWCC) Publication and Resource Document. Prepared for the NWCC by WEST, Inc., Cheyenne, Wyoming. August 2001. http://www.nationalwind.org/publications/default.htm and http://www.west-inc.com

Erickson, W.P., G.D. Johnson, D. Young, D. Strickland, R. Good, M. Bourassa, K. Bay, and K. Sernka. 2002b. Synthesis and Comparison of Baseline Avian and Bat Use, Raptor Nesting and Mortality Information from Proposed and Existing Wind Developments. Technical report prepared for Bonneville Power Administration, Portland, Oregon by WEST, Inc., Cheyenne, Wyoming. December 2002. http://www.bpa.gov/Power/pgc/wind/Avian_and_Bat_Study_12-2002.pdf

Erickson, W.P., G.D. Johnson, and D.P. Young, Jr. 2004b. Summary and Causes of Bird Mortality from Anthropogenic Causes with an Emphasis on Collisions. USDA Forest Service Technical Report PSW-GTR-191.

Erickson, W.P., K. Kronner, and K.J. Bay. 2007. Stateline II Wind Project Wildlife Monitoring Report, January - December 2006. Technical report submitted to FPL Energy, the Oregon Energy Facility Siting Council, and the Stateline Technical Advisory Committee.

Erickson, W.P., K. Kronner, and B. Gritski. 2003b. Nine Canyon Wind Power Project Avian and Bat Monitoring Report. September 2002 – August 2003. Prepared for the Nine Canyon Technical Advisory Committee and Energy Northwest by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants (NWC), Pendleton, Oregon. October 2003. http://www.west-inc.com/reports/nine_canyon_monitoring_final.pdf

Erickson, W.P., E. Lack, M. Bourassa, K. Sernka, and K. Kronner. 2001b. Wildlife Baseline Study for the Nine Canyon Wind Project, Final Report May 2000-October 2001 Technical report prepared for Energy Northwest, Richland, Washington.

Erickson, W.P., D. Young, G. Johnson, J. Jeffrey, K. Bay, R. Good, and H. Sawyer. 2003c. Wildlife Baseline Study for the Wild Horse Wind Project. Summary of Results from 2002-2003 Wildlife Surveys May 10, 2002- May 22, 2003. Draft report prepared for Zilkha Renewable Energy, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. November 2003.

Fishman Ecological Services LLC. 2003. Carcass Survey Results for SeaWest Windpower, Inc., Condon Site 2002-2003. Prepared for SeaWest WindPower Inc.

Harmata, A., K. Podruzny, and J. Zelenak. 1998. Avian Use of Norris Hill Wind Resource Area, Montana. Technical Report NREL/SR-500-23822. National Renewable Energy Laboratory. Golden, Colorado. 77 pp.

Higgins, K.F., R.G. Osborn, C.D. Dieter, and R.E. Usgaard. 1996. Monitoring of Seasonal Bird Activity and Mortality at the Buffalo Ridge Wind Resource Area, Minnesota, 1994-1995. Completion Report for the Research Period May 1, 1994 - December 31, 1995. Unpublished report prepared for Kenetech Windpower, Inc. by the South Dakota Cooperative Fish and Wildlife Research Unit, Brookings, South Dakota. 84 pp.

Jain, A. 2005. Bird and Bat Behavior and Mortality at a Northern Iowa Windfarm. M.S. Thesis. Iowa State University, Ames, Iowa. http://www.fws.gov/midwest/eco_serv/wind/references/Windfarmstudy.pdf

Jeffrey, J.D., W.P. Erickson, K.J. Bay, V.K. Poulton, W.L. Tidhar, and J.E. Baker. 2008. Wildlife Baseline Studies for the Golden Hills Wind Resource Area, Sherman County, Oregon. Final Report May 2006 – October 2007. Prepared for BP Alternative Energy North America Inc., Houston, Texas, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming.

Johnson, G.D. 2004. Analysis of Potential Wildlife and Habitat Impacts from the Klondike II Project, Sherman County, Oregon. Technical report prepared by WEST, Inc., for CH2M HILL and PPM Energy.

Johnson, G.D. and W.P. Erickson. 2004. Analysis of Potential Wildlife/Wind Plant Interactions, Bighorn Site, Klickitat County, Washington. Prepared for CH2M HILL, Portland, Oregon by WEST, Inc., Cheyenne, Wyoming. August 2004.

Johnson, G.D. and W.P. Erickson. 2008. Avian and Bat Cumulative Impacts Associated with Wind Energy Development in the Columbia Plateau Ecoregion of Eastern Washington and Oregon. Final Report prepared for Klickitat County Planning Department, Goldendale Washington. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. October 30, 2008.

Johnson, G.D., W.P. Erickson, K. Bay, and K. Kronner. 2002a. Baseline Ecological Studies for the Klondike Wind Project, Sherman County, Oregon. Final report prepared for Northwestern Wind Power, Goldendale, Washington, by Western EcoSystems Technology, Inc. (WEST) Cheyenne, Wyoming, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. May 29, 2002.

Johnson, G.D., W.P. Erickson, M.D. Strickland, M.F. Shepherd, and D.A. Shepherd. 2000a. Avian Monitoring Studies at the Buffalo Ridge Wind Resource Area, Minnesota: Results of a 4-Year Study. Final report prepared for Northern States Power Company, Minneapolis, Minnesota, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. September 22, 2000. 212 pp. http://www.west-inc.com

Johnson, G.D., W.P. Erickson, M.D. Strickland, M.F. Shepherd, D.A. Shepherd, and S.A. Sarappo. 2002b. Collision Mortality of Local and Migrant Birds at a Large-Scale Wind-Power Development on Buffalo Ridge, Minnesota. Wildlife Society Bulletin 30(3): 879-887.

Johnson, G.D., W.P. Erickson, and J. White. 2003. Avian and Bat Mortality During the First Year of Operation at the Klondike Phase I Wind Project, Sherman County, Oregon. March 2003. Technical report prepared for Northwestern Wind Power, Goldendale, Washington, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. http://www.west-inc.com

Johnson, G.D., J. Jeffrey, J. Baker, and K. Bay. 2007. Baseline Avian Studies for the Windy Flats Wind Energy Project, Klickitat County, Washington. Prepared for Windy Point Partners, LLC., by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. May 29, 2007.

Johnson, G.D., M.K. Perlik, W.P. Erickson, and M.D. Strickland. 2004. Bat Activity, Composition and Collision Mortality at a Large Wind Plant in Minnesota. Wildlife Society Bulletin 32: 1278-1288.

Johnson, G.D., Young, D. P. Jr., W.P. Erickson, C.E. Derby, M.D. Strickland, and R.E. Good. 2000b. Wildlife Monitoring Studies, SeaWest Windpower Plant, Carbon County, Wyoming, 1995-1999. Final report prepared for SeaWest Energy Corporation, San Diego, California, and the Bureau of Land Management, Rawlins, Wyoming, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. August 9, 2000. http://www.west-inc.com and http://www.west-inc.com/reports/fcr_final_baseline.pdf

Kerlinger, P. 2000. Avian Mortality at Communication Towers: A Review of the Recent Literature, Research, and Methodology. US Fish and Wildlife Service, Office of Migratory Bird Management. http://migratorybirds.fws.gov/issues/towers/review.pdf

Kerlinger, P. 2003. Faa and Lighting. Presentation at the NWCC Biological Significance Workshop, Washington, D.C. November 17-18, 2003.

Kerlinger, P. 2005. Summary of Bird Studies and Collision Rates at Wind Power Projects. Rebuttal testimony of Paul Kerlinger for the East Haven Windfarm. February 9, 2005. http://easthavenwindfarm.com/filing/feb/ehwf-pk-reb1.pdf

Kerlinger, P., L. Culp, and R. Curry. 2005. Post-Construction Avian Monitoring Study for the High Winds Wind Power Project, Solano County, California. Year One Report. Prepared for High Winds, LLC and FPL Energy.

Kerlinger, P., R. Curry, L. Culp, A. Jain, C. Wilkerson, B. Fischer, and A. Hasch. 2006. Post-Construction Avian and Bat Fatality Monitoring for the High Winds Wind Power Project, Solano County, California: Two Year Report. Prepared for High Winds LLC, FPL Energy by Curry and Kerlinger, LLC. April 2006.

Kerlinger, P., R. Curry, A. Hasch, and J. Guarnaccia. 2007. Migratory Bird and Bat Monitoring Study at the Crescent Ridge Wind Power Project, Bureau County, Illinois: September 2005 - August 2006. Final draft prepared for Orrick Herrington and Sutcliffe, LLP. May 2007.

Kerlinger, P. and J. Kerns. 2004. A Study of Bird and Bat Collisions at the Mountaineer Wind Energy Facility, Tucker County, West Virginia. Prepared for FPL Energy and the Mountaineer Wind Energy Center Technical Review Committee. February 14, 2004.

Kronner, K., B. Gritski, and S. Downes. 2008. Big Horn Wind Power Project Wildlife Fatality Monitoring Study: 2006−2007. Final report prepared for PPM Energy and the Big Horn Wind Project Technical Advisory Committee by Northwest Wildlife Consultants, Inc.(NWC), Mid-Columbia Field Office, Goldendale, Washington. June 1, 2008.

Kronner, K., B. Gritski, Z. Ruhlen, and T. Ruhlen. 2007. Leaning Juniper Phase I Wind Power Project, 2006-2007: Wildlife Monitoring Annual Report. Unpublished report prepared by Northwest Wildlife Consultants, Inc. for PacifiCorp Energy, Portland, Oregon.

Manly, B.F.J. 1997. Randomization, Bootstrap, and Monte Carlo Methods in Biology. Second edition. Chapman and Hall, New York. 399 pp.

Migratory Bird Treaty Act (MBTA). 1918. 16 United States Code § 703-712. July 13, 1918.

National Research Council (NRC). 2007. Environmental Impacts of Wind-Energy Projects. National Academies Press. Washington, D.C. www.nap.edu

Nicholson, C.P. 2003. Buffalo Mountain Windfarm Bird and Bat Mortality Monitoring Report: October 2001 - September 2002. Tennessee Valley Authority, Knoxville, Tennessee. February 2003.

Northwest Wildlife Consultants, Inc. (NWC) and Western Ecosystems Technology, Inc. (WEST). 2004. Ecological Baseline Studies for the Roosevelt Wind Project, Klickitat County, Washington. Final Report. Prepared by NWC, Pendleton, Oregon, and WEST, Inc., Cheyenne, Wyoming. September 2004.

Northwest Wildlife Consultants, Inc. (NWC) and Western Ecosystems Technology, Inc. (WEST). 2005a. Ecological Baseline Studies and Wildlife Impact Assessment for the White Creek Wind Power Project, Klickitat County, Washington. Prepared for Last Mile Electric Cooperative, Goldendale, Washington, by Northwest Wildlife Consultants, Inc., Goldendale, Washington, and Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. January 12, 2005.

Northwest Wildlife Consultants, Inc. (NWC) and Western Ecosystems Technology, Inc. (WEST). 2005b. Wildlife Baseline Study for the Leaning Juniper Wind Power Project, Gilliam County, Oregon. Prepared for PPM Energy, Portland, Oregon and CH2M HILL, Portland, Oregon by NWC, Pendleton, Oregon, and WEST, Inc., Cheyenne, Wyoming. November 3, 2005.

Northwest Wildlife Consultants, Inc. (NWC) and Western EcoSystems Technology, Inc. (WEST). 2007. Avian and Bat Monitoring Report for the Klondike II Wind Power Project. Sherman County, Oregon. Prepared for PPM Energy, Portland, Oregon. Managed and conducted by NWC, Pendleton, Oregon. Analysis conducted by WEST, Cheyenne, Wyoming. July 17, 2007.

Oregon Department of Fish and Wildlife (ODFW). 2008a. Sensitive Species: Frequently Asked Questions and Sensitive Species List. http://www.dfw.state.or.us/wildlife/diversity/species/docs/SSL_by_category.pdf

Oregon Department of Fish and Wildlife (ODFW). 2008b. Species Information: Threatened, Endangered, and Candidate Fish and Wildlife Species in Oregon. Updated September 15, 2008. http://www.dfw.state.or.us/wildlife/diversity/species/threatened_endangered_candidate_list.asp

Orloff, S. and A. Flannery. 1992. Wind Turbine Effects on Avian Activity, Habitat Use, and Mortality in Altamont Pass and Solano County Wind Resource Areas, 1989-1991. Final Report P700-92-001 to Alameda, Costra Costa, and Solano Counties, and the California Energy Commission, Sacramento, California, by Biosystems Analysis, Inc., Tiburon, California. March 1992.

Portland General Electric (PGE). 2009. Biglow Fact Sheet. Biglow Canyon Wind Farm, PGE. Revised March 24, 2009.

Reynolds, R.T., J.M. Scott, and R.A. Nussbaum. 1980. A Variable Circular-Plot Method for Estimating Bird Numbers. Condor 82(3): 309-313.

Shoenfeld, P. 2004. Suggestions Regarding Avian Mortality Extrapolation. Technical memo provided to FPL Energy. West Virginia Highlands Conservancy, HC70, Box 553, Davis, West Virginia, 26260.

Thorson, T.D., S.A. Bryce, D.A. Lammers, A.J. Woods, J.M. Omernik, J. Kagan, D.E. Pater, and J.A. Comstock. 2003. Ecoregions of Oregon. (Color poster with map, descriptive text, summary tables, and photographs.) US Geological Survey (USGS) map (map scale 1:1,500,000) USGS, Reston, Virginia. US Environmental Protection Agency (USEPA).

Tierney, R. 2007. Buffalo Gap I Wind Farm Avian Mortality Study: February 2006-January 2007. Final Survey Report. Prepared for AES SeaWest, Inc. TRC, Albuquerque, New Mexico.TRC Report No. 110766-C-01. May 2007.

URS Corporation, Western EcoSystems Technology, Inc. (WEST), and Northwest Wildlife Consultants, Inc. (NWC). 2001. Avian Baseline Study for the Stateline Project. Prepared for FPL Energy Vansycle, LLC, Juno Beach, Florida.

US Geological Survey (USGS) National Land Cover Database (NLCD). 2001. Land Use/Land Cover NLCD Data. USGS Headquarters, USGS National Center. Reston, Virginia.

Western EcoSystems Technology, Inc. (WEST). 2005a. Additional 2005 Fall Wildlife Surveys: Biglow Canyon Wind Farm, Sherman County, Oregon. Prepared for Orion Energy LLC, Oakland, California, by WEST, Cheyenne, Wyoming, and Walla Walla, Washington. November 7, 2005.

Western Ecosystems Technology, Inc. (WEST). 2005b. Ecological Baseline Study at the Elkhorn Wind Power Project. Exhibit A. Final report prepared for Zilkha Renewable Energy, LLC., Portland, Oregon, by WEST, Cheyenne, Wyoming. June 2005.

Western EcoSystems Technology, Inc. (WEST). 2005c. Ecological Baseline Study for the Proposed Reardon Wind Project, Lincoln County, Washington. Draft final report. Prepared for Energy Northwest, Richland, Washington, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. June 2005.

Western EcoSystems Technology, Inc. (WEST). 2005d. Wildlife and Habitat Baseline Study for the Proposed Biglow Canyon Wind Power Project, Sherman County, Oregon. Preliminary draft prepared for Orion Energy LLC, Oakland, California, by WEST, Cheyenne, Wyoming, and Walla Walla, Washington. September, 2005.

Western EcoSystems Technology, Inc. (WEST). 2005e. Wildlife and Habitat Baseline Study for the Proposed Biglow Canyon Wind Power Project, Sherman County, Oregon. March 2004 - August 2005. Prepared for Orion Energy LLC., Oakland, California. October, 2005. WEST. Cheyenne, Wyoming.

Western EcoSystems Technology, Inc. (WEST). 2006a. Diablo Winds Wildlife Monitoring Progress Report, March 2005 - February 2006. Technical report submitted to FPL Energy and Alameda County California. WEST. Cheyenne, Wyoming.

Western EcoSystems Technology, Inc. (WEST). 2006b. Wildlife Baseline Study for the North Valley County Wind Project: Summary of Results from 2006 Wildlife Surveys. Prepared for POWER Engineers, Boise, Idaho, and Wind Hunter, LLC., Grapevine, Texas. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. December 8, 2006.

Western Ecosystems Technology, Inc. (WEST). 2007a. Baseline Avian Studies for the Orion Sherman/Biglow Canyon North Wind Power Project. Draft prepared for Orion Energy by WEST, Cheyenne, Wyoming. January 25, 2007.

Western EcoSystems Technology, Inc. (WEST). 2007b. Wildlife and Habitat Baseline Study for the Vantage Wind Power Project, Kittitas County, Washington. Draft report prepared for Invenergy by Western EcoSystems Technology, Inc. (WEST), Cheyenne Wyoming and Walla Walla, Washington. June 2007.

Western EcoSystems Technology, Inc. (WEST) and Colorado Plateau Research Station (CPRS). 2006. Avian Studies for the Proposed Sunshine Wind Park, Coconino County, Arizona. Prepared for Sunshine Arizona Wind Energy, LLC., Flagstaff, Arizona, by WEST, Cheyenne, Wyoming, and the CPRS, Northern Arizona University, Flagstaff, Arizona. May 2006.

Western EcoSystems Technology, Inc. (WEST), EDAW, Inc., and Bloom Biological, Inc. 2007. Baseline Avian Use and Risk Assessment for the Homestead Wind Energy Project, Kern County, California. 2005 – 2006. Prepared for Horizon Wind Energy by Western EcoSystems Technology, Inc. (WEST), EDAW, Inc., San Diego, California, and Bloom Biological, Inc., Santa Anna, California. April 19, 2007.

Whitfield, D.P. and M. Madders. 2006. A Review of the Impacts of Wind Farms on Hen Harriers *Circus cyaneus* and an Estimation of Collision Avoidance Rates. Natural Research Information Note 1 (revised). Natural Research Ltd., Banchory, UK.

Woodward-Clyde International-Americas, (WCIA) and Western EcoSystems Technology, Inc. (WEST). 1997. Avian Baseline Study for the Vansycle Ridge Project - Vansycle Ridge, Oregon and Wildlife Mortality Studies, Vansycle Wind Project, Washington. Prepared for Esi Vansycle Partners, L.P., North Palm Beach, Florida.

Young, D.P. Jr., W.P. Erickson, K. Bay, J. Jeffrey, E.G. Lack, R.E. Good, and H.H. Sawyer. 2003a. Baseline Avian Studies for the Proposed Hopkins Ridge Wind Project, Columbia County, Washington. Final Report, March 2002 - March 2003. Prepared for RES North America, LLC., Portland, Oregon, by Western EcoSystems Technology, Inc.(WEST), Cheyenne, Wyoming. April 30, 2003.

Young, D.P. Jr., W.P. Erickson, K. Bay, J. Jeffrey, E.G. Lack, and H.H. Sawyer. 2003b. Baseline Avian Studies for the Proposed Desert Claim Wind Power Project, Kittitas County, Washington. Final Report. Prepared for Desert Claim Wind Power, LLC, Ellensburg, Washington, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. July 2003.

Young, D.P. Jr., W.P. Erickson, R.E. Good, M.D. Strickland, and G.D. Johnson. 2003c. Avian and Bat Mortality Associated with the Initial Phase of the Foote Creek Rim Windpower Project, Carbon County, Wyoming, Final Report, November 1998 - June 2002. Prepared for Pacificorp, Inc. Portland, Oregon, SeaWest Windpower Inc. San Diego, California, and Bureau of Land Management, Rawlins District Office, Rawlins, Wyoming.

Young, D.P. Jr., W.P. Erickson, J. Jeffrey, K. Bay, and M. Bourassa. 2005. Eurus Combine Hills Turbine Ranch. Phase I Post Construction Wildlife Monitoring Final Report February 2004 February 2005. Technical report for Eurus Energy America Corporation and the Combine Hills Technical Advisory Committee, Umatilla County, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon.

Young, D.P. Jr., W.P. Erickson, J. Jeffrey, K. Bay, R.E. Good, and E.G. Lack. 2003d. Avian and Sensitive Species Baseline Study Plan and Final Report. Eurus Combine Hills Turbine Ranch, Umatilla County, Oregon. Technical report prepared for Eurus Energy America Corporation, San Diego, California and Aeropower Services, Inc., Portland, Oregon, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. March 10, 2003.

Young, D.P. Jr., W.P. Erickson, J. Jeffrey, and V.K. Poulton. 2007a. Puget Sound Energy Hopkins Ridge Wind Project Phase I Post-Construction Avian and Bat Monitoring First Annual Report, January - December 2006. Technical report for Puget Sound Energy, Dayton, Washington and Hopkins Ridge Wind Project Technical Advisory Committee, Columbia County, Washington. Western EcoSystems Technology, Inc. (WEST) Cheyenne, Wyoming, and Walla Walla, Washington. 25 pp.

Young, D.P. Jr., W.P. Erickson, J. Jeffrey, and V.K. Poulton. 2007b. Puget Sound Energy, Hopkins Ridge Wind Project Phase I, Post-Construction Avian and Bat Monitoring, First Annual Report, January - December 2006. Technical report prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, for Puget Sound Energy.

Young, D.P. Jr., J. Jeffrey, W.P. Erickson, K. Bay, and V.K. Poulton. 2006. Eurus Combine Hills Turbine Ranch. Phase I Post Construction Wildlife Monitoring First Annual Report. Technical report prepared for Eurus Energy America Corporation, San Diego, California, and the Combine Hills Technical Advisory Committee, Umatilla County, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon.

Young, D.P. Jr., G.D. Johnson, V.K. Poulton, and K. Bay. 2007c. Ecological Baseline Studies for the Hatchet Ridge Wind Energy Project, Shasta County, California. Prepared for Hatchet Ridge Wind, LLC, Portland, Oregon by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. August 31, 2007. http://www.co.shasta.ca.us/Departments/Resourcemgmt/drm/Hatchet%20Ridge/DEIR/App_C-1.pdf

Young, D.P. Jr., V.K. Poulton, and K. Bay. 2007d. Ecological Baseline Studies Report. Proposed Dry Lake Wind Project, Navajo County, Arizona. Prepared for PPM Energy, Portland, Oregon, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. July 1, 2007.

Table 1. The land cover types, coverage, and composition within the Biglow Canyon Wind Farm, Phase I.

Land Cover	Acres	% Composition
Open Water	3.96	<0.1%
Developed, Open Space	612.86	2.6%
Developed, Low Intensity	3.23	<0.1%
Developed, Medium Intensity	0.66	<0.1%
Mixed Forest	2.45	<0.1%
Scrub-Shrub	4,193.45	17.7%
Grassland	906.60	3.8%
Crops	17,940.20	75.8%
Woody Wetlands	2.26	<0.1%
Emergent Wetlands	0.82	<0.1%
Total	**23,666.50**	**100%**

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

Table 2. Summary of bird and bat fatalities found during at the Biglow Canyon Wind Farm, Phase I.

Season	Dates	# of visits	# of surveys	# of Turbines Searched	# Bird Species	# Bird Fatalities	# Bat Species	# Bat Fatalities
Winter	11/1 to 3/15	4	200	50	3	3	0	0
Spring migration	3/16 to 5/15	5	250	50	9	14	1	2
Summer	5/16 to 8/15	3	150	50	4	9	2	2
Fall migration	8/16 to 10/31	5	250	50	11	16	2	46
Overall		**17**	**850**	**50**	**20**	**42**	**2**	**50**

Table 3. Total number of bird and bat fatalities and the composition of fatalities discovered at the Biglow Canyon Wind Farm, Phase I from January 10, 2008 – December 18, 2008.

		Fatalities found at scheduled search plots		All Fatalities	
Species	**Scientific Name**	**Total**	**% Composition**	**Total**	**% Composition**
horned lark	*Eremophila alpestris*	12	31.6	12	28.6
ring-necked pheasant	*Phasianus colchicus*	5	13.2	7	16.7
golden-crowned kinglet	*Regulus satrapa*	2	5.3	2	4.8
Townsend's warbler	*Dendroica townsendi*	2	5.3	2	4.8
rock pigeon	*Columba livia*	2	5.3	2	4.8
western meadowlark	*Sturnella neglecta*	2	5.3	2	4.8
house sparrow	*Passer domesticus*	1	2.6	2	4.8
downy woodpecker	*Picoides pubescens*	1	2.6	1	2.4
golden-crowned sparrow	*Zonotrichia atricapilla*	1	2.6	1	2.4
gray partridge	*Perdix perdix*	1	2.6	1	2.4
orange-crowned warbler	*Vermivora celata*	1	2.6	1	2.4
chukar	*Alectoris* ***chukar***	1	2.6	1	2.4
rough-legged hawk	*Buteo lagopus*	1	2.6	1	2.4
savannah sparrow	*Passerculus sandwichensis*	1	2.6	1	2.4
white-crowned sparrow	*Zonotrichia leucophrys*	1	2.6	1	2.4
ruby-crowned kinglet	*Regulus calendula*	1	2.6	1	2.4
red-tailed hawk	*Buteo jamaicensis*	1	2.6	1	2.4
song sparrow	*Melospiza melodia*	0	---	1	2.4
unidentified bird		1	2.6	1	2.4
unidentified passerine		1	2.6	1	2.4
Bird Subtotal		**38**	**100**	**42**	**100**
hoary bat	*Lasiurus cinereus*	21	51.2	25	50
silver-haired bat	*Lasionycteris noctivagans*	20	48.8	25	50
Bat Subtotal		**41**	**100**	**50**	**100**

Table 4. Number of bird fatalities by turbine in the Biglow Canyon Wind Farm, Phase I.

Turbine No.	No. of Fatalities
1	1
2	0
7	1
9	0
11	1
13	0
15	3
17	4
18	0
19	2
21	0
23	0
28	1
29	0
34	2
35	0
36	0
37	0
38	0
39	1
40	1
41	0
42	0
43	0
44	0
45	2
46	0
47	3
49	0
51	0
53	1
55	0
56	1
57	1
58	0
59	1
61	1
62	0
63	0
64	3

Table 4. Number of bird fatalities by turbine in the Biglow Canyon Wind Farm, Phase I.

Turbine No.	No. of Fatalities
65	2
66	1
67	3
68	0
69	0
71	0
73	0
74	0
75	0
76	2

Table 5. Distribution of distances of bird and bat fatalities from turbines at the Biglow Canyon Wind Farm, Phase I.

Distance to Turbine (m)	% Bat Fatalities	% Bird Fatalities
0 – 10	14.0	7.9
11 – 20	28.0	7.9
21 – 30	20.0	---
31 – 40	20.0	---
41 – 50	6.0	7.9
50 – 60	6.0	7.9
60 – 70	2.0	2.6
70 – 80	2.0	---
80 – 90	---	15.8
90 – 100	2.0	15.8
100 – 110	---	10.5
110 – 120	---	13.2
120 – 130	---	10.5

Table 6. Number of bat fatalities by turbine in the Biglow Canyon Wind Farm, Phase I.

Turbine No.	No. of Fatalities
1	0
2	1
7	0
9	1
11	1
13	0
15	1
17	0
18	0
19	1
21	2
23	1
28	1
29	1
34	0
35	2
36	4
37	0
38	0
39	0
40	2
41	0
42	2
43	1
44	0
45	0
46	0
47	1
49	1
51	0
53	0
55	1
56	1
57	0
58	2
59	1
61	1
62	2
63	0
64	0
65	1

Table 6. Number of bat fatalities by turbine in the Biglow Canyon Wind Farm, Phase I.

Turbine No.	No. of Fatalities
66	0
67	2
68	1
69	2
71	0
73	0
74	2
75	1
76	1

Table 7. Results of Searcher Efficiency Trials at the Biglow Canyon Wind Farm, Phase I.

		Large Birds		
Season	**# Placed**	**#Available**	**#Found**	**%Found**
Winter	21	20	18	90.0
Spring	18	18	18	100.0
Summer	23	23	20	87.0
Fall	19	19	16	84.2
Total	**81**	**80**	**72**	**90.0**
		Small Birds		
Season	**# Placed**	**#Available**	**#Found**	**%Found**
Winter	19	19	7	36.8
Spring	19	19	8	42.1
Summer	23	23	10	43.5
Fall	21	15	3	20.0
Total	**82**	**76**	**28**	**36.8**
	Grassland		**Agriculture**	
		Large Birds		
Season	**#Placed**	**%Found**	**#Placed**	**%Found**
Winter	6	83.3	15	92.9
Spring	6	100.0	12	100.0
Summer	5	100.0	18	83.3
Fall	5	60.0	14	92.3
Total	**22**	**86.4**	**59**	**91.2**
		Small Birds		
Season	**#Placed**	**%Found**	**#Placed**	**%Found**
Winter	5	40.0	14	35.7
Spring	8	37.5	11	45.5
Summer	0	---	23	43.5
Fall	8	14.3	13	25.0
Total	**21**	**30.0**	**61**	**39.3**

Table 8. Mortality estimates for birds and bats associated with the first year of monitoring of the Biglow Canyon Wind Farm, Phase I.

			90% Confidence Interval	
	Estimate	**se**	**Lower Limit**	**Upper Limit**
Searcher Efficiency Rates				
Large Birds	0.90	0.03	0.85	0.95
Small Birds	0.37	0.05	0.29	0.46
Mean Carcass Removal Time (days)				
Large Birds	17.84	1.77	15.00	20.76
Small Birds	10.10	1.29	8.07	12.20
Available and Detection Probabilities				
Large Birds migration season	0.72	0.04	0.65	0.77
Large Birds other seasons	0.55	0.05	0.47	0.61
Small Birds migration season	0.25	0.04	0.18	0.32
Small Birds other seasons	0.14	0.03	0.10	0.19
Fatality Estimates (#/turbine/yr)				
Large Birds	0.35	0.10	0.09	0.54
Small Birds	2.55	0.85	1.48	4.07
All Birds	2.90	0.85	1.83	4.46
All Birds without introduced species	2.52	0.84	1.46	4.04
Raptors	0.06	0.04	0	0.12
Nocturnal Migrants	0.72	0.31	0.29	1.31
Grassland Songbirds	1.44	0.52	0.73	2.42
Target Grassland Songbirds	0.22	0.17	0	0.54
Bats	3.29	0.80	2.27	4.85
Fatality Estimates (#/MW/yr)				
Large Birds	0.21	0.06	0.02	0.33
Small Birds	1.54	0.51	0.90	2.46
All Birds	1.76	0.52	1.11	2.71
All Birds without introduced species	1.53	0.51	0.88	2.45
Raptors	0.03	0.02	0	0.07
Nocturnal Migrants	0.44	0.19	0.18	0.79
Grassland Songbirds	0.87	0.31	0.44	1.47
Target Grassland Songbirds	0.13	0.10	0	0.33
Bats	1.99	0.49	1.38	2.94

Table 8. Mortality estimates for birds and bats associated with the first year of monitoring of the Biglow Canyon Wind Farm, Phase I.

	Estimate	se	90% Confidence Interval Lower Limit	90% Confidence Interval Upper Limit
Daily Estimates (#/day)				
Large Birds	0.001	<0.001	0.005	0.012
Small Birds	0.007	0.002	0.004	0.011
All Birds	0.008	0.002	0.005	0.012
All Birds without introduced species	0.007	0.002	0.004	0.011
Raptors	<0.001	<0.001	0	<0.001
Nocturnal Migrants	0.002	0.001	0.001	0.004
Grassland Songbirds	0.004	0.001	0.002	0.007
Bats	0.009	0.002	0.006	0.013

Table 9. Average number of bird carcasses found at scheduled search turbines lit with FAA aviation strobe lights compared to those at unlit turbines at the Biglow Canyon Wind Farm, Phase I.

	All Birds			Nocturnal Migrants		
	Lit	**Unlit**	**Overall**	**Lit**	**Unlit**	**Overall**
No. of Turbines	17	33	50	17	33	50
Total No. of Fatalities Found	17	21	38	6	3	9
Mean No. of Fatalities/Turbine	1.0	0.64		0.35	0.09	
Difference of means (90% CI)		**0.36 (-0.19 – 0.92)**			**-0.05 (-0.05 – 0.57)**	

Table 10. Average number of bat carcasses found at scheduled search turbines lit with FAA aviation strobe lights compared to those at unlit turbines at the Biglow Canyon Wind Farm, Phase I.

	Turbine Lighting		
	Lit	**Unlit**	**Overall**
No. of Turbines	17	33	50
Total No. of Bat Fatalities Found	13	28	41
Mean No. of Bat Fatalities/Turbine	0.77	0.85	
Difference of means(90% CI)		**-0.08 (-0.50 – 0.33)**	

Table 11. Summary of bird use (number of birds/plot/30-min survey), species richness (species/30-min survey), and sample size by season and overall during the John Day Canyon 800-m fixed-point bird use surveys at the Biglow Canyon Wind Farm, Phase I, January 17 - December 18, 2008.

Season	Number of Visits	Mean Use	# Species/ Survey	# Species	# Surveys Conducted
Spring	18	6.99	2.79	38	72
Summer	16	5.08	1.98	33	64
Fall	20	19.90	1.85	37	80
Winter	14	12.70	1.79	29	55
Overall	**68**	**11.79**	**2.10**	**58**	**271**

Table 12. Summary of overall bird use (number of birds/plot/5-min survey), species richness (species/5-min survey), and sample size during the Project Wind Turbine 400-m fixed-point bird use surveys in the Biglow Canyon Wind Farm, Phase I, January 10 - December 12, 2008.

Season	Number of Visits	Mean Use	# Species/ Survey	# Species	# Surveys Conducted
Spring	8	3.09	1.36	22	274
Summer	3	1.78	0.81	14	144
Fall	7	3.55	0.97	16	318
Winter	3	21.36	0.97	12	114
Overall	**21**	**7.62**	**1.03**	**33**	**850**

Table 13. Total number of individuals and groups for each bird type and species, by season and overall, during the John Day Canyon 800-m fixed-point bird use surveys at the Biglow Canyon Wind Farm, Phase I, January 17 - December 18, 2008.

		Spring		Summer		Fall		Winter		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# Grps**	**# obs**	**# grps**	**# obs**
Waterbirds		**1**	**11**	**0**	**0**	**2**	**5**	**0**	**0**	**3**	**16**
American white pelican	*Pelecanus erythrorhyncos*	0	0	0	0	1	1	0	0	1	1
double-crested cormorant	*Phalacrocorax auritus*	1	11	0	0	1	4	0	0	2	15
Waterfowl		**1**	**1**	**1**	**7**	**76**	**6,901**	**28**	**1,088**	**106**	**7,997**
Canada goose	*Branta canadensis*	0	0	1	7	74	6,892	26	935	101	7,834
greater white-fronted goose	*Anser albifrons*	0	0	0	0	1	7	0	0	1	7
mallard	*Anas platyrhynchos*	1	1	0	0	1	2	1	12	3	15
unidentified duck		0	0	0	0	0	0	1	141	1	141
Shorebirds		**2**	**5**	**0**	**0**	**0**	**0**	**1**	**1**	**3**	**6**
killdeer	*Charadrius vociferus*	0	0	0	0	0	0	1	1	1	1
long-billed curlew	*Numenius americanus*	2	5	0	0	0	0	0	0	2	5
Raptors		**123**	**134**	**81**	**91**	**97**	**107**	**53**	**56**	**354**	**388**
Accipiters		*0*	*0*	*1*	*1*	*7*	*7*	*0*	*0*	*8*	*8*
Cooper's hawk	*Accipiter cooperii*	0	0	0	0	2	2	0	0	2	2
sharp-shinned hawk	*Accipter striatus*	0	0	1	1	5	5	0	0	6	6
Buteos		*79*	*90*	*34*	*38*	*53*	*60*	*43*	*45*	*209*	*233*
ferruginous hawk	*Buteo regalis*	0	0	1	1	0	0	0	0	1	1
red-tailed hawk	*Buteo jamaicensis*	59	68	27	30	43	50	17	19	146	167
rough-legged hawk	*Buteo lagopus*	19	21	0	0	10	10	22	22	51	53
Swainson's hawk	*Buteo swainsoni*	1	1	5	5	0	0	0	0	6	6
unidentified buteo		0	0	1	2	0	0	4	4	5	6
Northern Harrier		*19*	*19*	*10*	*10*	*9*	*9*	*3*	*3*	*41*	*41*
northern harrier	*Circus cyaneus*	19	19	10	10	9	9	3	3	41	41

Table 13. Total number of individuals and groups for each bird type and species, by season and overall, during the John Day Canyon 800-m fixed-point bird use surveys at the Biglow Canyon Wind Farm, Phase I, January 17 - December 18, 2008.

		Spring		Summer		Fall		Winter		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# Grps**	**# obs**	**# grps**	**# obs**
Eagles		*6*	*6*	*5*	*6*	*8*	*9*	*2*	*3*	*21*	*24*
bald eagle	*Haliaeetus leucocephalus*	3	3	1	2	0	0	2	3	6	8
golden eagle	*Aquila chrysaetos*	3	3	4	4	8	9	0	0	15	16
Falcons		*19*	*19*	*29*	*34*	*17*	*19*	*5*	*5*	*70*	*77*
American kestrel	*Falco sparverius*	14	14	26	31	12	14	2	2	54	61
peregrine falcon	*Falco peregrinus*	0	0	0	0	2	2	0	0	2	2
prairie falcon	*Falco mexicanus*	5	5	3	3	3	3	3	3	14	14
Other Raptors		*0*	*0*	*2*	*2*	*3*	*3*	*0*	*0*	*5*	*5*
Osprey	*Pandion haliaetus*	0	0	0	0	3	3	0	0	3	3
unidentified raptor		0	0	2	2	0	0	0	0	2	2
Vultures		**8**	**8**	**3**	**3**	**3**	**11**	**0**	**0**	**14**	**22**
turkey vulture	*Cathartes aura*	8	8	3	3	3	11	0	0	14	22
Upland Gamebirds		**42**	**56**	**21**	**34**	**8**	**34**	**15**	**32**	**86**	**156**
California quail	*Callipepla californica*	0	0	2	3	0	0	0	0	2	3
chukar	*Alectoris chukar*	14	22	6	10	5	30	7	18	32	80
gray partridge	*Perdix perdix*	0	0	0	0	0	0	1	4	1	4
ring-necked pheasant	*Phasianus colchicus*	28	34	13	21	3	4	7	10	51	69
Doves/Pigeons		**5**	**6**	**7**	**19**	**5**	**14**	**3**	**5**	**20**	**44**
mourning dove	*Zenaida macroura*	3	3	7	19	3	6	3	5	16	33
rock pigeon	*Columba livia*	2	3	0	0	2	8	0	0	4	11
Passerines		**499**	**993**	**176**	**499**	**299**	**1,406**	**218**	**587**	**1,192**	**3,485**
American crow	*Corvus brachyrhynchos*	1	3	0	0	1	81	0	0	2	84
American goldfinch	*Carduelis tristis*	2	5	0	0	2	4	1	1	5	10
American pipit	*Anthus rubescens*	0	0	0	0	2	3	0	0	2	3
American robin	*Turdus migratorius*	3	7	1	1	1	1	0	0	5	9
barn swallow	*Hirundo rustica*	2	2	1	1	0	0	0	0	3	3
black-billed magpie	*Pica pica*	3	3	4	7	10	18	4	14	21	42
Brewer's blackbird	*Euphagus cyanocephalus*	7	7	3	5	2	9	0	0	12	21

Table 13. Total number of individuals and groups for each bird type and species, by season and overall, during the John Day Canyon 800-m fixed-point bird use surveys at the Biglow Canyon Wind Farm, Phase I, January 17 - December 18, 2008.

		Spring		Summer		Fall		Winter		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# Grps**	**# obs**	**# grps**	**# obs**
brown-headed cowbird	*Molothrus ater*	2	3	3	5	3	8	0	0	8	16
cliff swallow	*Petrochelidon pyrrhonota*	3	52	10	31	0	0	0	0	13	83
common raven	*Corvus corax*	54	69	14	19	78	141	28	57	174	286
dark-eyed junco	*Junco hyemalis*	2	18	0	0	0	0	0	0	2	18
European starling	*Sturnus vulgaris*	11	69	7	24	12	243	7	85	37	421
grasshopper sparrow	*Ammodramus savannarum*	2	2	2	2	0	0	0	0	4	4
gray-crowned rosy finch	*Leucosticte arctoa*	0	0	0	0	0	0	1	1	1	1
horned lark	*Eremophila alpestris*	240	401	73	270	112	746	128	305	553	1,722
house finch	*Carpodacus mexicanus*	0	0	0	0	15	59	5	42	20	101
northern rough-winged swallow	*Stelgidopteryx serripennis*	1	3	5	6	2	5	0	0	8	14
northern shrike	*Lanius excubitor*	2	2	0	0	0	0	0	0	2	2
red-winged blackbird	*Agelaius phoeniceus*	7	54	2	7	1	1	1	4	11	66
sage thrasher	*Oreoscoptes montanus*	0	0	0	0	1	1	0	0	1	1
Say's phoebe	*Sayornis saya*	1	1	0	0	0	0	0	0	1	1
tree swallow	*Tachycineta bicolor*	0	0	1	7	0	0	0	0	1	7
unidentified bluebird		0	0	0	0	0	0	1	1	1	1
unidentified passerine		0	0	0	0	0	0	1	1	1	1
unidentified sparrow		0	0	1	1	0	0	0	0	1	1
unidentified swallow		2	3	4	25	1	4	0	0	7	32
vesper sparrow	*Pooecetes gramineus*	1	1	1	1	0	0	0	0	2	2
violet-green swallow	*Tachycineta thalassina*	7	14	3	16	0	0	0	0	10	30
western kingbird	*Tyrannus verticalis*	4	5	1	1	0	0	0	0	5	6
western meadowlark	*Sturnella neglecta*	141	268	40	70	56	82	41	76	278	496
western tanager	*Piranga ludoviciana*	1	1	0	0	0	0	0	0	1	1
Other Birds		**1**	**1**	**1**	**1**	**4**	**10**	**1**	**1**	**7**	**13**
common nighthawk	*Chordeiles minor*	1	1	1	1	0	0	0	0	2	2
northern flicker	*Colaptes auratus*	0	0	0	0	1	1	1	1	2	2

Table 13. Total number of individuals and groups for each bird type and species, by season and overall, during the John Day Canyon 800-m fixed-point bird use surveys at the Biglow Canyon Wind Farm, Phase I, January 17 - December 18, 2008.

		Spring		Summer		Fall		Winter		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# Grps**	**# obs**	**# grps**	**# obs**
Vaux's swift	*Chaetura vauxi*	0	0	0	0	3	9	0	0	3	9
Overall		**682**	**1,215**	**290**	**654**	**494**	**8,488**	**319**	**1,770**	**1,785**	**12,127**

Table 14. Total number of groups and individuals for each bird type and species by season during the Project Wind Turbine 400-m fixed-point bird use surveys in the Biglow Canyon Wind Farm, Phase I, January 10 - December 12, 2008.

		Spring		Summer		Fall		Winter		Total	
Species/Type	Scientific Name	# grps	# obs	# grps	# obs	# grps	# obs	# Grps	# obs	# grps	# obs
Waterbirds/Waterfowl		**2**	**38**	**1**	**1**	**10**	**349**	**0**	**0**	**13**	**388**
Canada goose	*Branta canadensis*	1	24	0	0	10	349	0	0	11	373
double-crested cormorant	*Phalacrocorax auritus*	1	14	0	0	0	0	0	0	1	14
unidentified gull		0	0	1	1	0	0	0	0	1	1
Raptors		**27**	**29**	**8**	**8**	**25**	**26**	**12**	**12**	**72**	**75**
Accipiters		*0*	*0*	*0*	*0*	*1*	*1*	*0*	*0*	*1*	*1*
Cooper's hawk	*Accipiter cooperii*	0	0	0	0	1	1	0	0	1	1
Buteos		*16*	*17*	*3*	*3*	*16*	*16*	*7*	*7*	*42*	*43*
red-tailed hawk	*Buteo jamaicensis*	13	14	2	2	13	13	3	3	31	32
rough-legged hawk	*Buteo lagopus*	2	2	0	0	3	3	4	4	9	9
Swainson's hawk	*Buteo swainsoni*	1	1	1	1	0	0	0	0	2	2
Northern Harrier		*9*	*10*	*4*	*4*	*2*	*2*	*0*	*0*	*15*	*16*
northern harrier	*Circus cyaneus*	9	10	4	4	2	2	0	0	15	16
Eagles		*0*	*0*	*0*	*0*	*1*	*1*	*2*	*2*	*3*	*3*
bald eagle	*Haliaeetus leucocephalus*	0	0	0	0	1	1	1	1	2	2
golden eagle	*Aquila chrysaetos*	0	0	0	0	0	0	1	1	1	1
Falcons		*1*	*1*	*1*	*1*	*5*	*6*	*3*	*3*	*10*	*11*
American kestrel	*Falco sparverius*	0	0	1	1	5	6	1	1	7	8
prairie falcon	*Falco mexicanus*	1	1	0	0	0	0	2	2	3	3
Other Raptors		*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*	*1*	*1*
unidentified raptor		1	1	0	0	0	0	0	0	1	1
Upland Gamebirds		**24**	**24**	**4**	**4**	**1**	**3**	**0**	**0**	**29**	**31**
California quail	*Callipepla californica*	0	0	1	1	0	0	0	0	1	1
ring-necked pheasant	*Phasianus colchicus*	24	24	3	3	1	3	0	0	28	30
Passerines		**719**	**888**	**182**	**246**	**406**	**734**	**189**	**1,109**	**1,496**	**2,977**
Blackbirds/Orioles		*192*	*231*	*20*	*22*	*77*	*85*	*45*	*93*	*334*	*431*
European starling	*Sturnus vulgaris*	2	4	1	1	4	11	2	42	9	58

Table 14. Total number of groups and individuals for each bird type and species by season during the Project Wind Turbine 400-m fixed-point bird use surveys in the Biglow Canyon Wind Farm, Phase I, January 10 - December 12, 2008.

		Spring		Summer		Fall		Winter		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# Grps**	**# obs**	**# grps**	**# obs**
red-winged blackbird	*Agelaius phoeniceus*	1	1	0	0	0	0	0	0	1	1
western meadowlark	*Sturnella neglecta*	189	226	19	21	73	74	43	51	324	372
Finches		*3*	*10*	*0*	*0*	*0*	*0*	*4*	*30*	*7*	*40*
gray-crowned rosy finch	*Leucosticte arctoa*	0	0	0	0	0	0	1	19	1	19
house finch	*Carpodacus mexicanus*	3	10	0	0	0	0	3	11	6	21
Grassland/Sparrows		*486*	*584*	*157*	*218*	*297*	*608*	*129*	*175*	*1,069*	*1,585*
American pipit	*Anthus rubescens*	4	11	0	0	2	7	0	0	6	18
chipping sparrow	*Spizella passerina*	2	2	0	0	0	0	0	0	2	2
dark-eyed junco	*Junco hyemalis*	1	1	0	0	0	0	0	0	1	1
grasshopper sparrow	*Ammodramus savannarum*	3	3	1	1	0	0	0	0	4	4
horned lark	*Eremophila alpestris*	471	562	156	217	294	564	129	175	1,050	1,518
savannah sparrow	*Passerculus sandwichensis*	2	2	0	0	0	0	0	0	2	2
vesper sparrow	*Pooecetes gramineus*	0	0	0	0	1	37	0	0	1	37
white-crowned sparrow	*Zonotrichia leucophrys*	3	3	0	0	0	0	0	0	3	3
Swallows		*2*	*3*	*1*	*1*	*1*	*2*	*0*	*0*	*4*	*6*
barn swallow	*Hirundo rustica*	2	3	1	1	0	0	0	0	3	4
tree swallow	*Tachycineta bicolor*	0	0	0	0	1	2	0	0	1	2
Thrushes		2	17	2	2	0	0	0	0	4	19
American robin	*Turdus migratorius*	2	17	2	2	0	0	0	0	4	19
Corvids		*34*	*43*	*2*	*3*	*31*	*39*	*11*	*811*	*78*	*896*
American crow	*Corvus brachyrhynchos*	0	0	0	0	1	2	0	0	1	2
common raven	*Corvus corax*	34	43	2	3	30	37	11	811	77	894
Overall		**772**	**979**	**195**	**259**	**442**	**1,112**	**201**	**1,121**	**1,610**	**3,471**

Table 15. Mean bird use (number of birds/plot/30-min survey), percent of total composition (%), and frequency of occurrence (%) for each bird type and species by season during the John Day Canyon 800-m fixed-point bird use surveys at the Biglow Canyon Wind Farm, Phase I, January 17 - December 18, 2008.

	Use				% Composition				% Frequency			
Species/Type	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
Waterbirds	**0**	**0**	**0.05**	**0**	**0**	**0**	**0.3**	**0**	**0**	**0**	**1.3**	**0**
double-crested cormorant	0	0	0.05	0	0	0	0.3	0	0	0	1.3	0
Waterfowl	**0.01**	**0**	**9.68**	**8.43**	**0.2**	**0**	**48.6**	**66.4**	**1.4**	**0**	**14.8**	**8.9**
Canada goose	0	0	9.59	8.43	0	0	48.2	66.4	0	0	13.5	8.9
greater white-fronted goose	0	0	0.09	0	0	0	0.4	0	0	0	1.3	0
mallard	0.01	0	0	0	0.2	0	0	0	1.4	0	0	0
Shorebirds	**0.07**	**0**	**0**	**0.02**	**1.0**	**0**	**0**	**0.1**	**2.8**	**0**	**0**	**1.8**
killdeer	0	0	0	0.02	0	0	0	0.1	0	0	0	1.8
long-billed curlew	0.07	0	0	0	1.0	0	0	0	2.8	0	0	0
Raptors	**0.83**	**0.75**	**0.52**	**0.64**	**11.9**	**14.8**	**2.6**	**5.1**	**51.4**	**45.3**	**34.8**	**46.4**
Accipiters	*0*	*0*	*0.05*	*0*	*0*	*0*	*0.3*	*0*	*0*	*0*	*5.4*	*0*
sharp-shinned hawk	0	0	0.05	0	0	0	0.3	0	0	0	5.4	0
Buteos	*0.50*	*0.19*	*0.22*	*0.48*	*7.2*	*3.7*	*1.1*	*3.8*	*34.7*	*18.8*	*14.4*	*37.5*
ferruginous hawk	0	0.02	0	0	0	0.3	0	0	0	1.6	0	0
red-tailed hawk	0.33	0.16	0.16	0.14	4.8	3.1	0.8	1.1	27.8	15.6	10.6	12.5
rough-legged hawk	0.17	0	0.06	0.34	2.4	0	0.3	2.7	11.1	0	5.0	26.8
Swainson's hawk	0	0.02	0	0	0	0.3	0	0	0	1.6	0	0
Northern Harrier	*0.14*	*0.14*	*0.05*	*0.05*	*2.0*	*2.8*	*0.3*	*0.4*	*12.5*	*12.5*	*5.0*	*5.4*
northern harrier	0.14	0.14	0.05	0.05	2.0	2.8	0.3	0.4	12.5	12.5	5.0	5.4
Eagles	*0.01*	*0.02*	*0.01*	*0.02*	*0.2*	*0.3*	*0.1*	*0.1*	*1.4*	*1.6*	*1.3*	*1.8*
bald eagle	0.01	0	0	0.02	0.2	0	0	0.1	1.4	0	0	1.8
golden eagle	0	0.02	0.01	0	0	0.3	0.1	0	0	1.6	1.3	0
Falcons	*0.18*	*0.41*	*0.19*	*0.09*	*2.6*	*8.0*	*0.9*	*0.7*	*16.7*	*28.1*	*15.0*	*8.9*
American kestrel	0.13	0.38	0.15	0.04	1.8	7.4	0.8	0.3	11.1	28.1	12.5	3.6
peregrine falcon	0	0	0.01	0	0	0	0.1	0	0	0	1.3	0
prairie falcon	0.06	0.03	0.03	0.05	0.8	0.6	0.1	0.4	5.6	3.1	2.5	5.4

Table 15. Mean bird use (number of birds/plot/30-min survey), percent of total composition (%), and frequency of occurrence (%) for each bird type and species by season during the John Day Canyon 800-m fixed-point bird use surveys at the Biglow Canyon Wind Farm, Phase I, January 17 - December 18, 2008.

	Use				% Composition				% Frequency			
Species/Type	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
Vultures	**0.06**	**0.02**	**0**	**0**	**0.8**	**0.3**	**0**	**0**	**4.2**	**1.6**	**0**	**0**
turkey vulture	0.06	0.02	0	0	0.8	0.3	0	0	4.2	1.6	0	0
Upland Gamebirds	**0.78**	**0.53**	**0.43**	**0.57**	**11.1**	**10.5**	**2.1**	**4.5**	**47.2**	**26.6**	**8.8**	**17.9**
California quail	0	0.05	0	0	0	0.9	0	0	0	3.1	0	0
chukar	0.31	0.16	0.38	0.32	4.4	3.1	1.9	2.5	19.4	9.4	5.0	12.5
gray partridge	0	0	0	0.07	0	0	0	0.6	0	0	0	1.8
ring-necked pheasant	0.47	0.33	0.05	0.18	6.8	6.5	0.3	1.4	36.1	20.3	3.8	12.5
Doves/Pigeons	**0.08**	**0.30**	**0.18**	**0.09**	**1.2**	**5.8**	**0.9**	**0.7**	**5.6**	**10.9**	**5.0**	**5.4**
mourning dove	0.04	0.30	0.08	0.09	0.6	5.8	0.4	0.7	4.2	10.9	3.8	5.4
rock pigeon	0.04	0	0.10	0	0.6	0	0.5	0	2.8	0	2.5	0
Passerines	**5.14**	**3.48**	**8.92**	**2.93**	**73.6**	**68.6**	**44.8**	**23.1**	**94.4**	**67.2**	**75.2**	**68.5**
American goldfinch	0.07	0	0.01	0.02	1.0	0	0.1	0.1	1.4	0	1.3	1.8
American pipit	0	0	0.04	0	0	0	0.2	0	0	0	2.5	0
American robin	0.01	0.02	0	0	0.2	0.3	0	0	1.4	1.6	0	0
barn swallow	0	0.02	0	0	0	0.3	0	0	0	1.6	0	0
Brewer's blackbird	0.03	0.03	0	0	0.4	0.6	0	0	2.8	1.6	0	0
brown-headed cowbird	0.04	0	0.10	0	0.6	0	0.5	0	2.8	0	3.8	0
cliff swallow	0.72	0.17	0	0	10.3	3.4	0	0	4.2	6.3	0	0
common raven	0.07	0	0.05	0.04	1.0	0	0.3	0.3	4.2	0	3.8	1.8
European starling	0.04	0.16	0.43	0.46	0.6	3.1	2.1	3.7	2.8	6.3	4.2	1.8
grasshopper sparrow	0.03	0.02	0	0	0.4	0.3	0	0	2.8	1.6	0	0
gray-crowned rosy finch	0	0	0	0.02	0	0	0	0.1	0	0	0	1.8
horned lark	3.72	2.72	7.79	2.20	53.3	53.5	39.2	17.3	86.1	57.8	68.5	64.9
house finch	0	0	0.37	0.14	0	0	1.8	1.1	0	0	11.7	3.6
northern rough-winged swallow	0.04	0.05	0.06	0	0.6	0.9	0.3	0	1.4	3.1	2.5	0
red-winged blackbird	0.01	0	0.01	0	0.2	0	0.1	0	1.4	0	1.3	0
unidentified bluebird	0	0	0	0.02	0	0	0	0.1	0	0	0	1.8
unidentified sparrow	0	0.02	0	0	0	0.3	0	0	0	1.6	0	0

Table 15. Mean bird use (number of birds/plot/30-min survey), percent of total composition (%), and frequency of occurrence (%) for each bird type and species by season during the John Day Canyon 800-m fixed-point bird use surveys at the Biglow Canyon Wind Farm, Phase I, January 17 - December 18, 2008.

	Use				% Composition				% Frequency			
Species/Type	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
vesper sparrow	0.01	0	0	0	0.2	0	0	0	1.4	0	0	0
violet-green swallow	0.01	0.20	0	0	0.2	4.0	0	0	1.4	1.6	0	0
western kingbird	0.06	0.02	0	0	0.8	0.3	0	0	4.2	1.6	0	0
western meadowlark	0.25	0.08	0.06	0.04	3.6	1.5	0.3	0.3	18.1	4.7	3.8	1.8
western tanager	0.01	0	0	0	0.2	0	0	0	1.4	0	0	0
Other Birds	**0.01**	**0**	**0.13**	**0.02**	**0.2**	**0**	**0.6**	**0.1**	**1.4**	**0**	**5.0**	**1.8**
common nighthawk	0.01	0	0	0	0.2	0	0	0	1.4	0	0	0
northern flicker	0	0	0.01	0.02	0	0	0.1	0.1	0	0	1.3	1.8
Vaux's swift	0	0	0.11	0	0	0	0.6	0	0	0	3.8	0
Overall	**6.99**	**5.08**	**19.90**	**12.70**	**100**	**100**	**100**	**100**				

Table 16. Mean bird use (number of birds/plot/5-min survey), percent of total composition, and frequency of occurrence (%) for each bird type and species by season during the Project Wind Turbine 400-m fixed-point bird use surveys in the Biglow Canyon Wind Farm, Phase I, January 10 - December 12, 2008.

	Use				% Composition				% Frequency			
Species/Type	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
Waterbirds/Waterfowl	**0.10**	**0.01**	**1.05**	**0**	**3.3**	**0.4**	**29.6**	**0**	**0.5**	**0.7**	**2.7**	**0**
Canada goose	0.07	0	1.05	0	2.1	0	29.6	0	0.3	0	2.7	0
double-crested cormorant	0.04	0	0	0	1.2	0	0	0	0.3	0	0	0
unidentified gull	0	0.01	0	0	0	0.4	0	0	0	0.7	0	0
Raptors	**0.08**	**0.06**	**0.08**	**0.08**	**2.7**	**3.1**	**2.3**	**0.4**	**7.9**	**5.5**	**6.7**	**6.7**
Accipiters	*0*	*0*	*<0.01*	*0*	*0*	*0*	*0.1*	*0*	*0*	*0*	*0.3*	*0*
Cooper's hawk	0	0	<0.01	0	0	0	0.1	0	0	0	0.3	0
Buteos	*0.05*	*0.02*	*0.05*	*0.05*	*1.7*	*1.2*	*1.5*	*0.2*	*5.0*	*2.1*	*4.9*	*3.3*
red-tailed hawk	0.04	0.01	0.04	0.02	1.5	0.8	1.2	0.1	4.2	1.4	4.0	2.0
rough-legged hawk	0.01	0	0.01	0.03	0.2	0	0.3	0.1	0.5	0	0.9	2.0
Swainson's hawk	<0.01	0.01	0	0	0.1	0.4	0	0	0.3	0.7	0	0
Northern Harrier	*0.03*	*0.03*	*0.01*	*0*	*0.8*	*1.5*	*0.2*	*0*	*2.4*	*2.8*	*0.6*	*0*
northern harrier	0.03	0.03	0.01	0	0.8	1.5	0.2	0	2.4	2.8	0.6	0
Eagles	*0*	*0*	*<0.01*	*0.01*	*0*	*0*	*0.1*	*0.1*	*0*	*0*	*0.3*	*1.3*
bald eagle	0	0	<0.01	0.01	0	0	0.1	<0.1	0	0	0.3	0.7
golden eagle	0	0	0	0.01	0	0	0	<0.1	0	0	0	0.7
Falcons	*<0.01*	*0.01*	*0.02*	*0.02*	*0.1*	*0.4*	*0.5*	*0.1*	*0.3*	*0.7*	*1.5*	*2.0*
American kestrel	0	0.01	0.02	0.01	0	0.4	0.5	<0.1	0	0.7	1.5	0.7
prairie falcon	<0.01	0	0	0.01	0.1	0	0	0.1	0.3	0	0	1.3
Other Raptors	*<0.01*	*0*	*0*	*0*	*0.1*	*0*	*0*	*0*	*0.3*	*0*	*0*	*0*
unidentified raptor	<0.01	0	0	0	0.1	0	0	0	0.3	0	0	0
Upland Gamebirds	**0.07**	**0.03**	**0.01**	**0**	**2.3**	**1.5**	**0.2**	**0**	**6.8**	**2.0**	**0.3**	**0**
California quail	0	0.01	0	0	0	0.4	0	0	0	0.7	0	0
ring-necked pheasant	0.07	0.02	0.01	0	2.3	1.1	0.2	0	6.8	2.0	0.3	0
Passerines	**2.83**	**1.69**	**2.41**	**21.28**	**91.7**	**95.0**	**67.8**	**99.6**	**77.7**	**59.8**	**67.2**	**62.9**
Blackbirds/Orioles	*0.64*	*0.15*	*0.26*	*0.62*	*20.7*	*8.5*	*7.3*	*2.9*	*32.7*	*11.1*	*18.0*	*20.7*
European starling	0.01	0.01	0.03	0.28	0.3	0.4	0.9	1.3	0.5	0.7	1.2	1.3

Table 16. Mean bird use (number of birds/plot/5-min survey), percent of total composition, and frequency of occurrence (%) for each bird type and species by season during the Project Wind Turbine 400-m fixed-point bird use surveys in the Biglow Canyon Wind Farm, Phase I, January 10 - December 12, 2008.

	Use				% Composition				% Frequency			
Species/Type	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
red-winged blackbird	<0.01	0	0	0	0.1	0	0	0	0.3	0	0	0
western meadowlark	0.63	0.15	0.23	0.34	20.3	8.1	6.4	1.6	32.4	10.4	17.1	20.7
Finches	*0.03*	*0*	*0*	*0.20*	*0.9*	*0*	*0*	*0.9*	*0.8*	*0*	*0*	*2.7*
gray-crowned rosy finch	0	0	0	0.13	0	0	0	0.6	0	0	0	0.7
house finch	0.03	0	0	0.07	0.9	0	0	0.3	0.8	0	0	2.0
Grassland/Sparrows	*2.00*	*1.50*	*2.01*	*1.30*	*64.7*	*84.1*	*56.8*	*6.1*	*74.4*	*56.3*	*56.5*	*52.8*
American pipit	0.03	0	0.03	0	0.9	0	0.9	0	0.5	0	0.9	0
chipping sparrow	0.01	0	0	0	0.2	0	0	0	0.3	0	0	0
dark-eyed junco	<0.01	0	0	0	0.1	0	0	0	0.3	0	0	0
grasshopper sparrow	0.01	0.01	0	0	0.2	0.4	0	0	0.8	0.7	0	0
horned lark	1.94	1.49	1.81	1.30	62.8	83.7	51.1	6.1	73.7	56.3	56.5	52.8
savannah sparrow	0.01	0	0	0	0.2	0	0	0	0.5	0	0	0
vesper sparrow	0	0	0.17	0	0	0	4.8	0	0	0	0.5	0
white-crowned sparrow	0.01	0	0	0	0.4	0	0	0	1.2	0	0	0
Swallows	*0.01*	*0.01*	*0.01*	*0*	*0.2*	*0.4*	*0.2*	*0*	*0.5*	*0.7*	*0.3*	*0*
barn swallow	0.01	0.01	0	0	0.2	0.4	0	0	0.5	0.7	0	0
tree swallow	0	0	0.01	0	0	0	0.2	0	0	0	0.3	0
Thrushes	*0.04*	*0.01*	*0*	*0*	*1.4*	*0.8*	*0*	*0*	*0.3*	*1.4*	*0*	*0*
American robin	0.04	0.01	0	0	1.4	0.8	0	0	0.3	1.4	0	0
Corvids	*0.11*	*0.02*	*0.13*	*19.16*	*3.7*	*1.1*	*3.6*	*89.7*	*8.7*	*1.4*	*9.3*	*12.5*
American crow	0	0	0.01	0	0	0	0.2	0	0	0	0.3	0
common raven	0.11	0.02	0.12	19.16	3.7	1.1	3.4	89.7	8.7	1.4	9.3	12.5
Overall	**3.09**	**1.78**	**3.55**	**21.36**	**100**	**100**	**100**	**100**				

Table 17. Flight height characteristics by bird type during the John Day Canyon 800-m fixed-point bird use surveys at the Biglow Canyon Wind Farm, Phase I, January 17 - December 18, 2008.

Bird Type	# Groups Flying	# Obs Flying	Mean Flight Height	% Obs Flying	% within Flight Height Categories 0-114 ft	114-427 ft	> 427 ft
Waterbirds	1	4	190.00	100	0	0	100
Waterfowl	33	1,285	85.79	100	44.0	44.7	11.3
Shorebirds	1	2	4.00	33.3	100	0	0
Raptors	163	176	32.32	94.6	64.8	33.5	1.7
Accipiters	*4*	*4*	*21.25*	*100*	*100*	*0*	*0*
Buteos	*80*	*88*	*34.96*	*94.6*	*62.5*	*36.4*	*1.1*
Northern Harrier	*25*	*25*	*19.68*	*96.2*	*76.0*	*24.0*	*0*
Eagles	*3*	*3*	*72.67*	*75.0*	*0*	*100*	*0*
Falcons	*51*	*56*	*32.86*	*94.9*	*64.3*	*32.1*	*3.6*
Other Raptors	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Vultures	5	5	53.80	100	40.0	60.0	0
Upland Gamebirds	4	32	1.25	20.5	100	0	0
Doves/Pigeons	10	22	16.50	50.0	72.7	27.3	0
Passerines	589	2,200	16.00	70.1	87.0	12.3	0.8
Other Birds	4	10	35.25	83.3	50.0	50.0	0
Overall	**810**	**3,736**	**22.59**	**77.3**	**70.9**	**24.5**	**4.5**

ZOR: The likely "zone of risk" for potential collision with a turbine blade, or 114-427 ft (35-130 m) above ground level (AGL).

Table 18. Relative exposure index and flight characteristics by species during the John Day Canyon 800-m fixed-point bird use surveys at the Biglow Canyon Wind Farm, Phase I, January 17 - December 18, 2008.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within ZOR based on initial obs	Exposure Index	% Within ZOR at anytime
Canada goose	31	4.90	100	44.9	2.20	55.1
horned lark	336	4.33	76.7	8.4	0.28	11.6
cliff swallow	13	0.22	100	68.7	0.15	79.5
red-tailed hawk	45	0.20	92.7	37.3	0.07	62.7
rough-legged hawk	33	0.14	97.2	37.1	0.05	54.3
American kestrel	40	0.16	95.7	33.3	0.05	37.8
rock pigeon	4	0.04	100	54.5	0.02	54.5
northern harrier	25	0.09	96.2	24.0	0.02	36.0
house finch	19	0.14	99.0	13.0	0.02	13.0
brown-headed cowbird	7	0.04	93.8	46.7	0.02	46.7
Vaux's swift	3	0.03	100	44.4	0.01	44.4
prairie falcon	10	0.04	90.9	30.0	0.01	40.0
turkey vulture	5	0.02	100	60.0	0.01	60.0
common raven	84	0.04	84.6	28.7	0.01	39.2
golden eagle	2	0.01	100	100	0.01	100
Brewer's blackbird	12	0.01	100	42.9	0.01	42.9
unidentified bluebird	1	<0.01	100	100	<0.01	100
bald eagle	1	0.01	50.0	100	<0.01	100
common nighthawk	1	<0.01	100	100	<0.01	100
northern rough-winged swallow	8	0.04	100	7.1	<0.01	7.1
European starling	27	0.28	96.3	0.7	<0.01	6.9
western meadowlark	28	0.11	8.5	7.1	<0.01	7.1
red-winged blackbird	7	0.01	100	4.3	<0.01	4.3
chukar	2	0.30	30.0	0	0	0
ring-necked pheasant	1	0.25	5.8	0	0	0
mourning dove	6	0.12	33.3	0	0	0

Table 18. Relative exposure index and flight characteristics by species during the John Day Canyon 800-m fixed-point bird use surveys at the Biglow Canyon Wind Farm, Phase I, January 17 - December 18, 2008.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within ZOR based on initial obs	Exposure Index	% Within ZOR at anytime
violet-green swallow	10	0.05	100	0	0	0
greater white-fronted goose	1	0.03	100	0	0	0
American goldfinch	5	0.03	100	0	0	0
gray partridge	1	0.02	100	0	0	0
long-billed curlew	1	0.02	40.0	0	0	0
western kingbird	2	0.02	50.0	0	0	0
sharp-shinned hawk	4	0.02	100	0	0	25.0
double-crested cormorant	1	0.01	100	0	0	0
American pipit	2	0.01	100	0	0	0
grasshopper sparrow	0	0.01	0	0	0	0
California quail	0	0.01	0	0	0	0
northern flicker	0	0.01	0	0	0	0
American robin	2	0.01	22.2	0	0	0
gray-crowned rosy finch	1	<0.01	100	0	0	0
killdeer	0	<0.01	0	0	0	0
peregrine falcon	1	<0.01	100	0	0	100
mallard	1	<0.01	100	0	0	0
vesper sparrow	1	<0.01	50.0	0	0	0
western tanager	1	<0.01	100	0	0	0
barn swallow	2	<0.01	66.7	0	0	0
ferruginous hawk	1	<0.01	100	0	0	0
Swainson's hawk	1	<0.01	100	0	0	0
unidentified sparrow	1	<0.01	100	0	0	0
American crow	1	0	100	0	0	0
American white pelican	0	0	0	0	0	0
black-billed magpie	7	0	33.3	0	0	0
Cooper's hawk	0	0	0	0	0	0

Table 18. Relative exposure index and flight characteristics by species during the John Day Canyon 800-m fixed-point bird use surveys at the Biglow Canyon Wind Farm, Phase I, January 17 - December 18, 2008.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within ZOR based on initial obs	Exposure Index	% Within ZOR at anytime
dark-eyed junco	1	0	94.4	0	0	0
northern shrike	0	0	0	0	0	0
osprey	0	0	0	0	0	0
sage thrasher	1	0	100	0	0	0
Say's phoebe	1	0	100	0	0	100
tree swallow	1	0	100	100	0	100
unidentified buteo	0	0	0	0	0	0
unidentified duck	0	0	0	0	0	0
unidentified passerine	1	0	100	100	0	100
unidentified raptor	0	0	0	0	0	0
unidentified swallow	7	0	100	50.0	0	100

ZOR: The likely “zone of risk” for potential collision with a turbine blade, or 114-427 ft (35-130 m) above ground level (AGL).

Table 19. Incidental wildlife observed during all surveys at the Biglow Canyon Wind Farm, Phase I, January 10, 2008 – December 18, 2008.

Common name	Scientific name	grps	obs
red-tailed hawk	*Buteo jamaicensis*	20	27
American goldfinch	*Carduelis tristis*	1	15
chipping sparrow	*Spizella passerina*	1	12
house finch	*Carpodacus mexicanus*	1	12
dark-eyed junco	*Junco hyemalis*	1	11
golden-crowned kinglet	*Regulus satrapa*	1	9
northern harrier	*Circus cyaneus*	7	8
American pipit	*Anthus rubescens*	1	7
prairie falcon	*Falco mexicanus*	6	6
great-horned owl	*Bubo virginianus*	5	6
American kestrel	*Falco sparverius*	5	5
ring-necked pheasant	*Phasianus colchicus*	5	5
yellow-rumped warbler	*Dendroica coronata*	1	4
rough-legged hawk	*Buteo lagopus*	3	3
golden eagle	*Aquila chrysaetos*	2	2
sharp-shinned hawk	*Accipter striatus*	2	2
sandhill crane	*Grus canadensis*	1	2
Cooper's hawk	*Accipiter cooperii*	1	1
loggerhead shrike	*Lanius ludovicianus*	1	1
merlin	*Falco columbarius*	1	1
mountain bluebird	*Sialia currucoides*	1	1
northern shrike	*Lanius excubitor*	1	1
savannah sparrow	*Passerculus sandwichensis*	1	1
Bird Subtotal		**69**	**142**
mule deer	*Odocoileus hemionus*	221	1,028
coyote	*Canis latrans*	37	54
white-tailed jack rabbit	*Lepus townsendii*	32	38
pronghorn	*Antilocapra americana*	4	23
elk	*Cervus elephus*	3	22
Mammal Subtotal		**297**	**1,165**
gopher snake	*Pituophis catenifer*	8	8
western rattlesnake	*Crotalus viridis oreganus*	1	1
western yellow-bellied racer	*Coluber constrictor mormon*	1	1
western toad	*Bufo boreas*	1	1
Reptile/Amphibian Subtotal		**11**	**11**

Table 20. 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**
Biglow Canyon I, OR	**0.03**	**1.76**	**1.99**	This study
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. 2005
Hopkins Ridge I, WA, 2006	0.14	1.2	0.6	Young et al. 2007a
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. 2003b
Stateline, WA/OR	0.10	2.4	1.7	Erickson et al. 2004a, 2007
Condon, OR	0.02[a]	0.05[a]	NA[a]	Fishman 2003
Vansycle, OR	0.00	1.0	1.1	Erickson et al. 2000
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.

Table 21. Summary of sensitive/special-status species observed during the John Day Canyon (JDC) 800-m and the Project Wind Turbine (PWT) 400-m fixed-point (FP) bird use surveys and incidentally (INC) at the Biglow Canyon Wind Farm, Phase I, January 10 – December 18, 2008.

			JDC 800-m FP		PWT400-m FP		INC		Total	
Species	**Scientific Name**	**Status**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
bald eagle	*Haliaeetus leucocephalus*	ST, EA	6	8	3	3	0	0	9	11
golden eagle	*Aquila chrysaetos*	EA	15	16	1	1	2	2	18	19
peregrine falcon	*Falco peregrinus*	SE	2	2	0	0	0	0	2	2
grasshopper sparrow	*Ammodramus savannarum*	SSC	4	4	4	4	0	0	8	8
Swainson's hawk	*Buteo swainsoni*	SSC	6	6	2	2	0	0	8	8
long-billed curlew	*Numenius americanus*	SSC	2	5	0	0	0	0	2	5
ferruginous hawk	*Buteo regalis*	SSC,SOC	1	1	0	0	0	0	1	1
loggerhead shrike	*Lanius ludovicianus*	SSC	0	0	0	0	1	1	1	1
greater sandhill crane	*Grus canadensis tabida*	SSC	0	0	0	0	1	1	1	1
Bird Subtotal			**36**	**42**	**10**	**10**	**4**	**4**	**50**	**56**
white-tailed jack rabbit	*Lepus townsendii*	SSC	0	0	0	0	32	38	32	38
western toad	*Bufo boreas*	SSC	0	0	0	0	1	1	1	1
Non-Bird Subtotal			**0**	**0**	**0**	**0**	**33**	**39**	**33**	**39**
Total	**11 species**		**36**	**42**	**10**	**10**	**37**	**43**	**83**	**95**

ST = state threatened; SE = state endangered; SSC = State species of special/sensitive status: e.g., vulnerable, critical, undetermined (Data from ECOS 2009; ODFW 2008a, ODFW 2008b). EA = Bald and Golden Eagle Protection Act (BGEPA 1940). SOC = Federal Species of Concern.

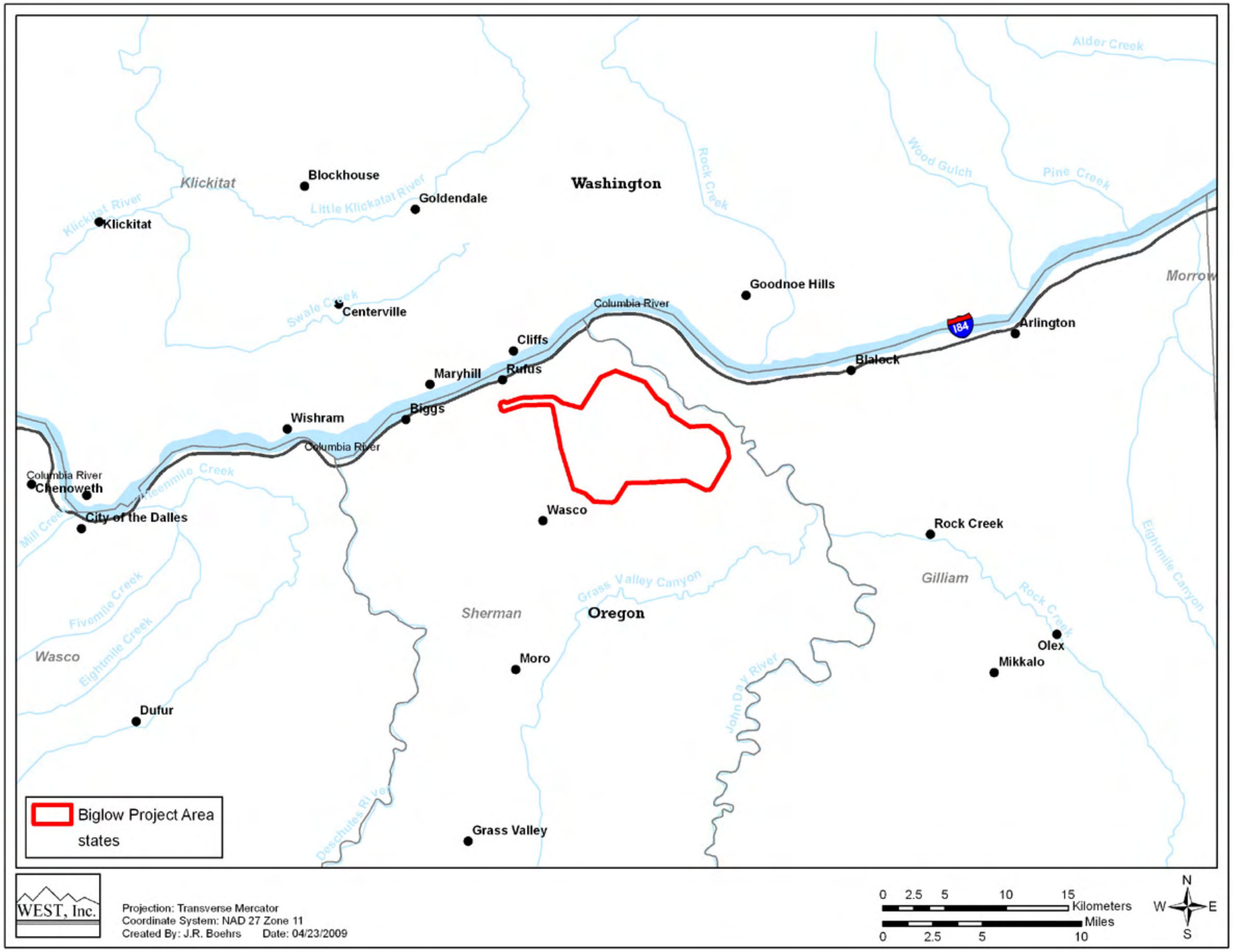


Figure 1. Regional location of the Biglow Canyon Wind Farm, Phase I, Sherman County, Oregon.

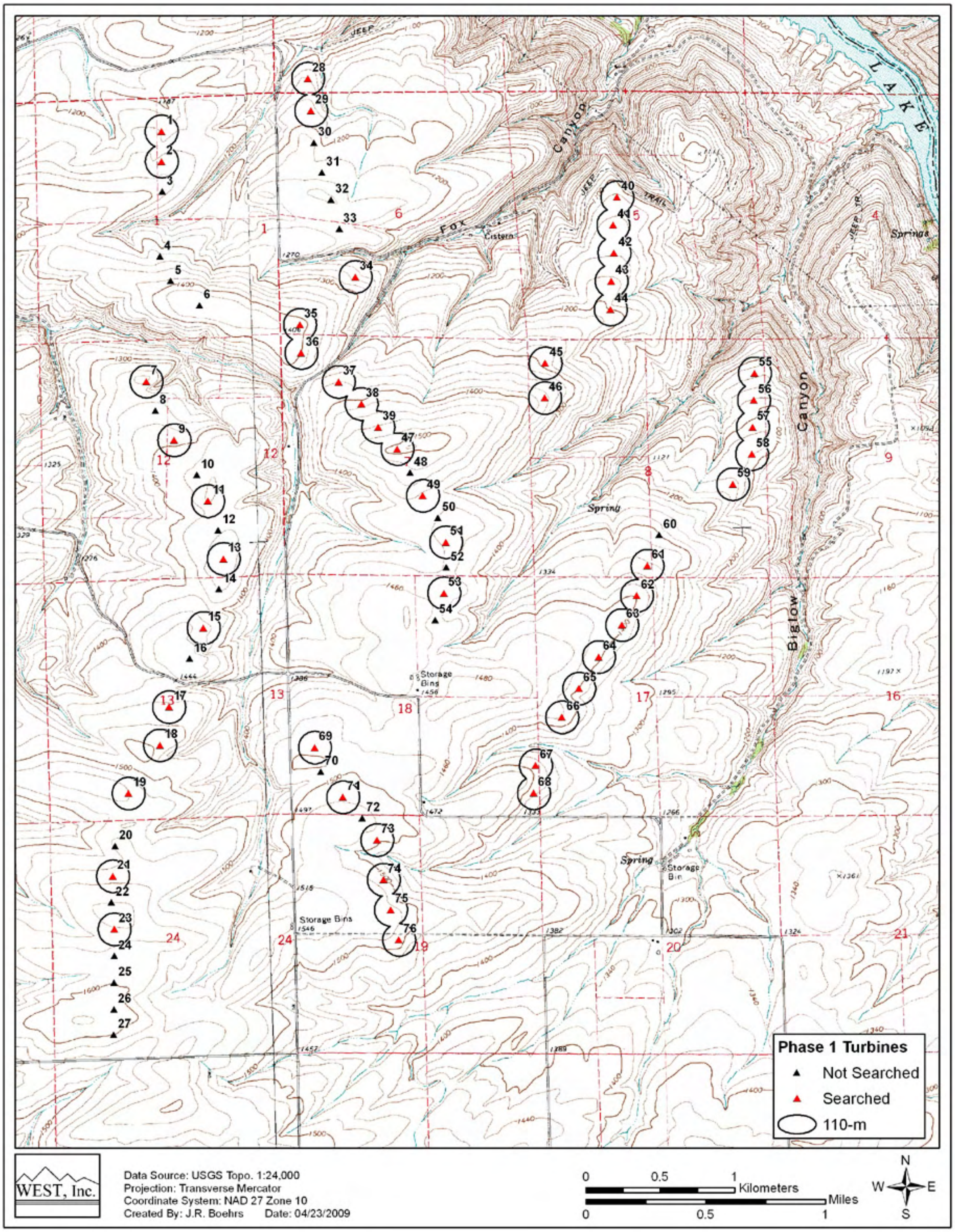


Figure 2. Elevation and topography of the Biglow Canyon Wind Farm, Phase I.

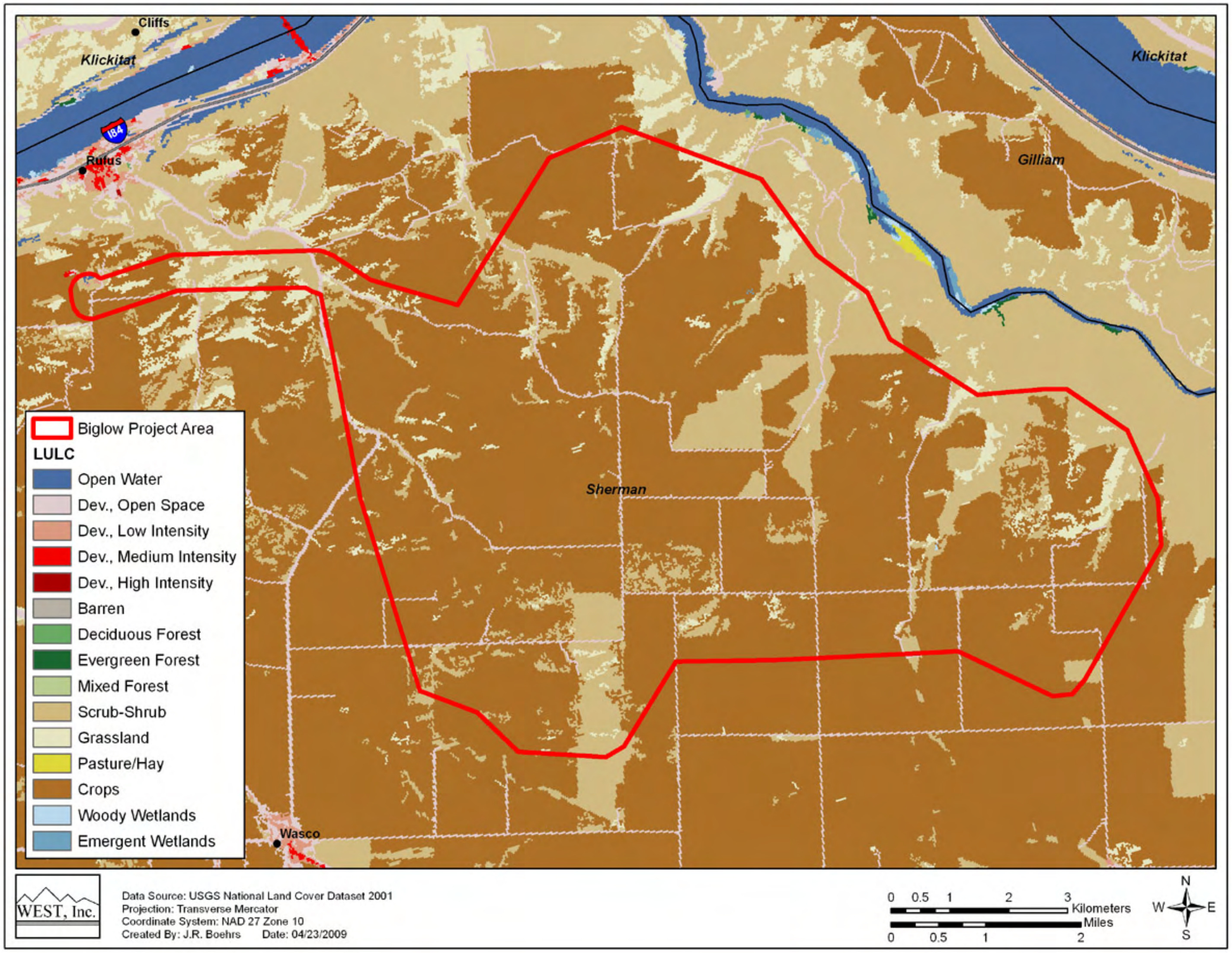


Figure 3. General land cover types in the Biglow Canyon Wind Farm, Phase I vicinity (USGS NLCD 2001).

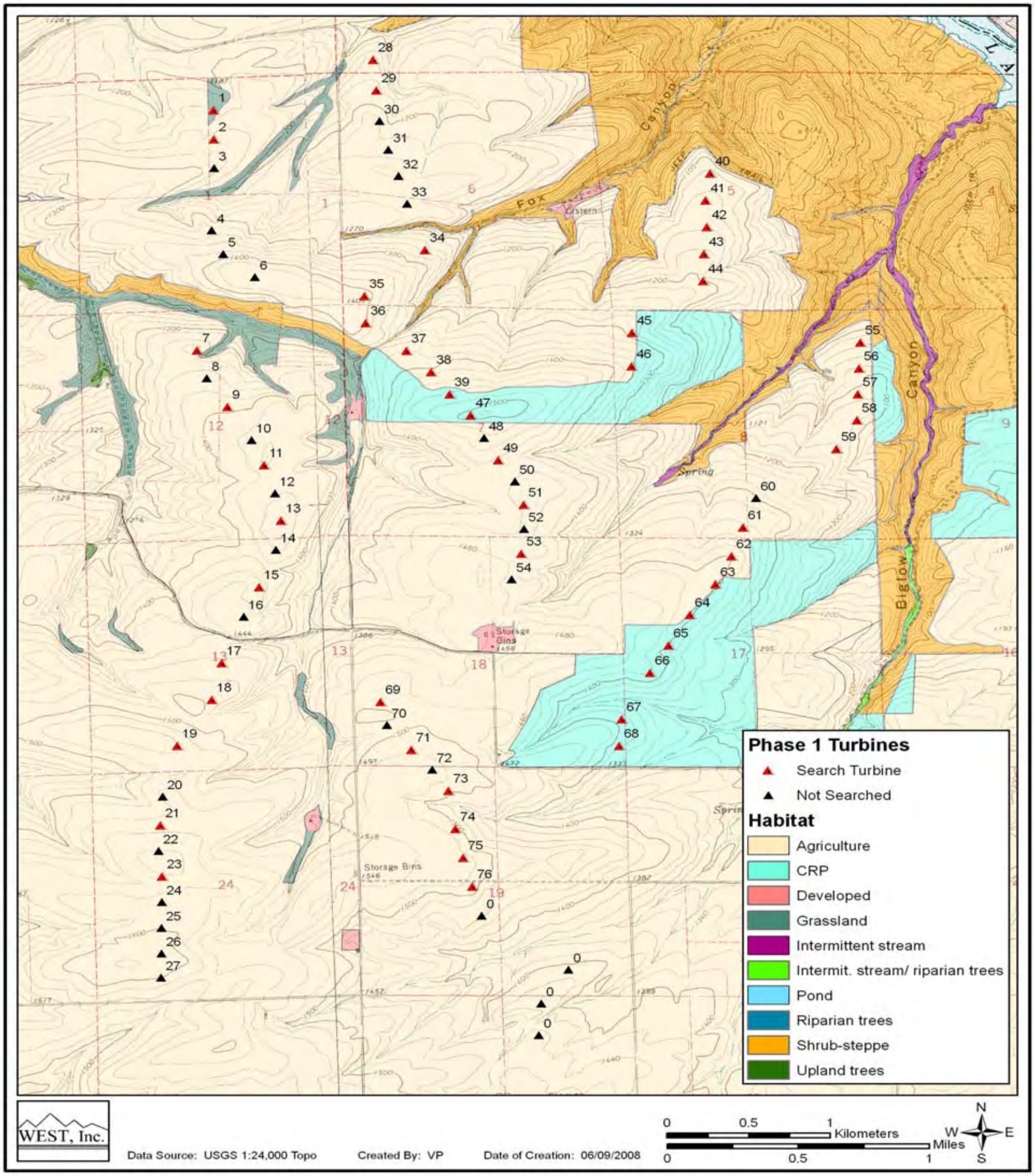


Figure 4. Location of carcass search plots and habitats at the Biglow Canyon Wind Farm, Phase I.

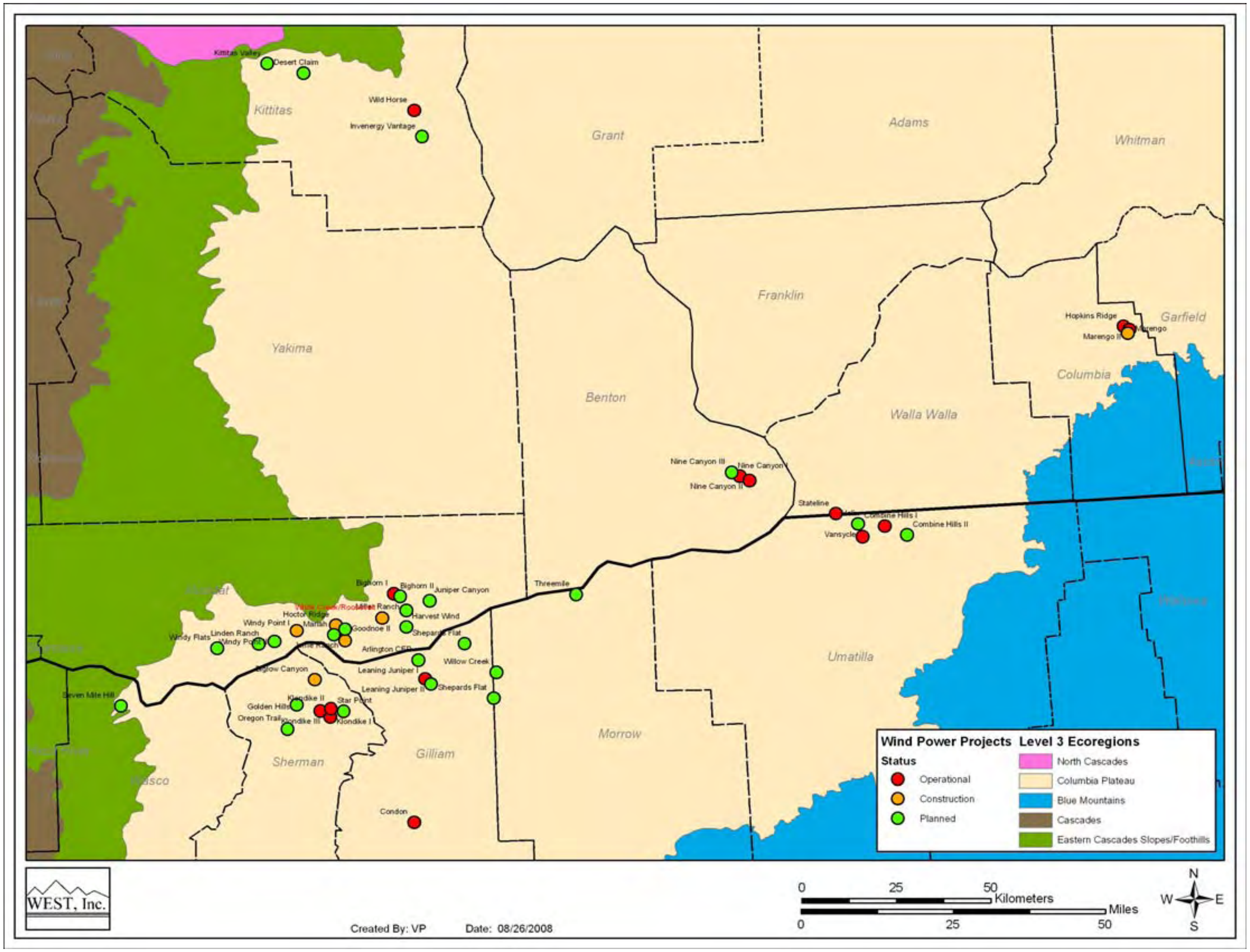


Figure 5. Location of existing and proposed wind energy facilities in the Columbia Plateau Ecoregion of Washington and Oregon.

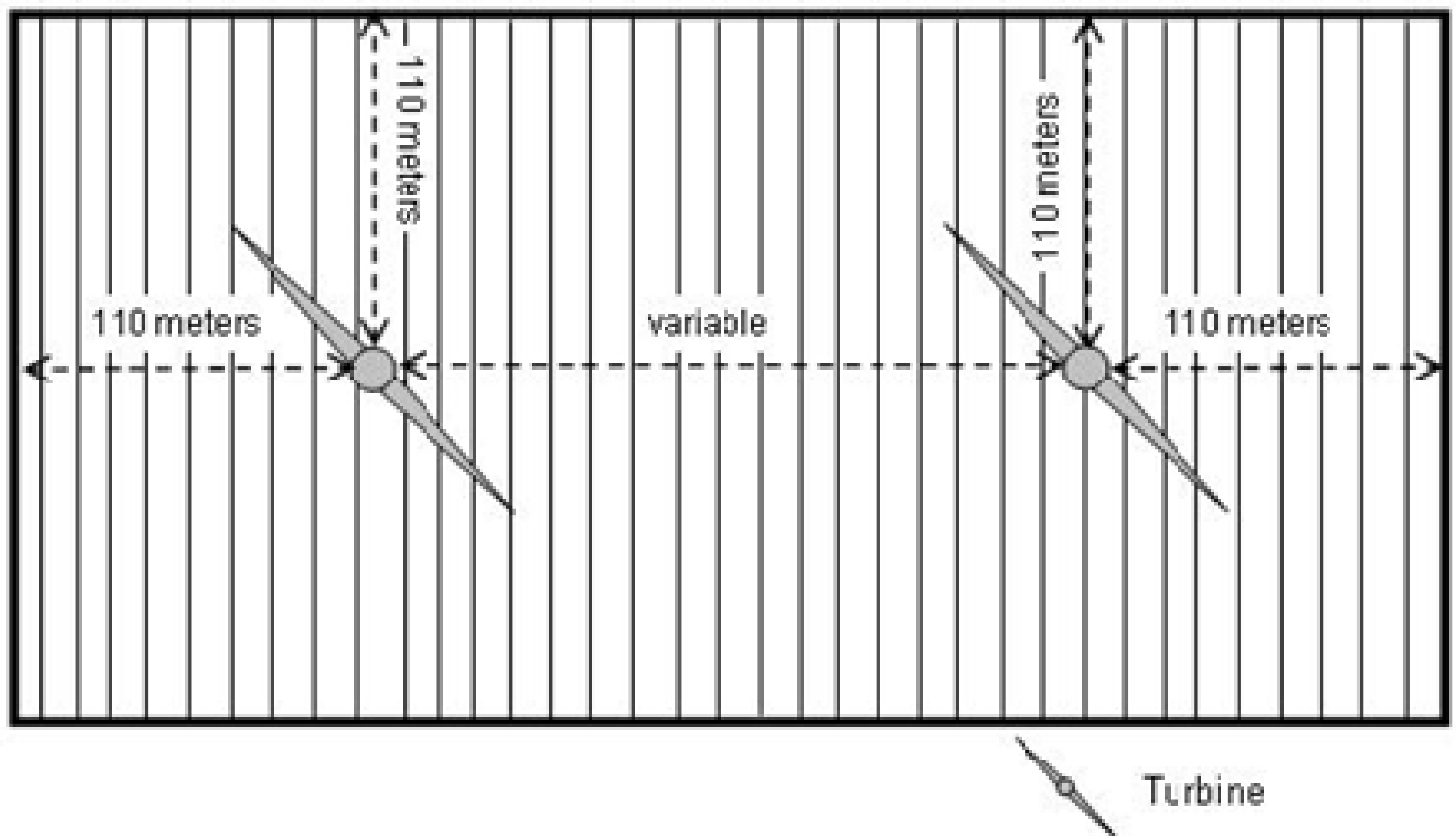


Figure 6. Illustration of search plots and search transects used at the Biglow Canyon Wind Farm, Phase I.

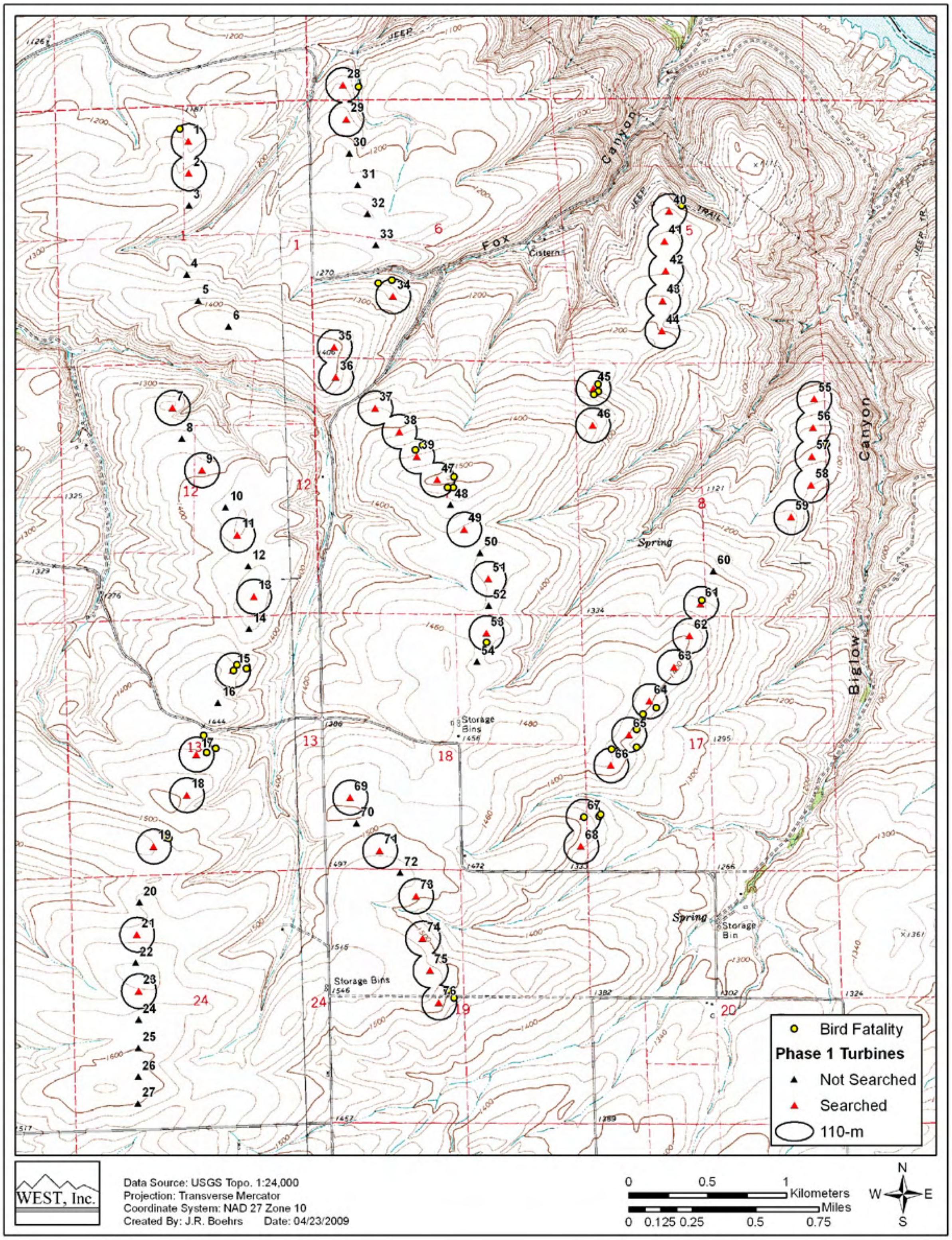


Figure 7. Location of bird fatalities found at study plots at the Biglow Canyon Wind Farm, Phase I.

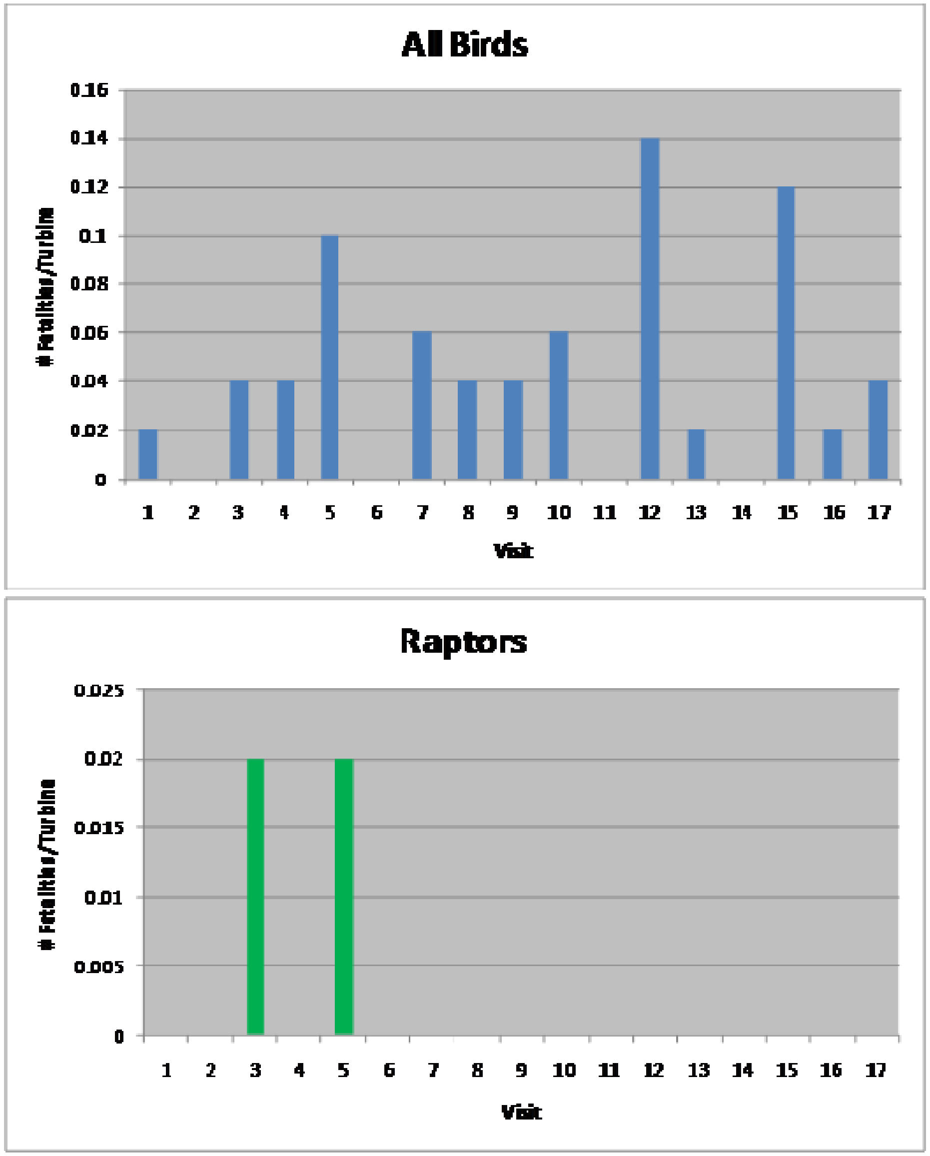


Figure 8. Timing of bird and raptor mortality at the Biglow Canyon Wind Farm, Phase I.

Visit	Dates
1	1/10/08-2/12/08
2	2/13/08-3/5/08
3	3/13/08-3/26/08
4	3/27/08-4/8/08
5	4/10/08-4/22/08
6	4/24/08-5/7/08
7	5/8/08-5/22/08
8	5/23/08-6/19/08
9	6/20/08-7/17/08
10	7/18/08-8/13/08
11	8/14/08-8/27/08
12	8/28/08-9/9/08
13	9/10/08-9/23/08
14	9/24/08-10/7/08
15	10/8/09-10/21/08
16	10/22/08-11/18/08
17	11/19/08-12/12/08

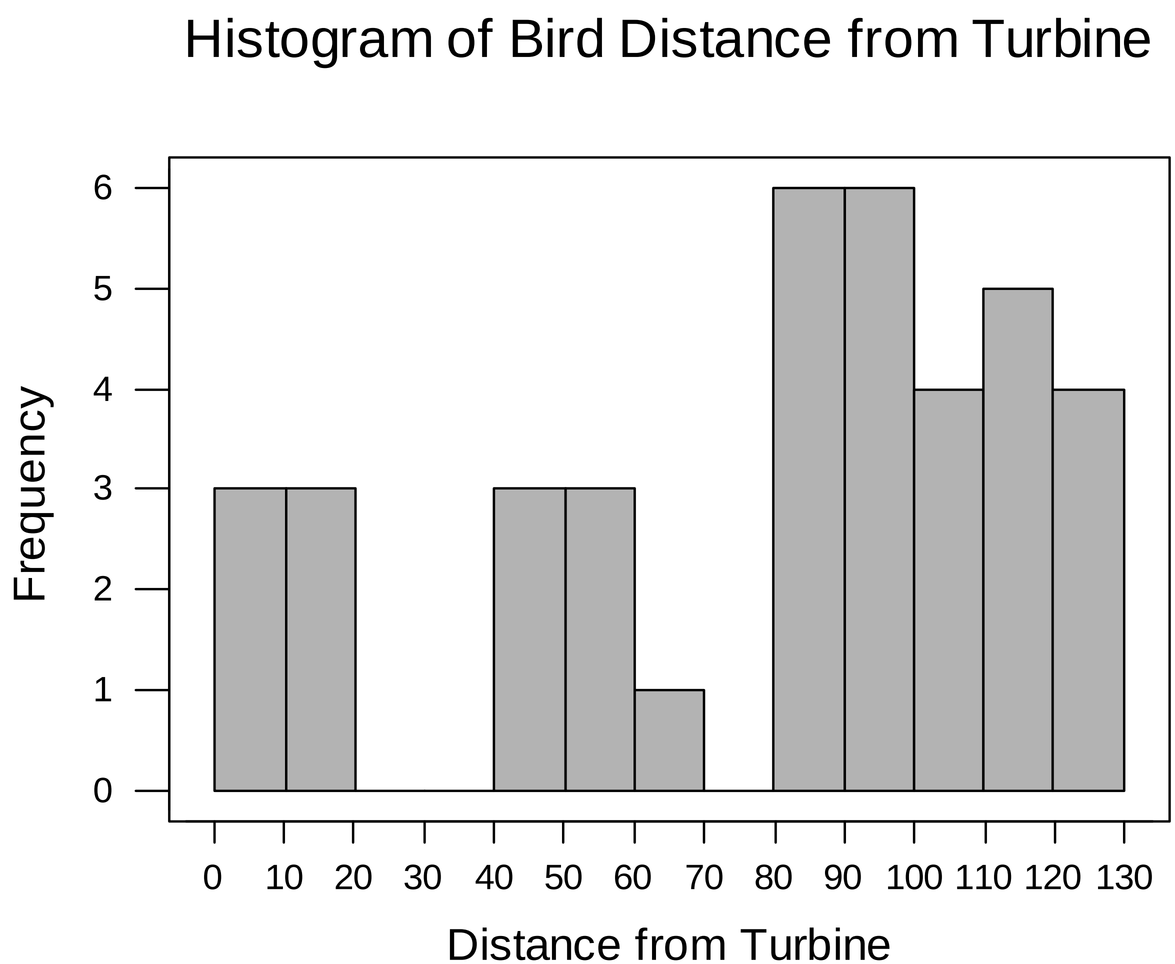


Figure 9. Distance from turbine for bird fatalities on scheduled search plots during standard carcass surveys at the Biglow Canyon Wind Farm, Phase I.

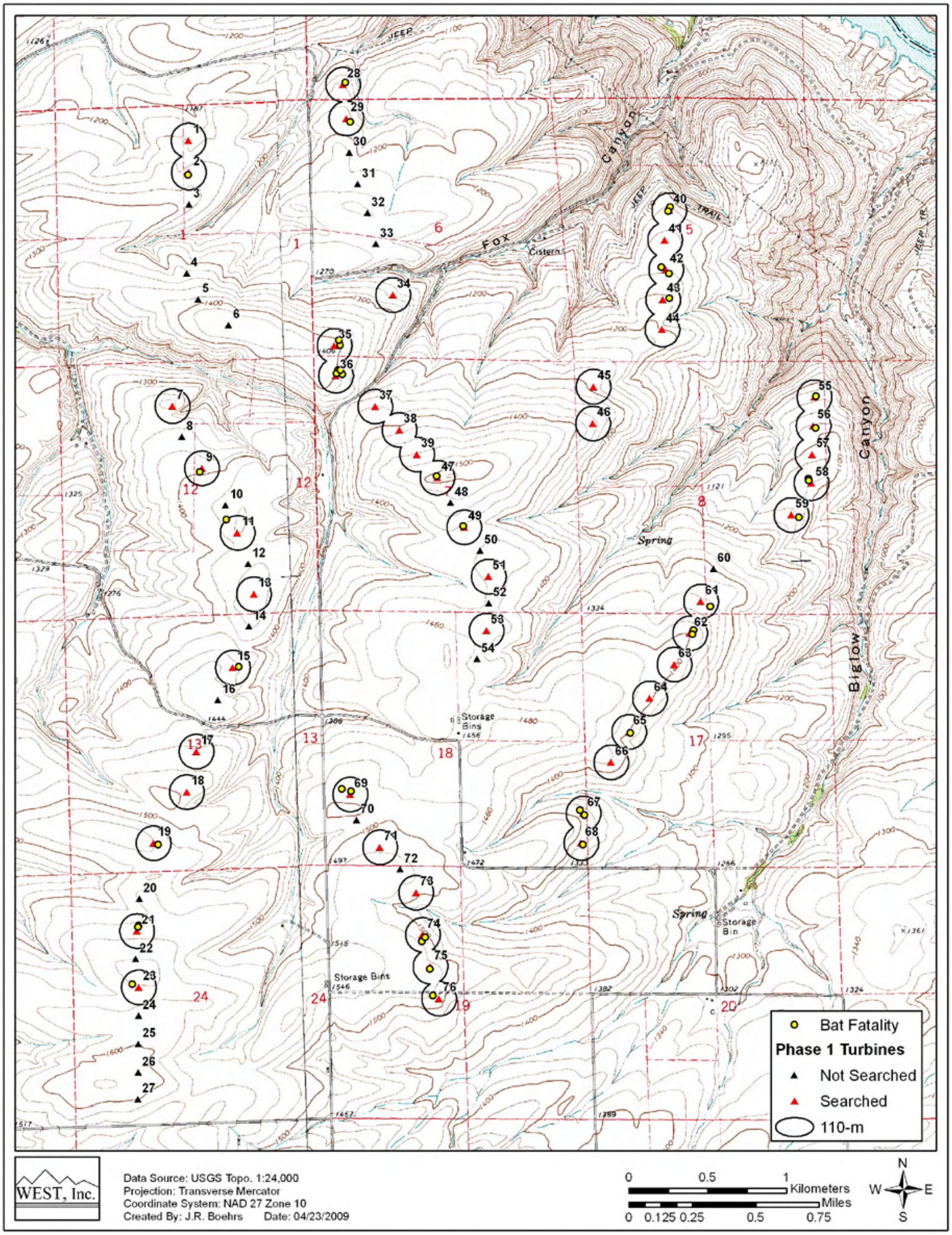
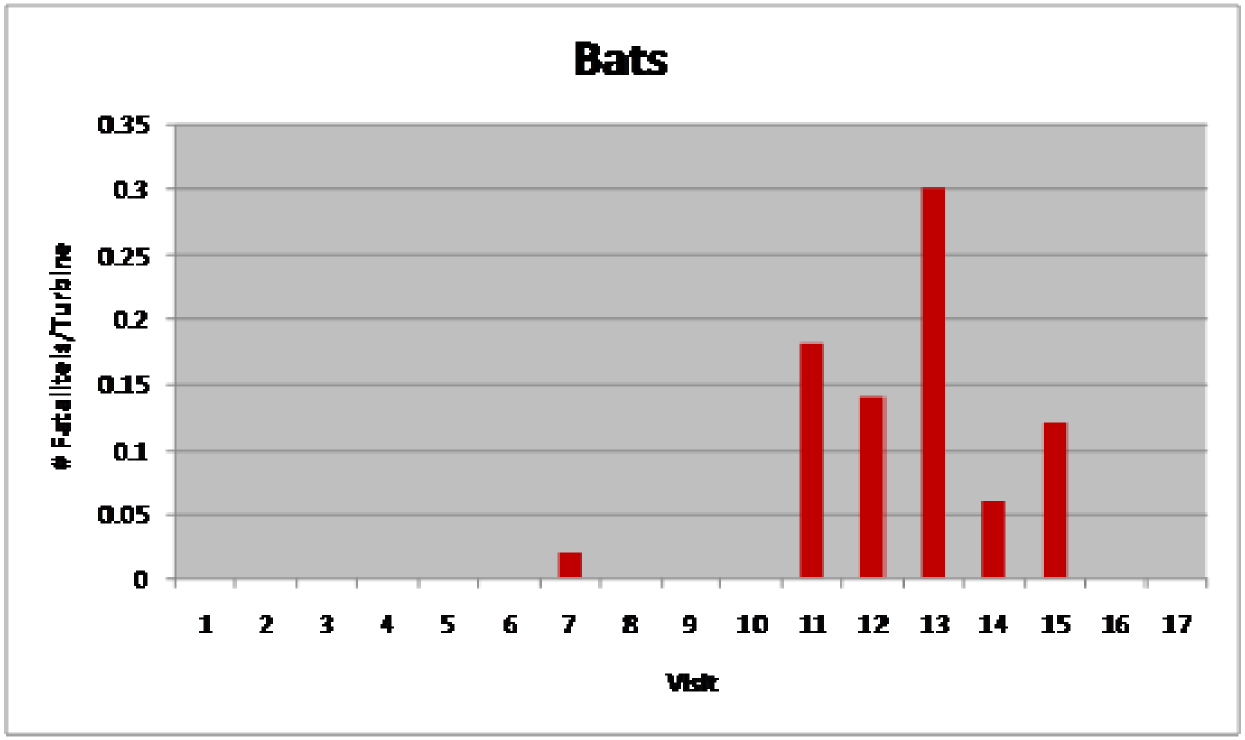


Figure 10. Location of bat fatalities found at the Biglow Canyon Wind Farm, Phase I.



Visit	Dates
1	1/10/08-2/12/08
2	2/13/08-3/5/08
3	3/13/08-3/26/08
4	3/27/08-4/8/08
5	4/10/08-4/22/08
6	4/24/08-5/7/08
7	5/8/08-5/22/08
8	5/23/08-6/19/08
9	6/20/08-7/17/08
10	7/18/08-8/13/08
11	8/14/08-8/27/08
12	8/28/08-9/9/08
13	9/10/08-9/23/08
14	9/24/08-10/7/08
15	10/8/09-10/21/08
16	10/22/08-11/18/08
17	11/19/08-12/12/08

Figure 11. Timing of bat mortality at the Biglow Canyon Wind Project, Phase I.

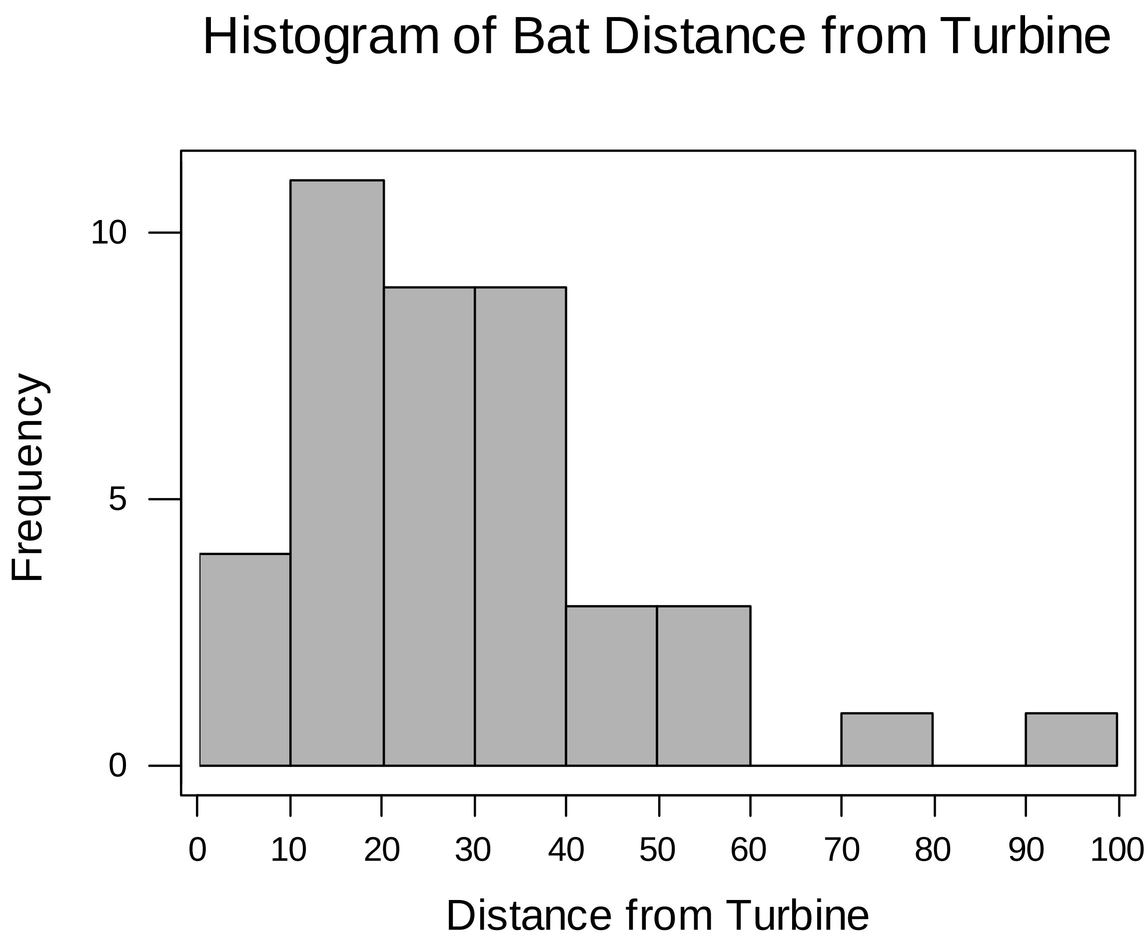


Figure 12. Distance from turbine for bat fatalities on scheduled search plots during standard carcass surveys at the Biglow Canyon Wind Farm, Phase I.

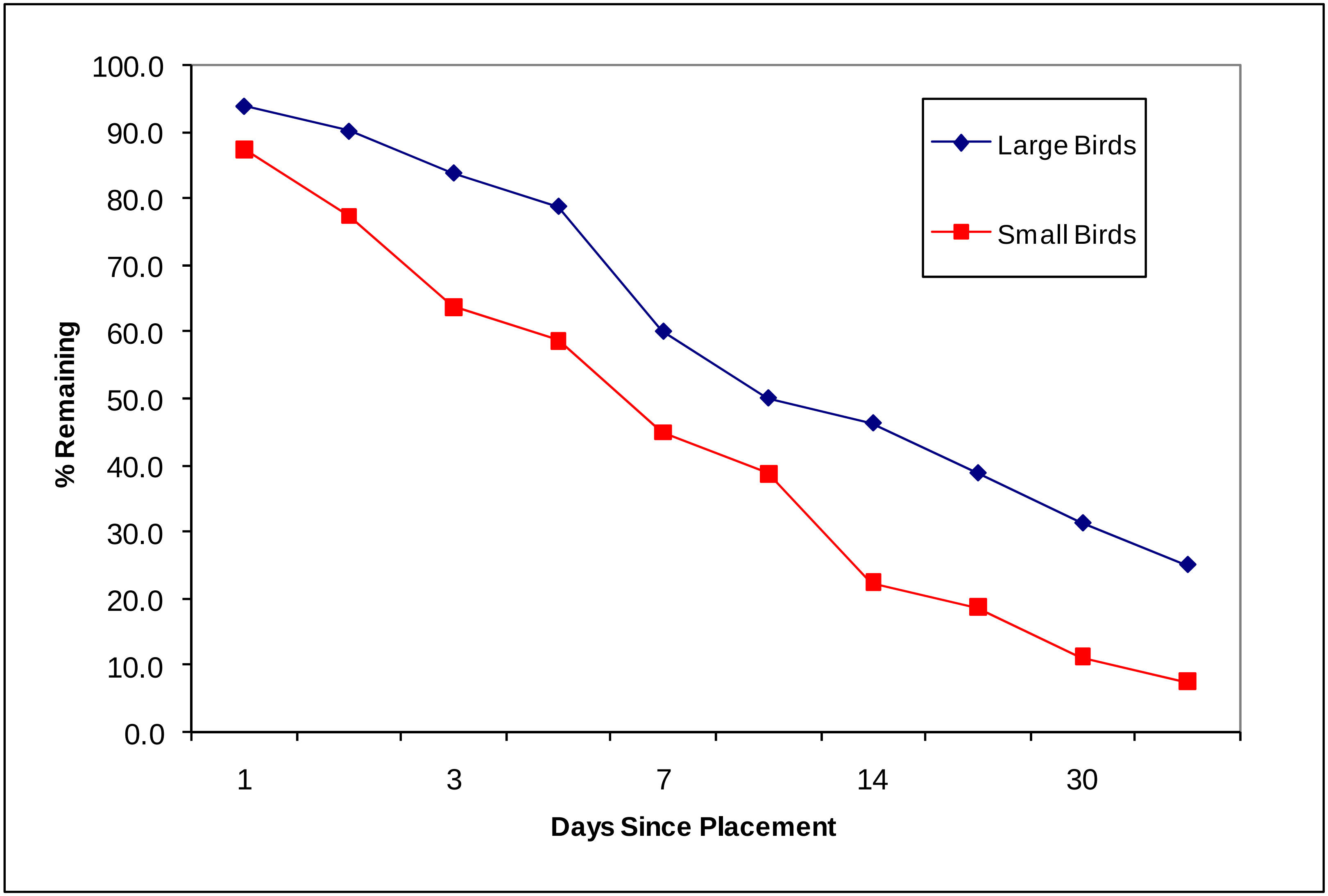


Figure 13. Removal rates for large and small birds at the Biglow Canyon Wind Farm, Phase I.

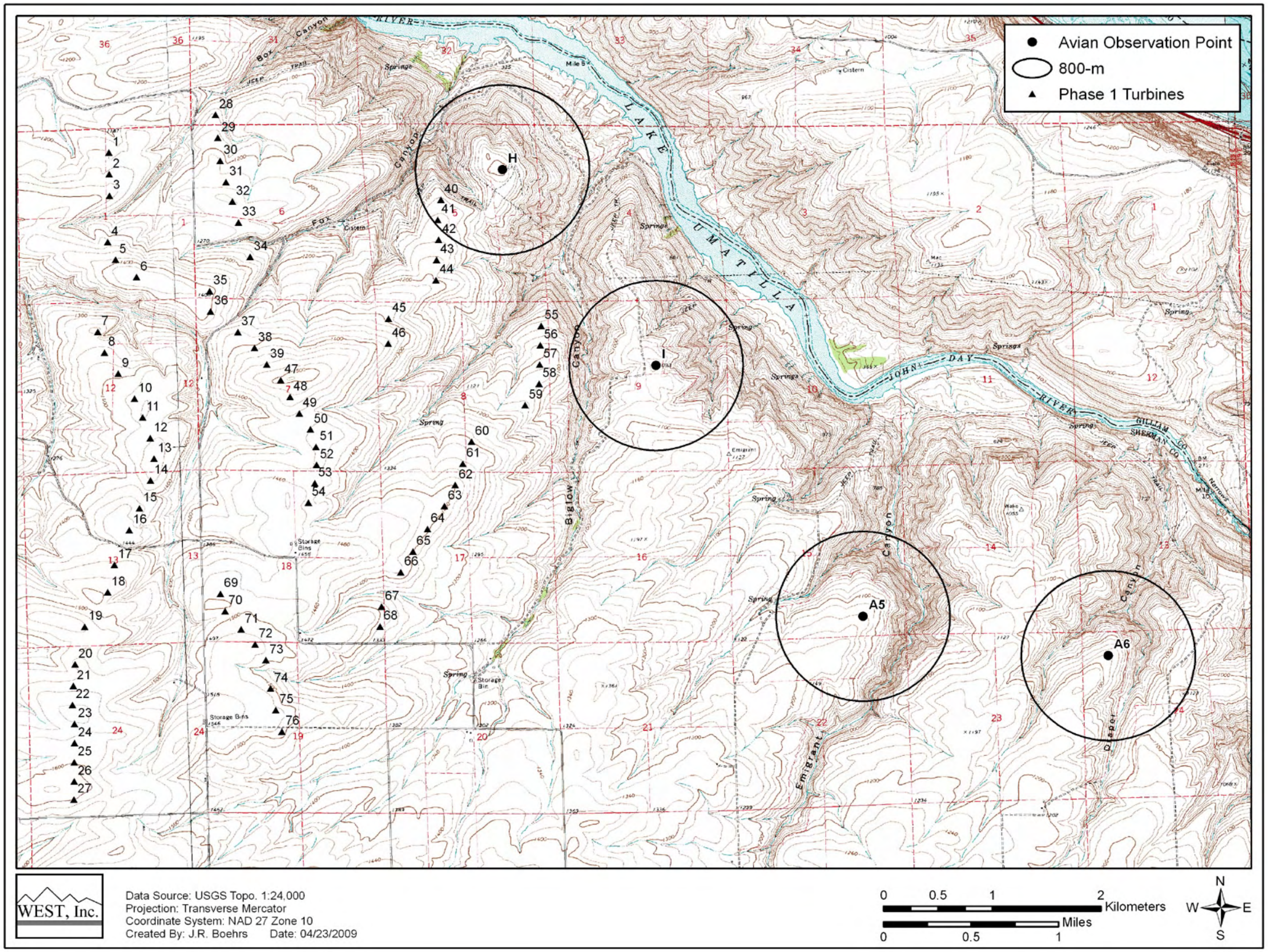


Figure 14. Locations of the John Day Canyon bird use surveys (30-min, 800-m fixed-point), and 2008 wind turbines at the Biglow Canyon Wind Farm, Phase I.

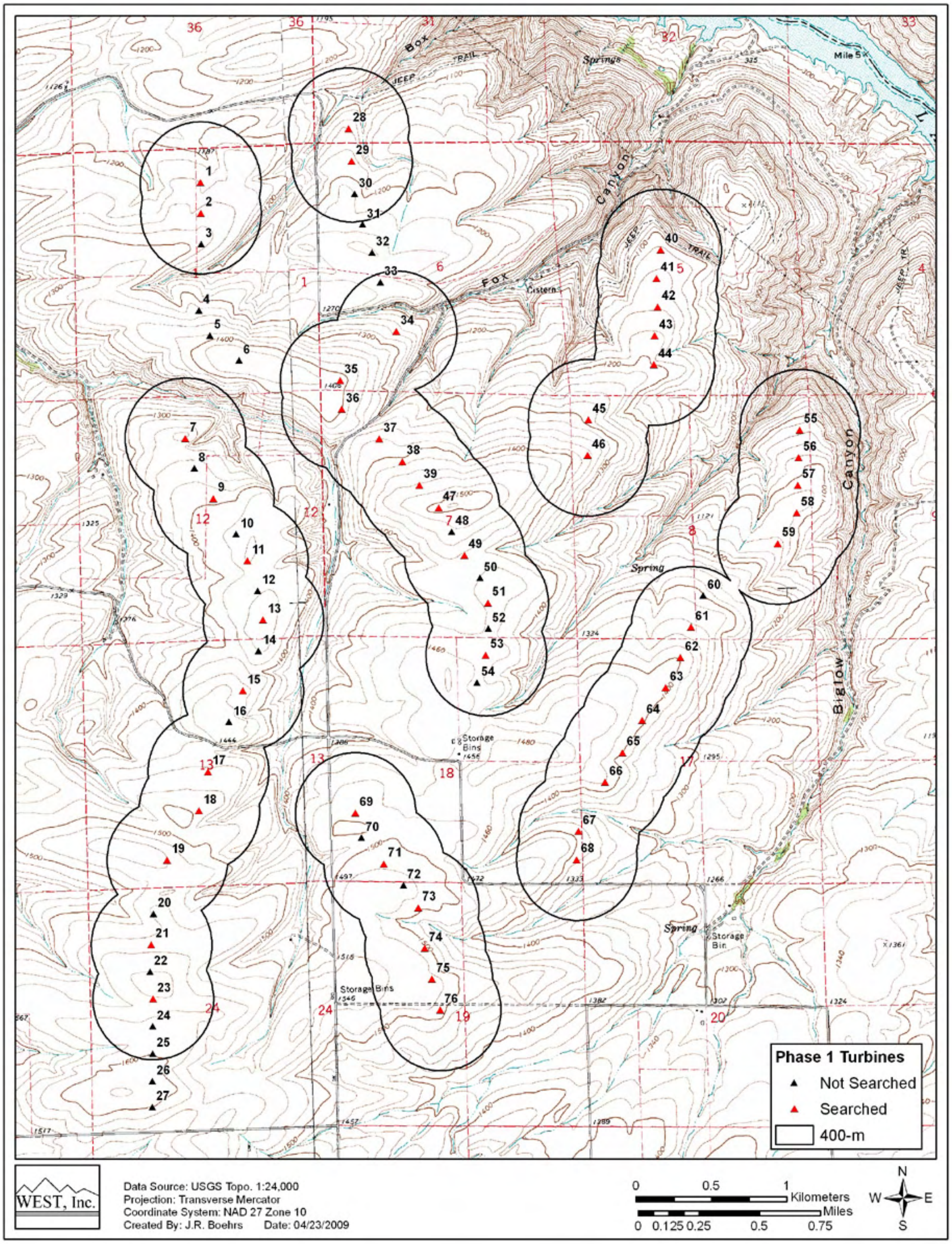


Figure 15. Locations of study turbines used for general bird use surveys (5-min, Project Wind Turbine 400-m fixed-point) at the Biglow Canyon Wind Farm, Phase I.

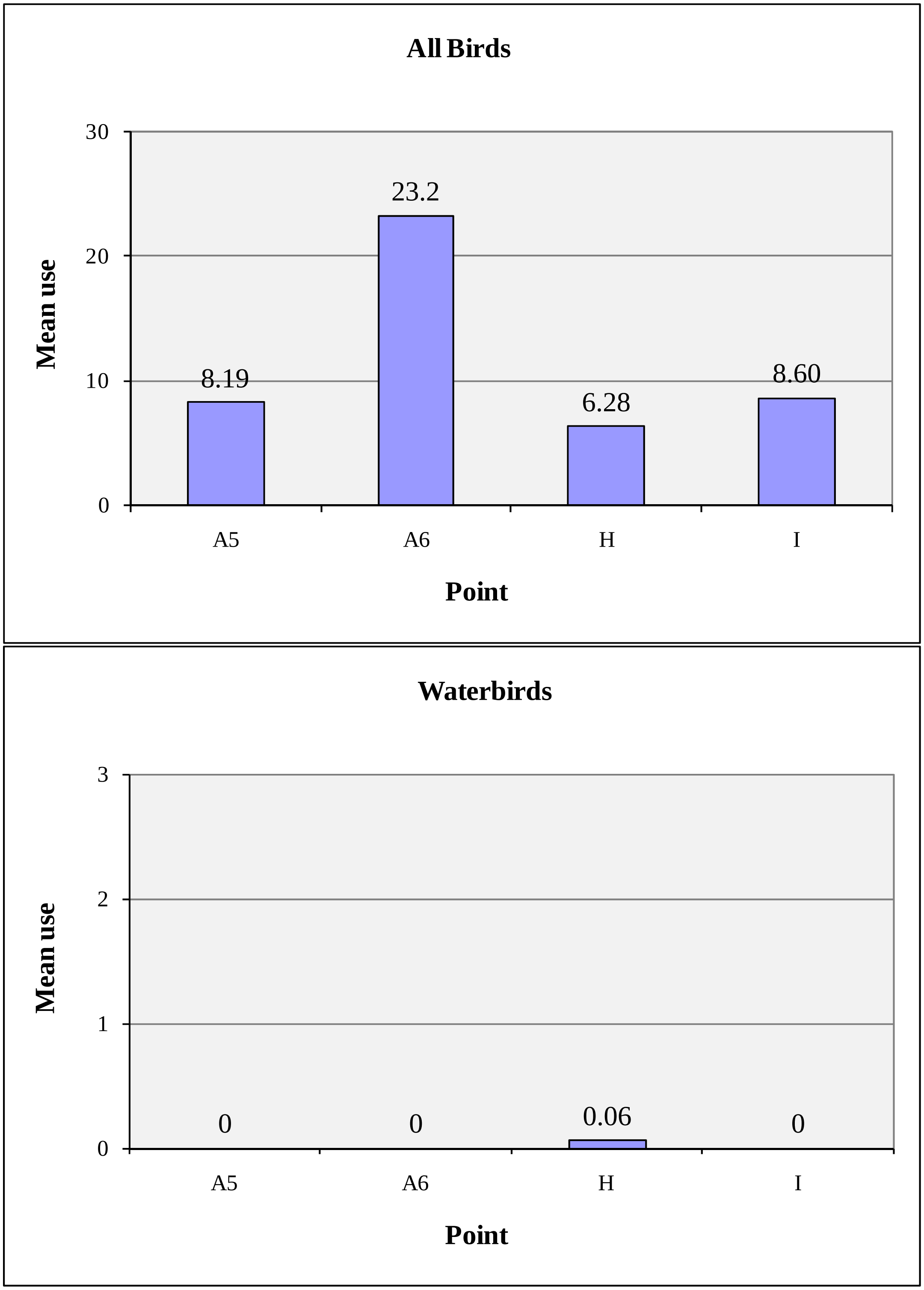
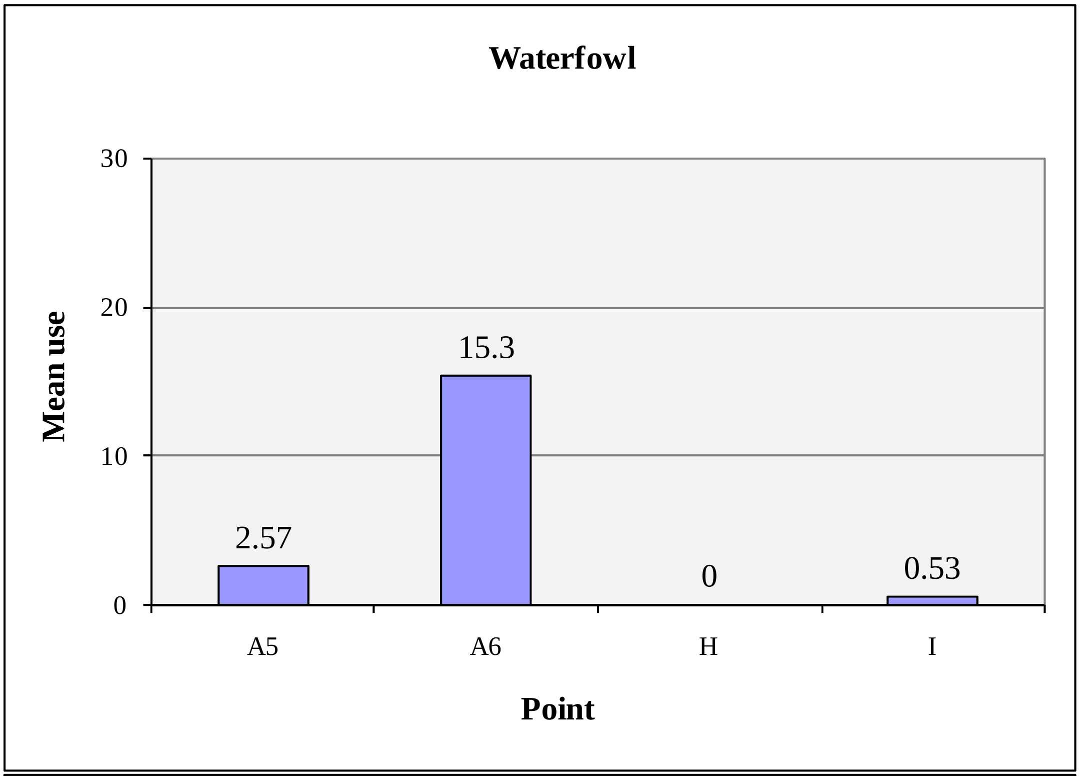


Figure 16a. Mean use (number of birds/30-min survey) at each John Day Canyon 800-m fixed-point bird use survey point for all birds, major bird types, and raptor subtypes at the Biglow Canyon Wind Farm, Phase I.



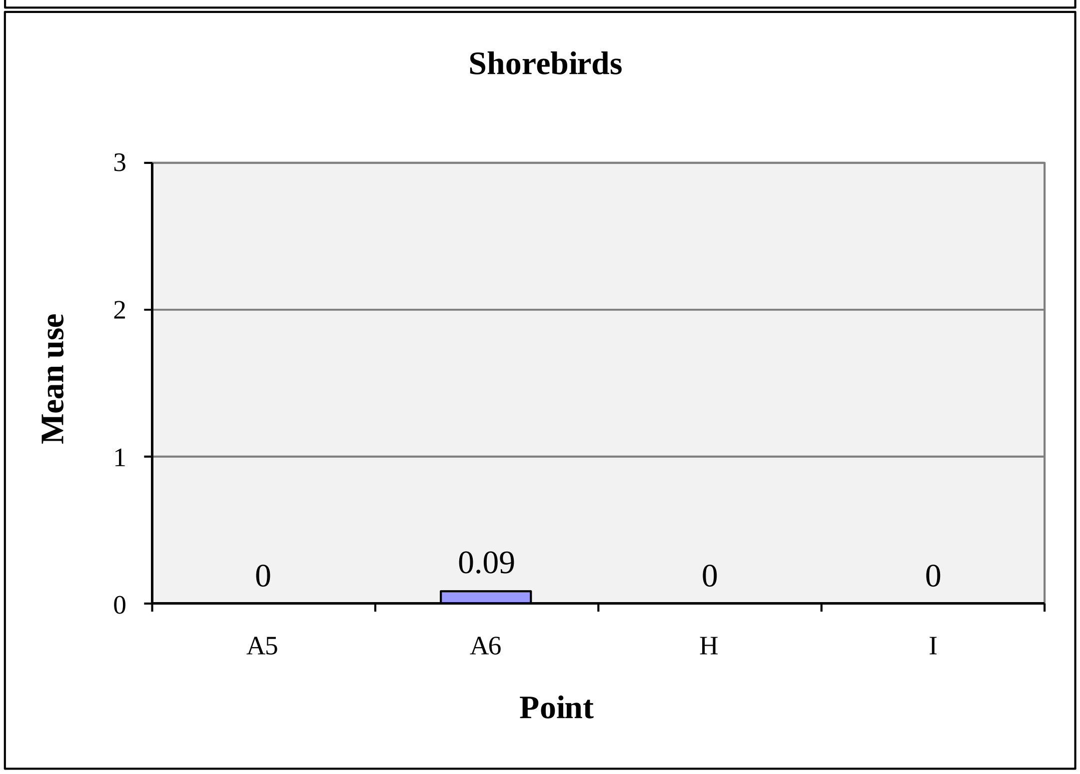
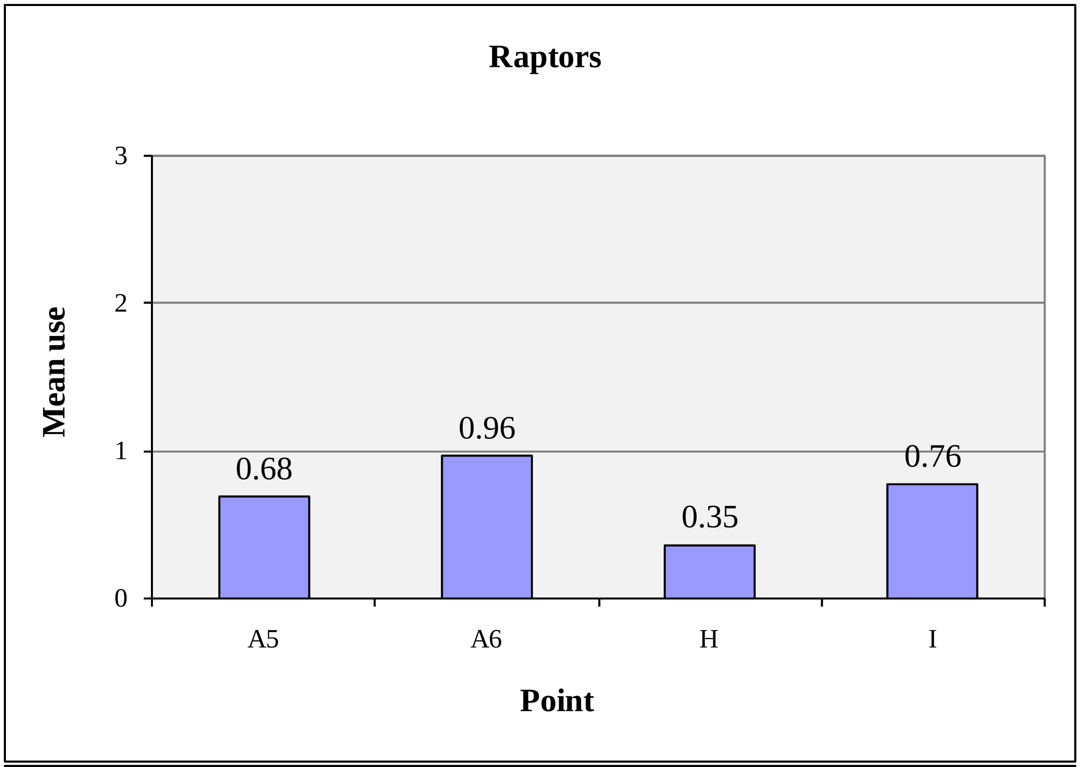


Figure 16b (*continued*). Mean use (number of birds/30-min survey) at each John Day Canyon 800-m fixed-point bird use survey point for all birds, major bird types, and raptor subtypes at the Biglow Canyon Wind Farm, Phase I.



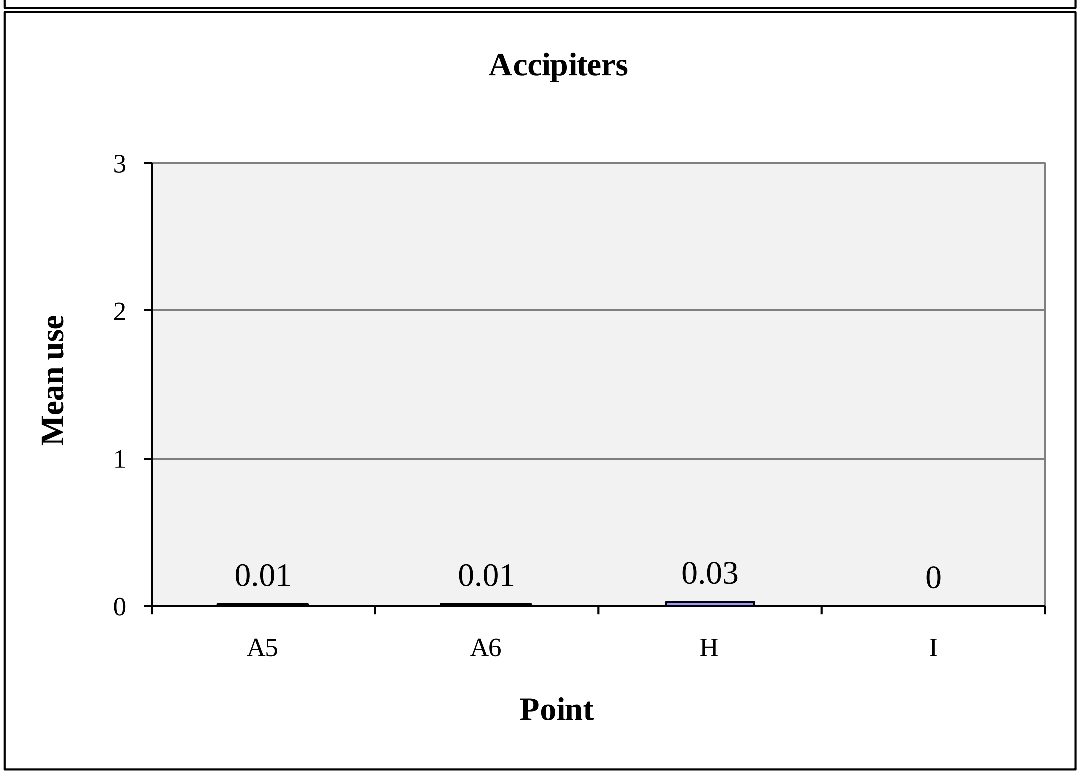
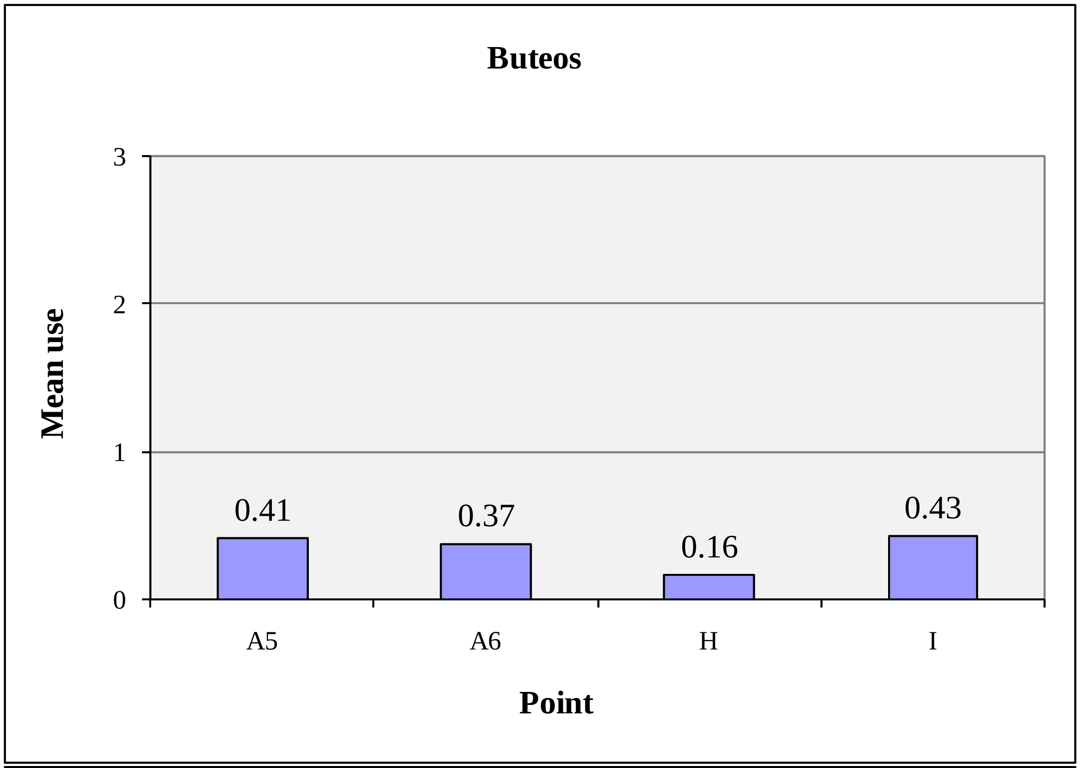


Figure 16c (*continued*). Mean use (number of birds/30-min survey) at each John Day Canyon 800-m fixed-point bird use survey point for all birds, major bird types, and raptor subtypes at the Biglow Canyon Wind Farm, Phase I.



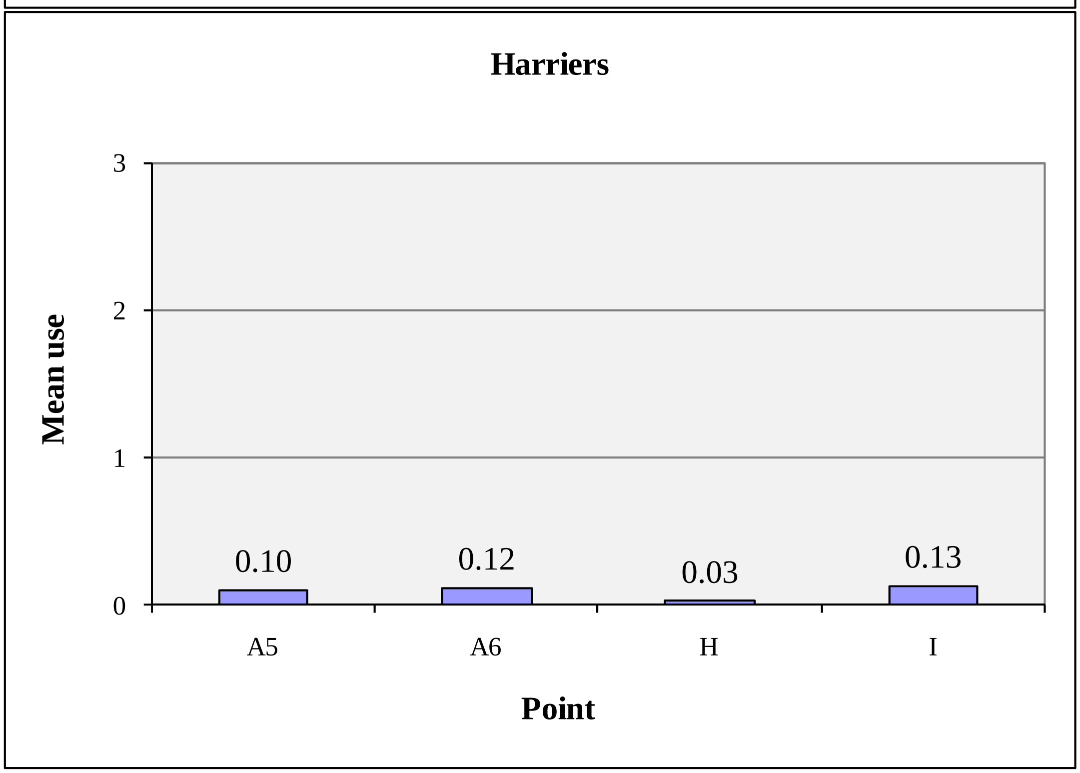
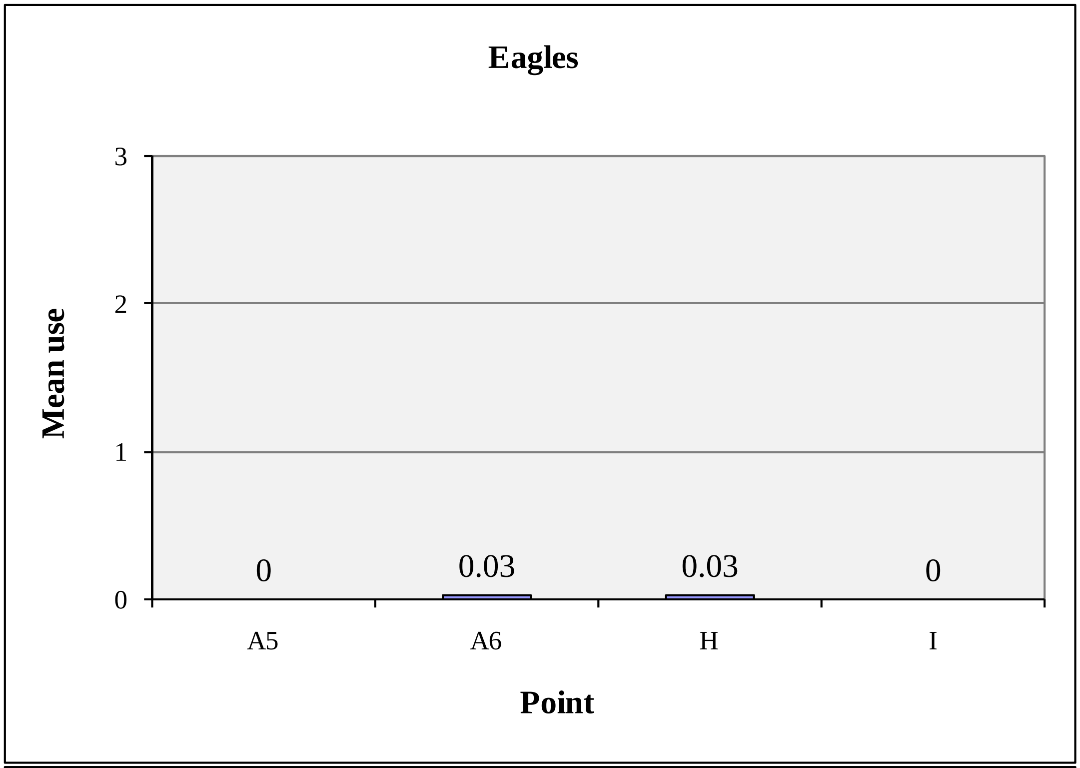


Figure 16d (*continued*). Mean use (number of birds/30-min survey) at each John Day Canyon 800-m fixed-point bird use survey point for all birds, major bird types, and raptor subtypes at the Biglow Canyon Wind Farm, Phase I.



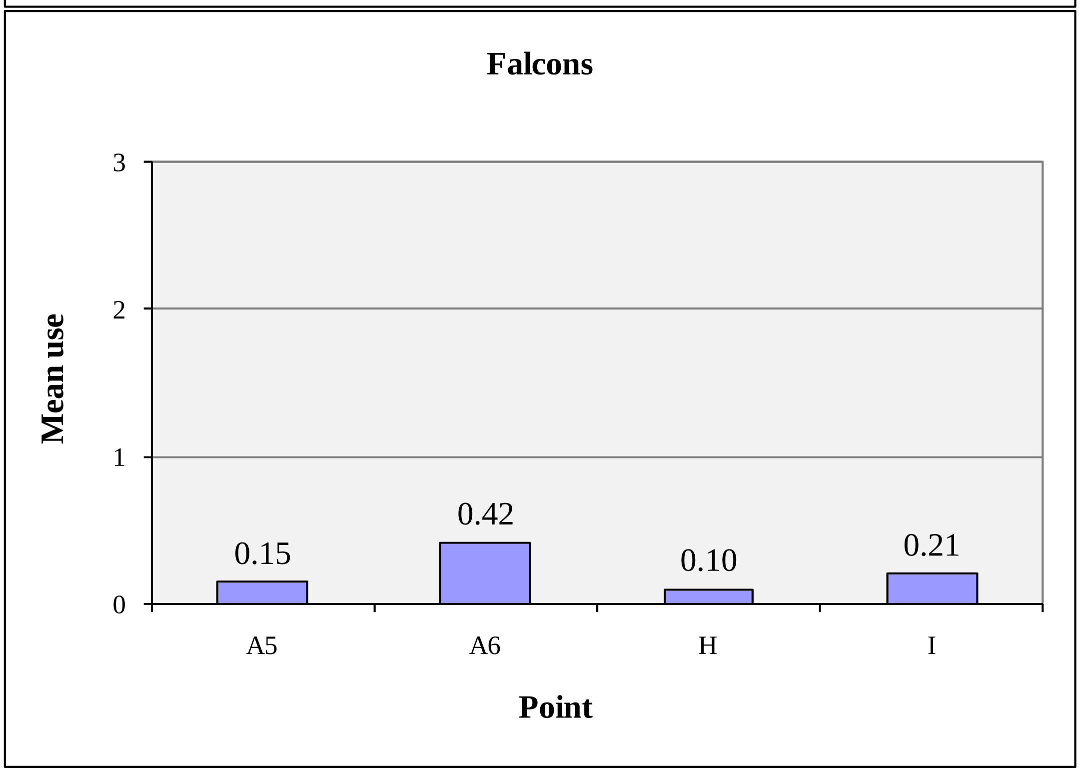
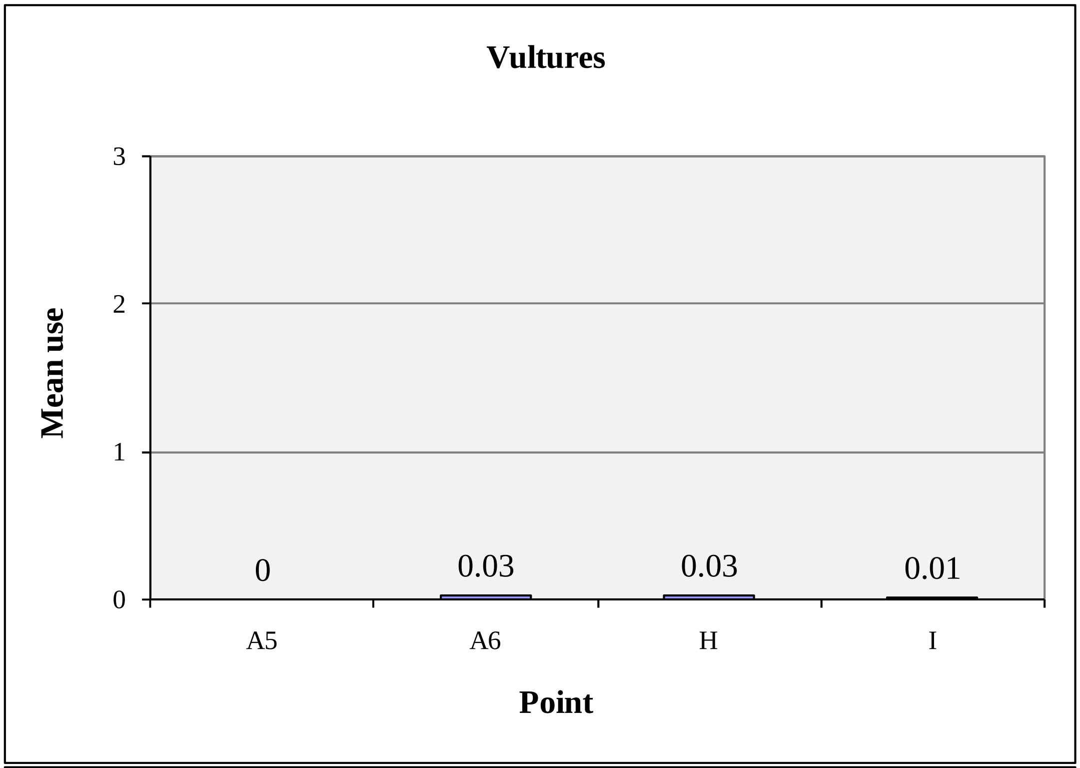


Figure 16e (*continued*). Mean use (number of birds/30-min survey) at each John Day Canyon 800-m fixed-point bird use survey point for all birds, major bird types, and raptor subtypes at the Biglow Canyon Wind Farm, Phase I.



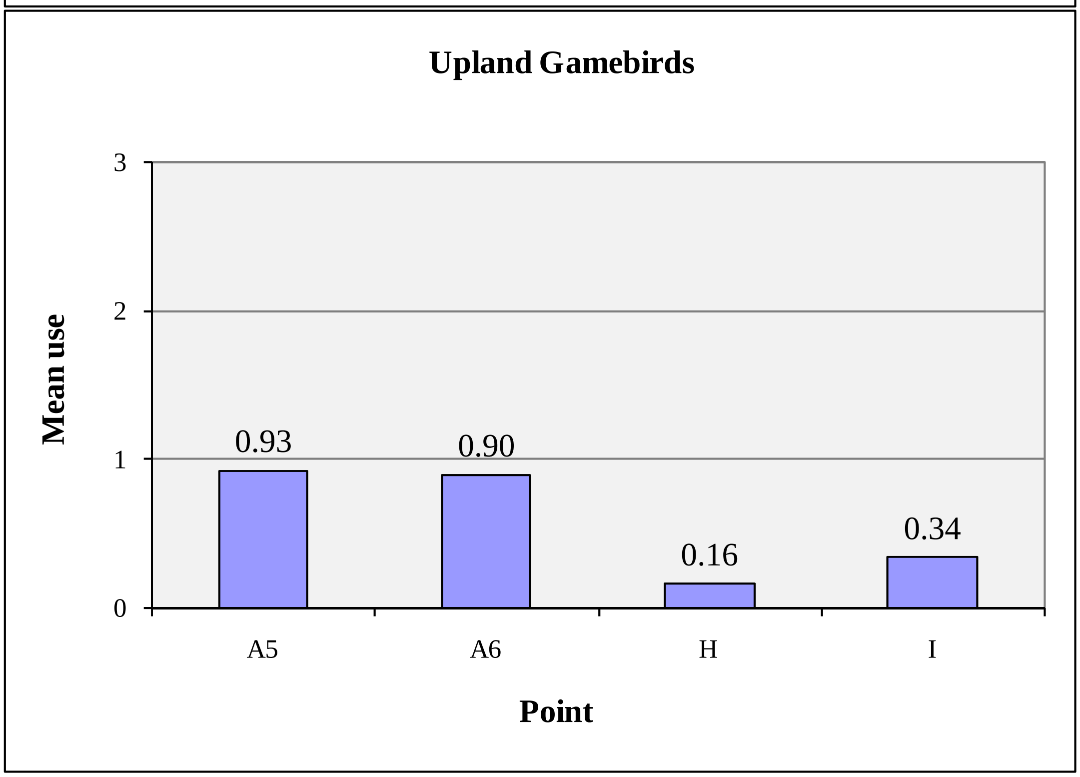
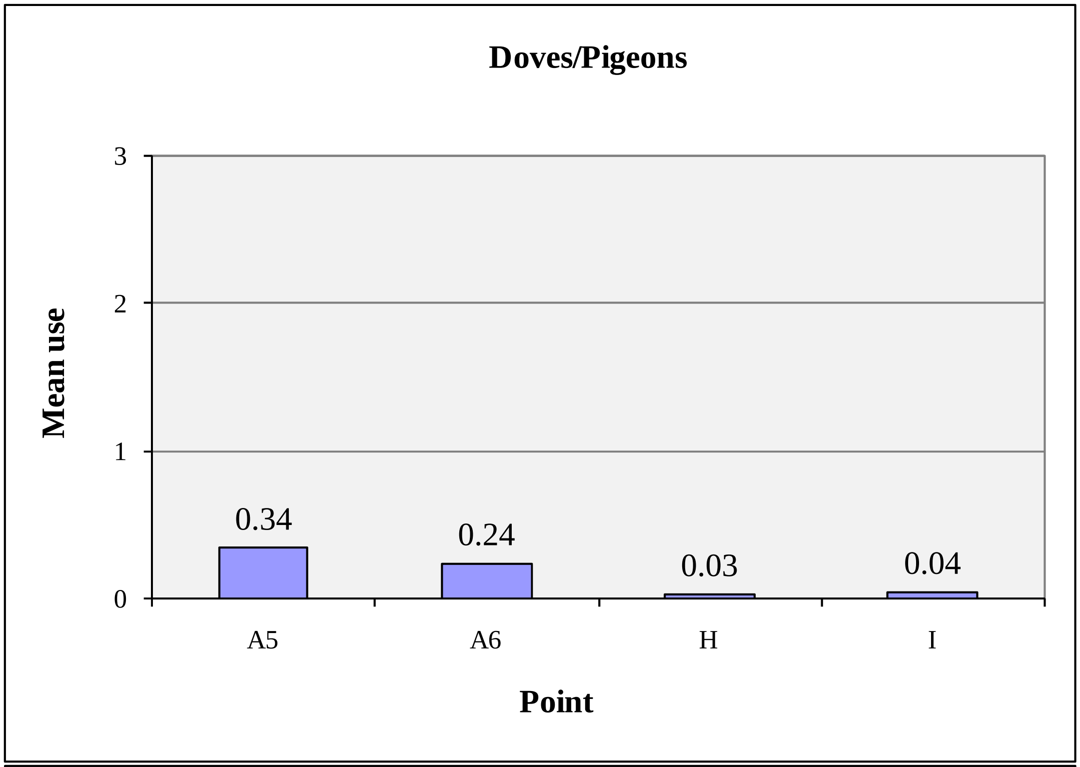


Figure 16f (*continued*). Mean use (number of birds/30-min survey) at each John Day Canyon 800-m fixed-point bird use survey point for all birds, major bird types, and raptor subtypes at the Biglow Canyon Wind Farm, Phase I.



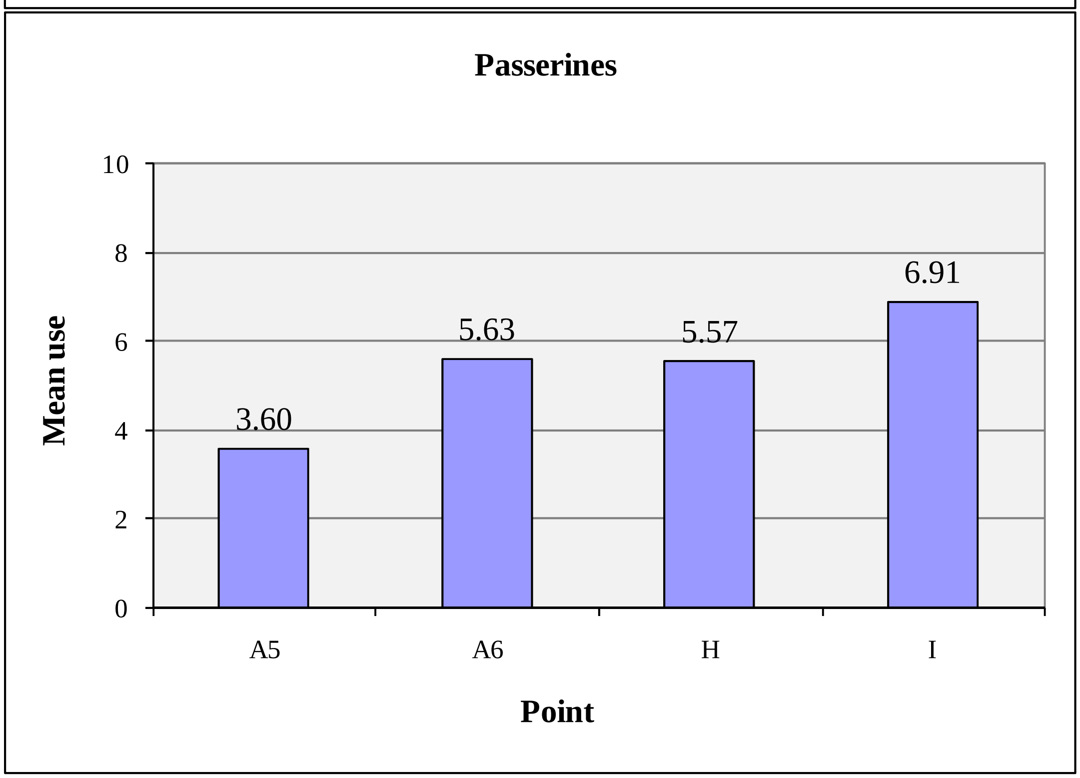


Figure 16g (*continued*). Mean use (number of birds/30-min survey) at each John Day Canyon 800-m fixed-point bird use survey point for all birds, major bird types, and raptor subtypes at the Biglow Canyon Wind Farm, Phase I.

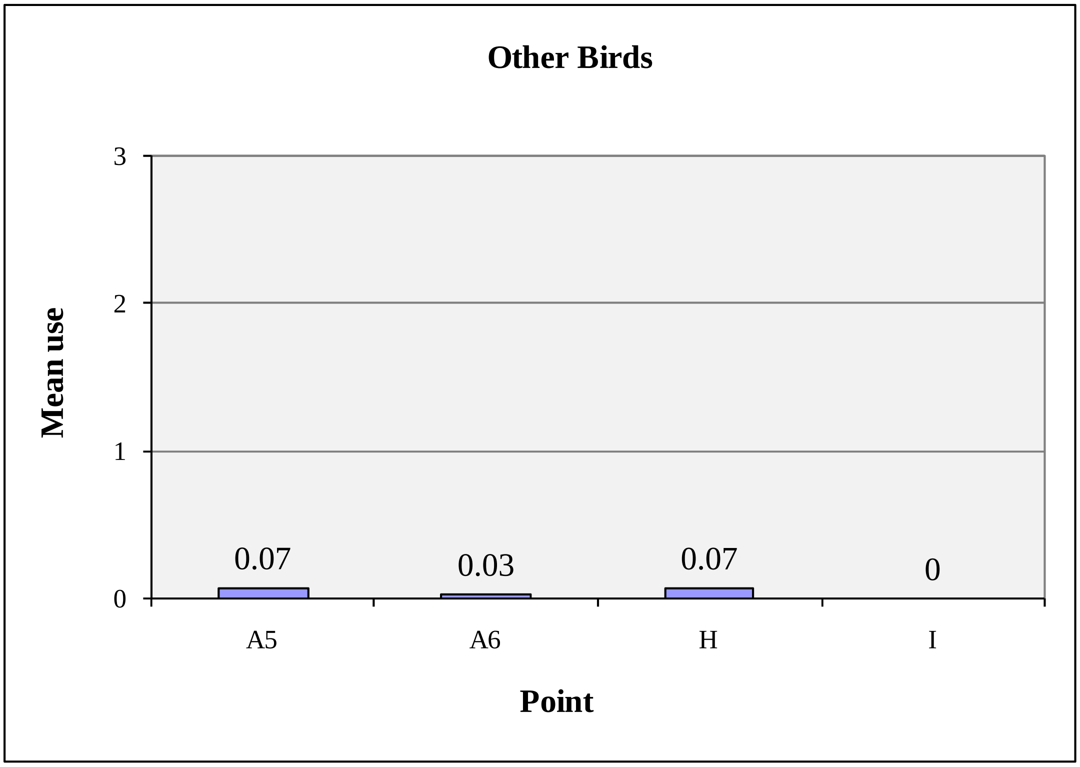


Figure 16h (*continued*). Mean use (number of birds/30-min survey) at each John Day Canyon 800-m fixed-point bird use survey point for all birds, major bird types, and raptor subtypes at the Biglow Canyon Wind Project, Phase I.

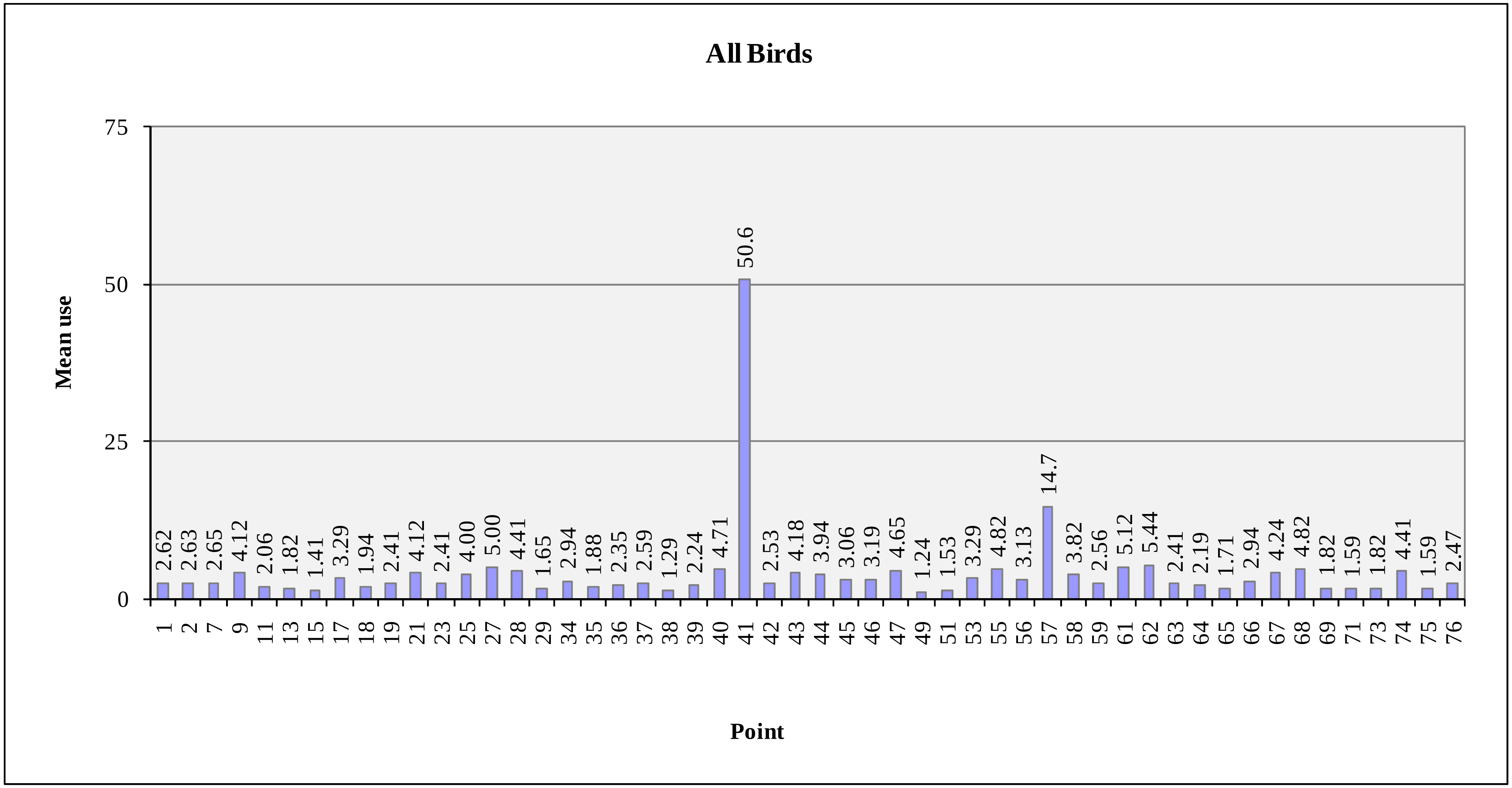


Figure 17a. Mean use (number of birds/5-min survey) at each Project Wind Turbine 400-m fixed-point bird use point for all birds, major bird types, and passerine subtypes at the Biglow Canyon Wind Farm, Phase I, January 10 - December 12, 2008.

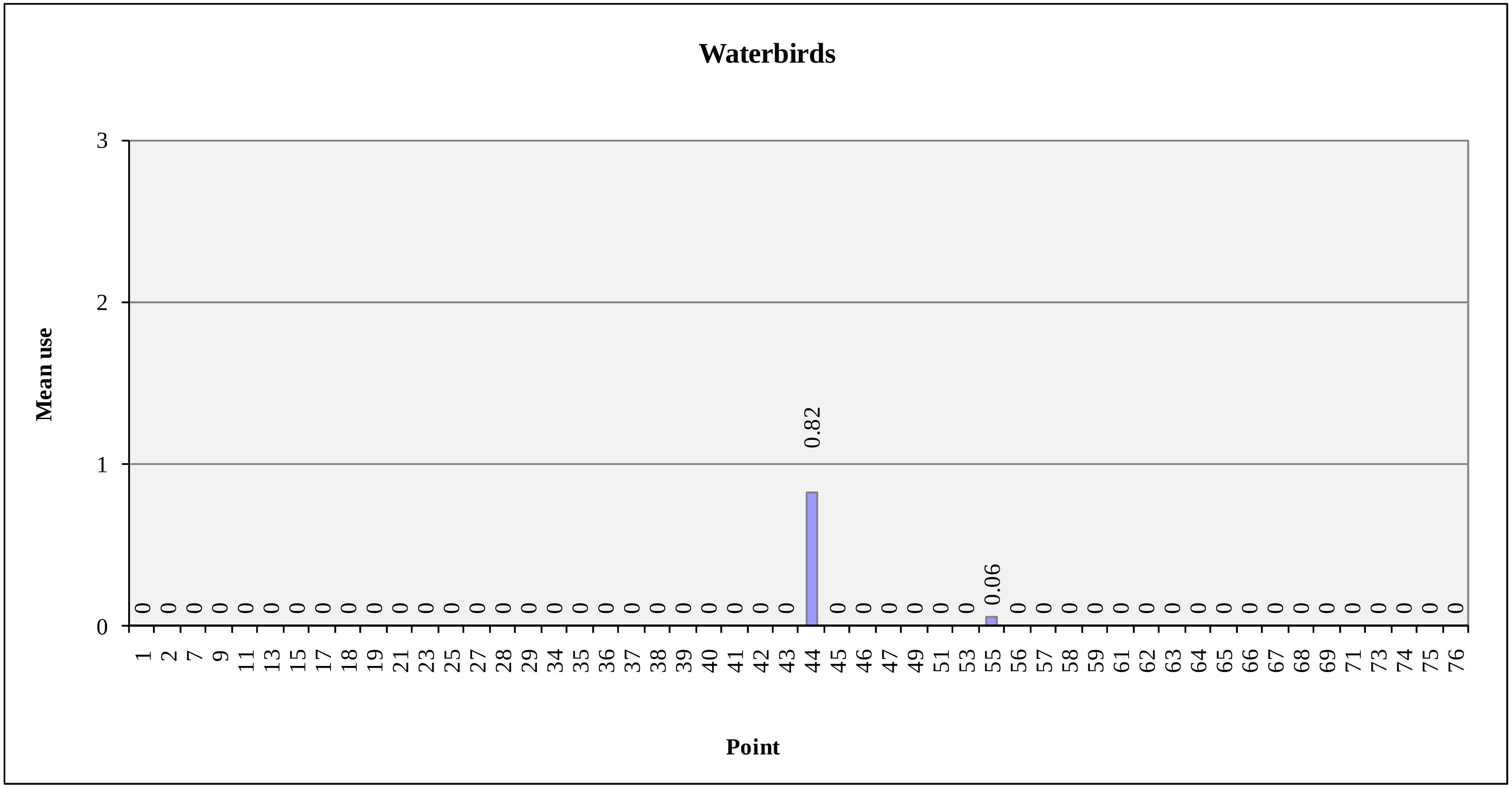


Figure 17b (*continued*). Mean use (number of birds/5-min survey) at each Project Wind Turbine 400-m fixed-point bird use point for all birds, major bird types, and passerine subtypes at the Biglow Canyon Wind Farm, Phase I, January 10 - December 12, 2008.

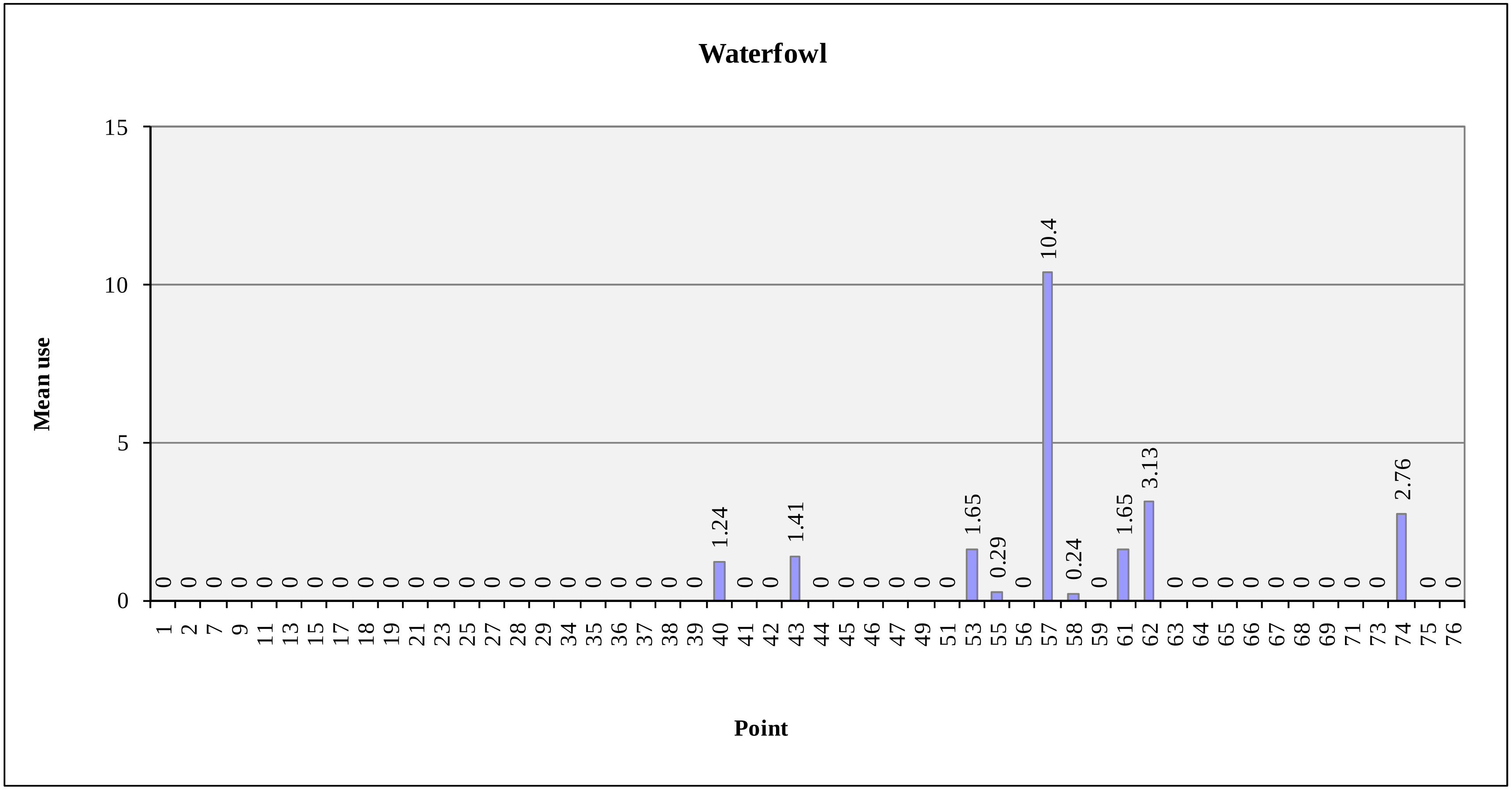


Figure 17c (*continued*). Mean use (number of birds/5-min survey) at each Project Wind Turbine 400-m fixed-point bird use point for all birds, major bird types, and passerine subtypes at the Biglow Canyon Wind Farm, Phase I, January 10 - December 12, 2008.

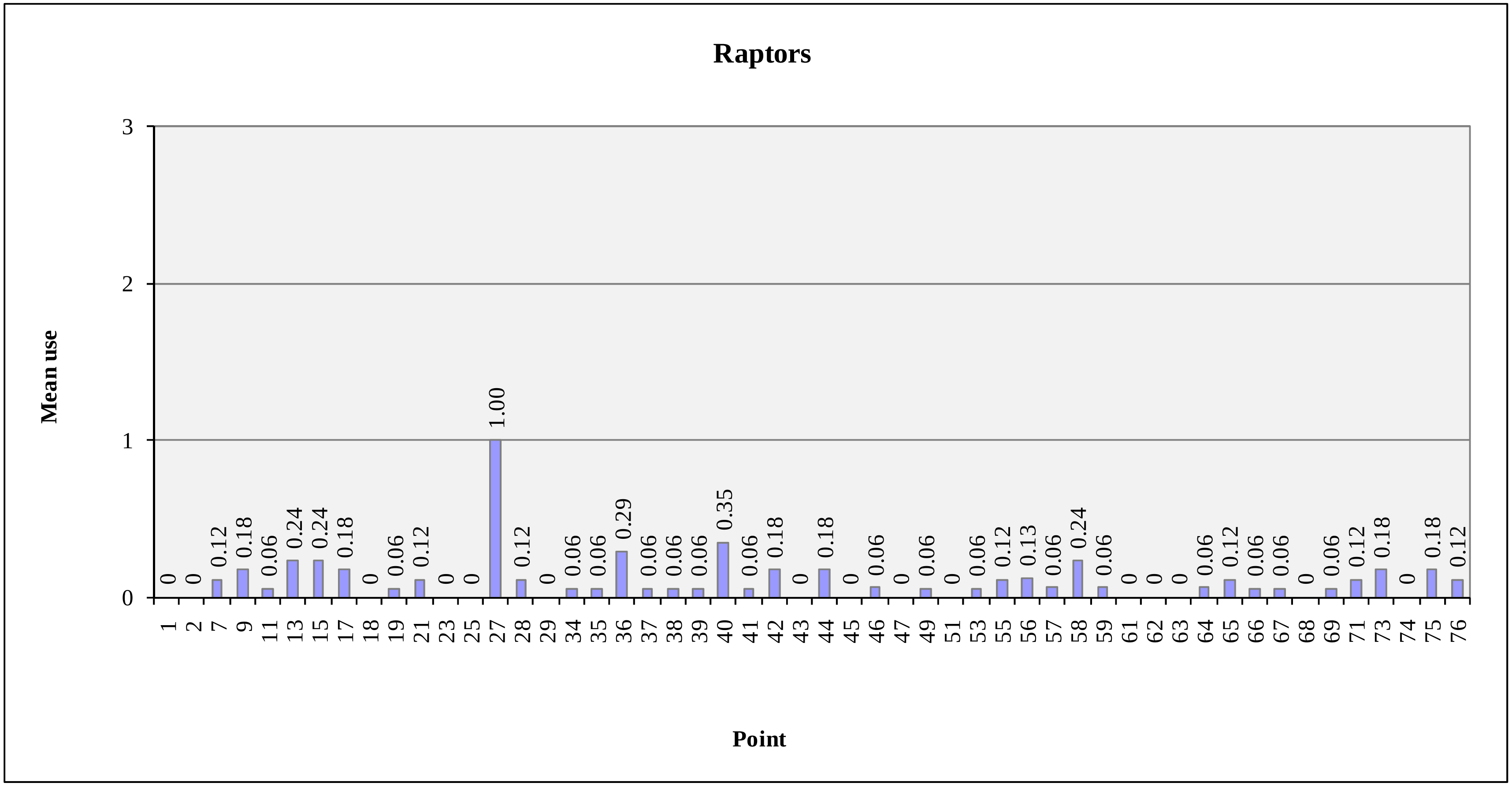


Figure 17d (*continued*). Mean use (number of birds/5-min survey) at each Project Wind Turbine 400-m fixed-point bird use point for all birds, major bird types, and passerine subtypes at the Biglow Canyon Wind Farm, Phase I, January 10 - December 12, 2008.

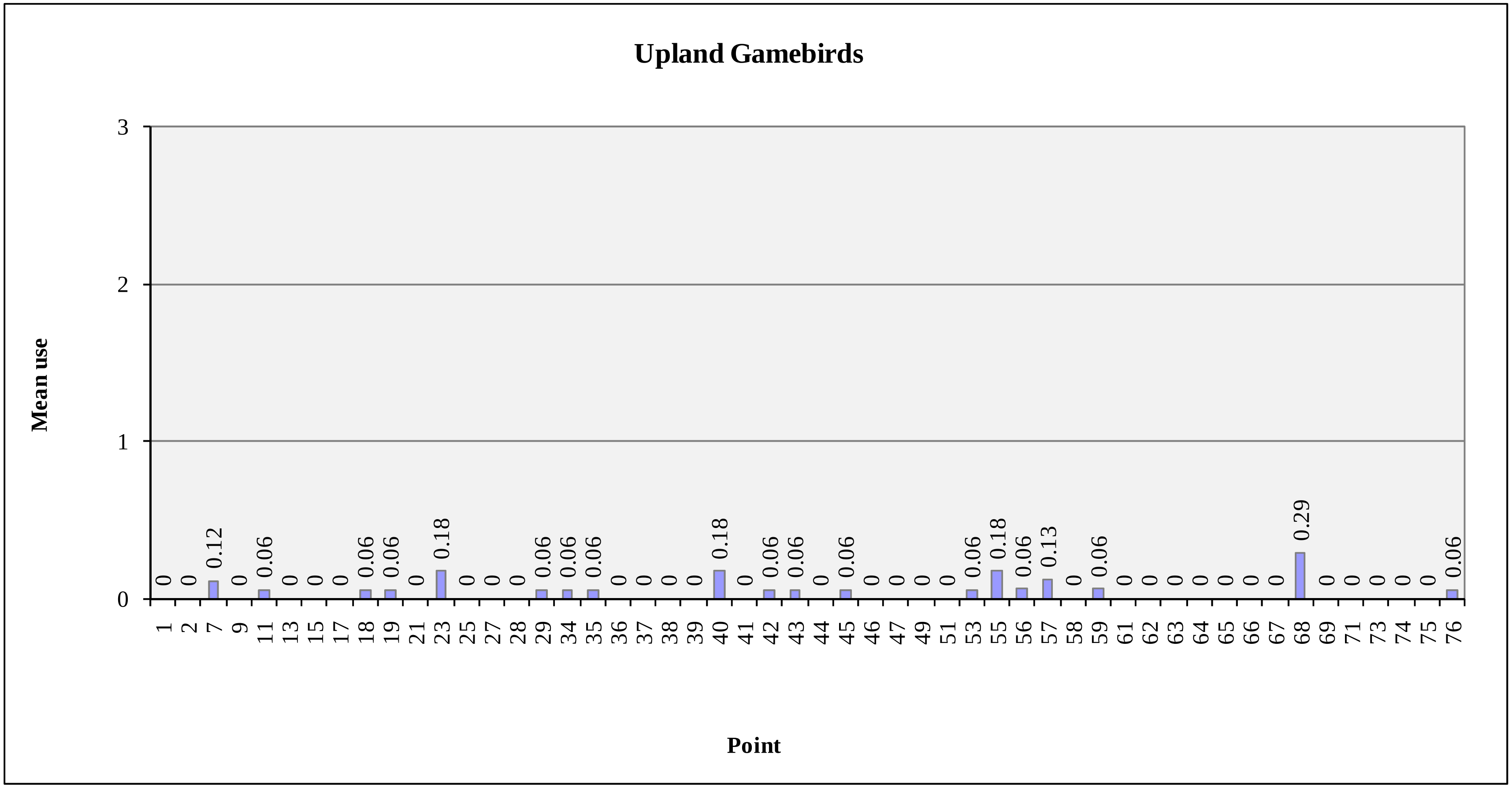


Figure 17e (*continued*). Mean use (number of birds/5-min survey) at each Project Wind Turbine 400-m fixed-point bird use point for all birds, major bird types, and passerine subtypes at the Biglow Canyon Wind Farm, Phase I, January 10 - December 12, 2008.

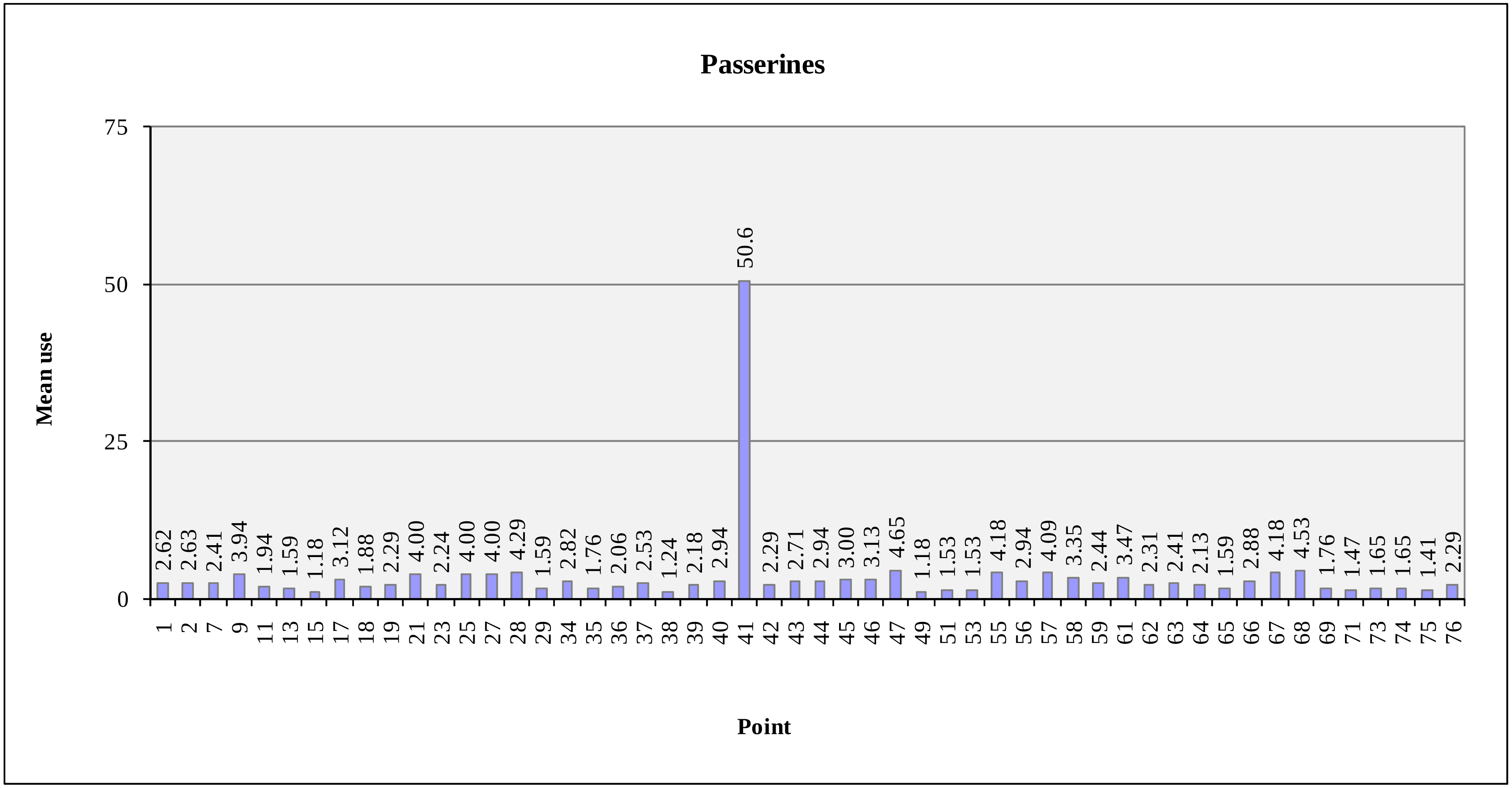


Figure 17f (*continued*). Mean use (number of birds/5-min survey) at each Project Wind Turbine 400-m fixed-point bird use point for all birds, major bird types, and passerine subtypes at the Biglow Canyon Wind Farm, Phase I, January 10 - December 12, 2008.

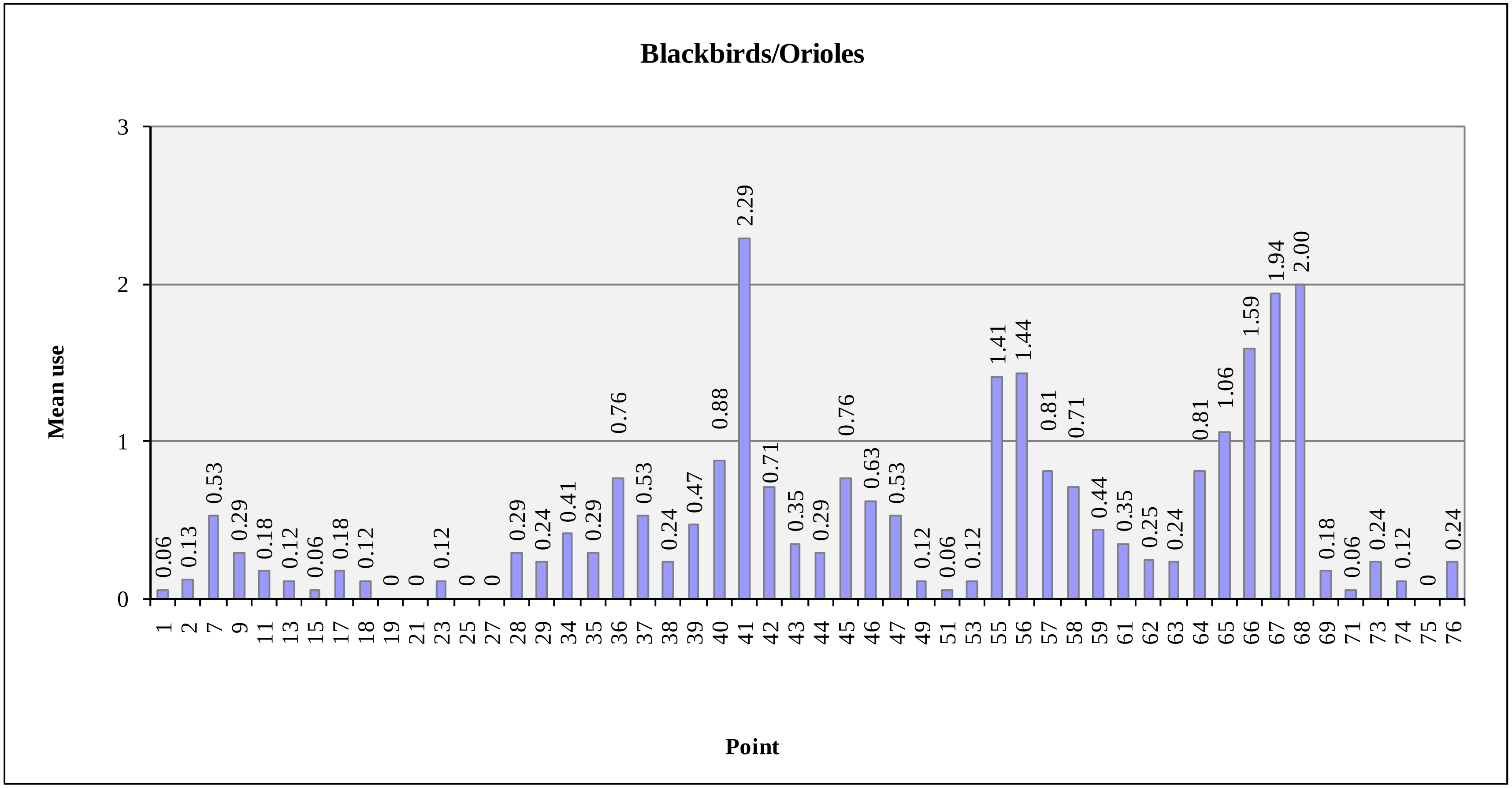


Figure 17g (*continued*). Mean use (number of birds/5-min survey) at each Project Wind Turbine 400-m fixed-point bird use point for all birds, major bird types, and passerine subtypes at the Biglow Canyon Wind Farm, Phase I, January 10 - December 12, 2008.

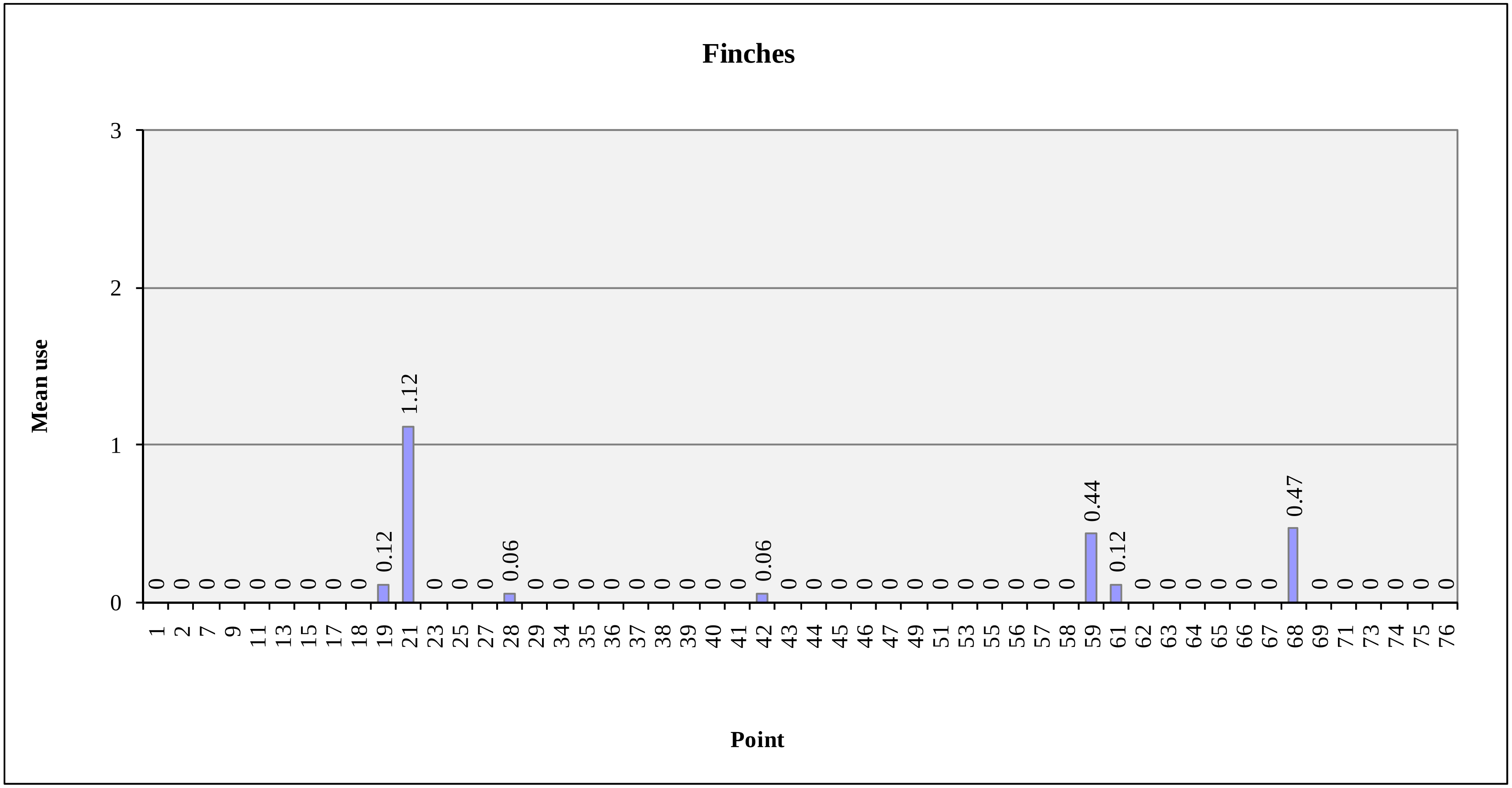


Figure 17h (*continued*). Mean use (number of birds/5-min survey) at each Project Wind Turbine 400-m fixed-point bird use point for all birds, major bird types, and passerine subtypes at the Biglow Canyon Wind Farm, Phase I, January 10 - December 12, 2008.

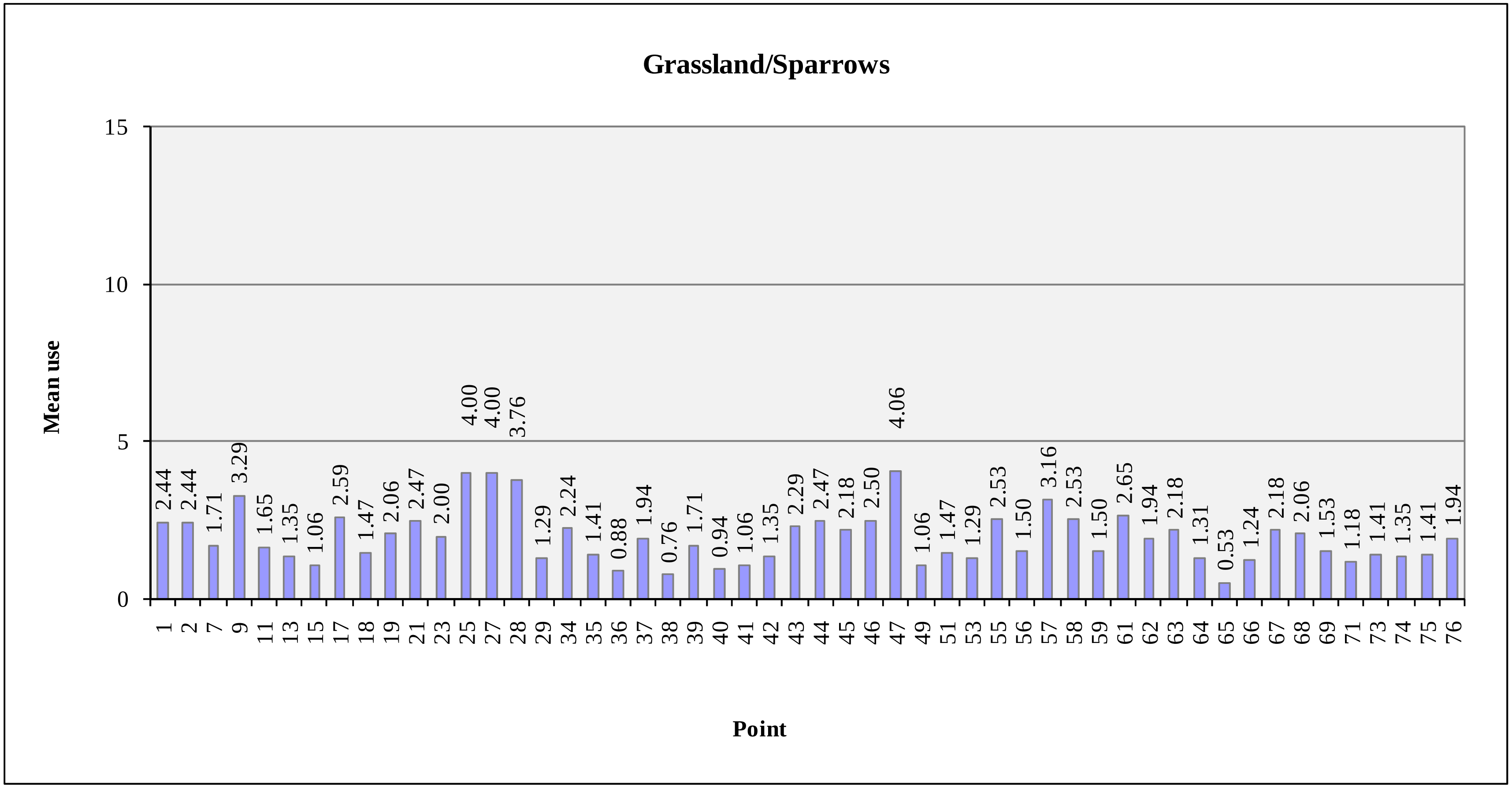


Figure 17i (*continued*). Mean use (number of birds/5-min survey) at each Project Wind Turbine 400-m fixed-point bird use point for all birds, major bird types, and passerine subtypes at the Biglow Canyon Wind Farm, Phase I, January 10 - December 12, 2008.

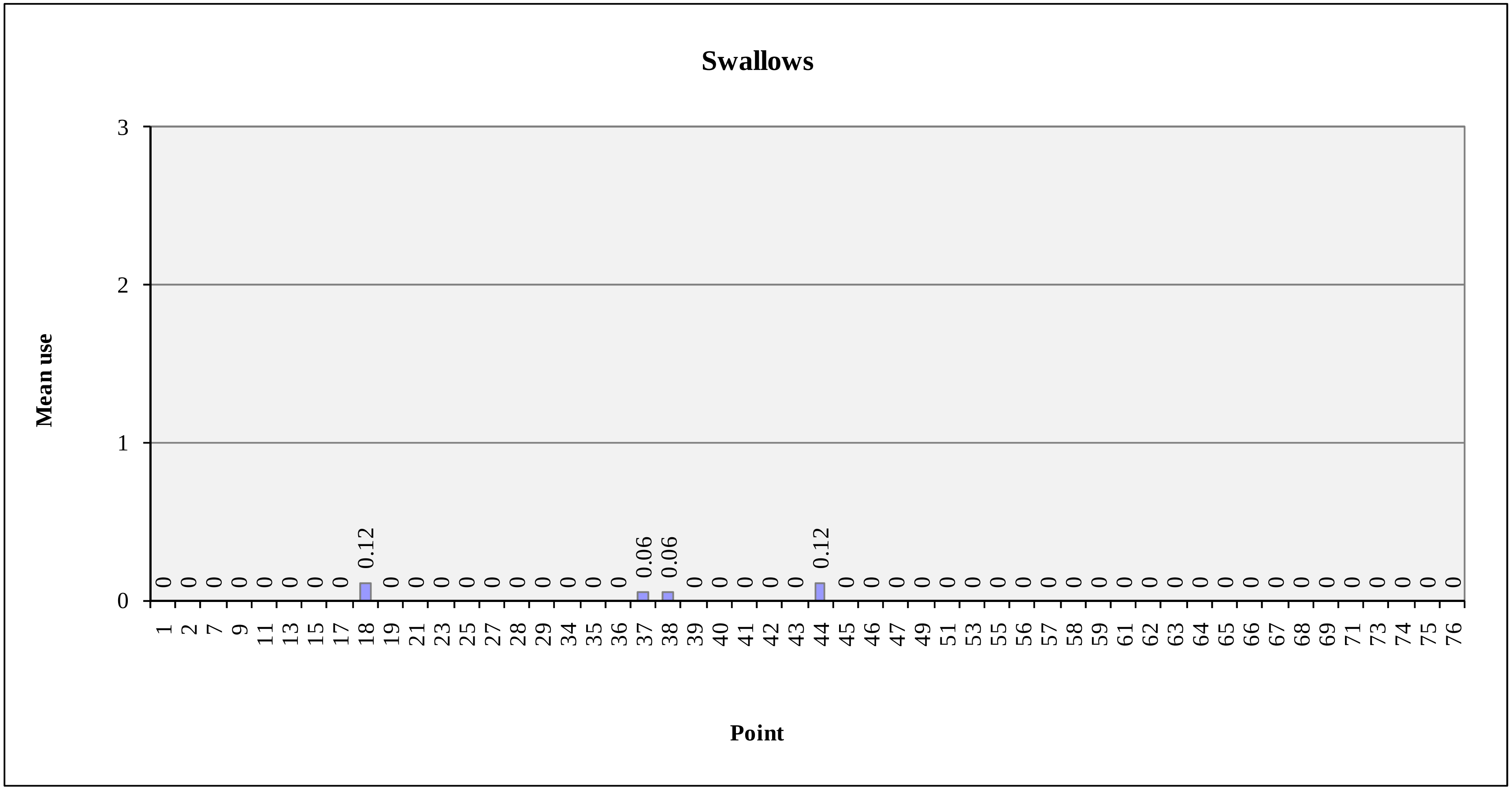


Figure 17j (*continued*). Mean use (number of birds/5-min survey) at each Project Wind Turbine 400-m fixed-point bird use point for all birds, major bird types, and passerine subtypes at the Biglow Canyon Wind Farm, Phase I, January 10 - December 12, 2008.

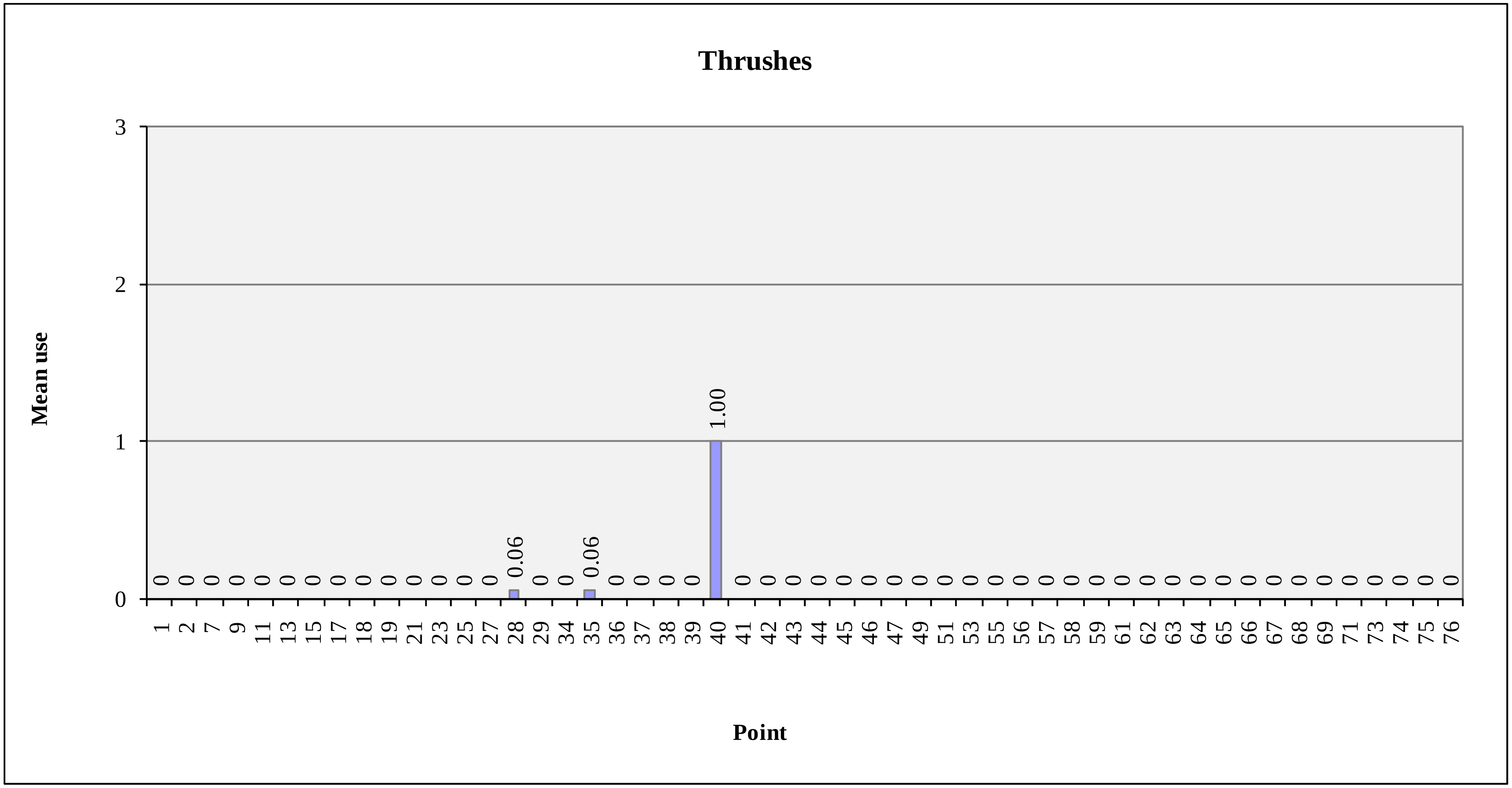


Figure 17k (*continued*). Mean use (number of birds/5-min survey) at each Project Wind Turbine 400-m fixed-point bird use point for all birds, major bird types, and passerine subtypes at the Biglow Canyon Wind Farm, Phase I, January 10 - December 12, 2008.

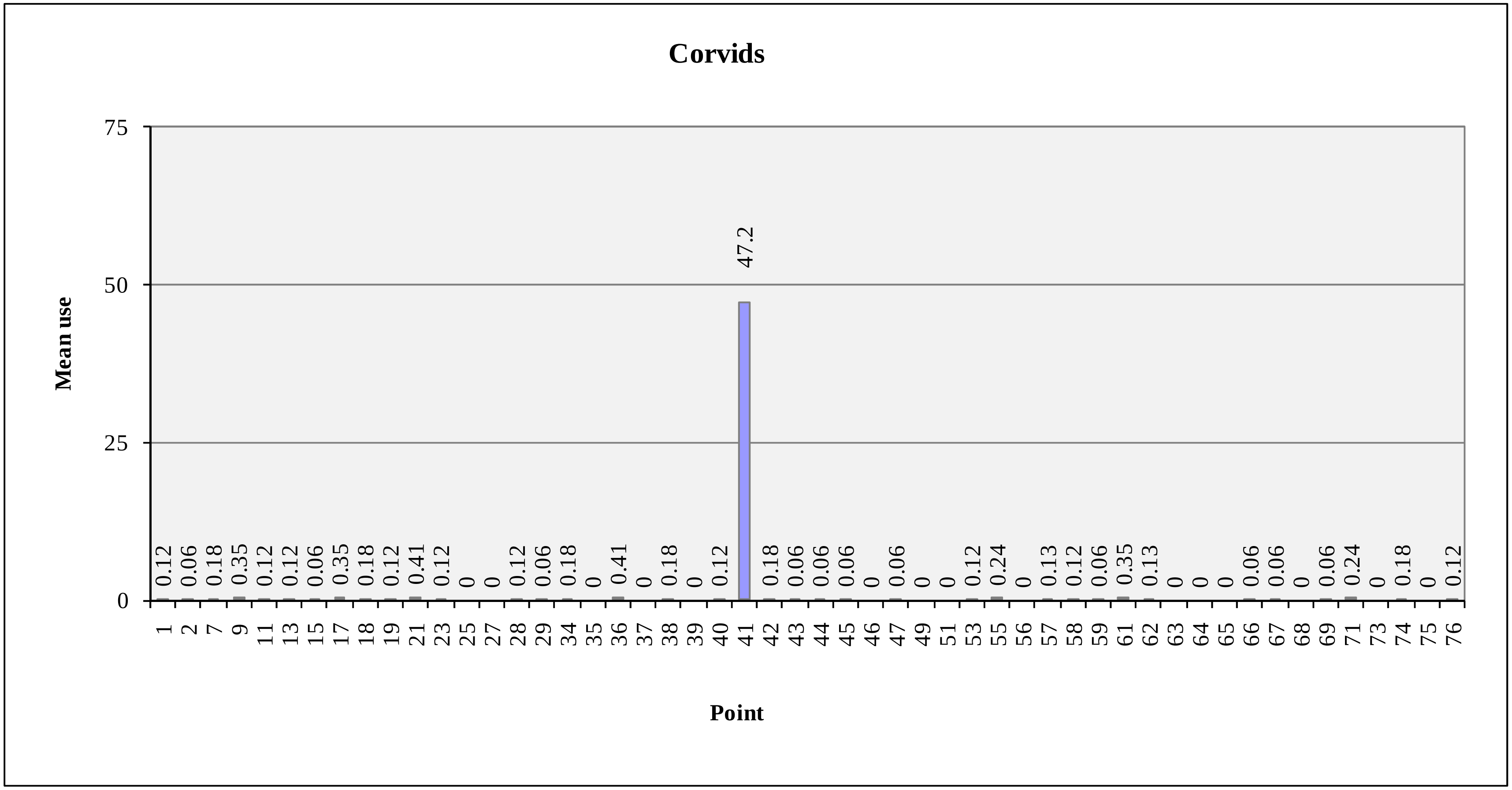


Figure 17l (*continued*). Mean use (number of birds/5-min survey) at each Project Wind Turbine 400-m fixed-point bird use point for all birds, major bird types, and passerine subtypes at the Biglow Canyon Wind Farm, Phase I, January 10 - December 12, 2008.

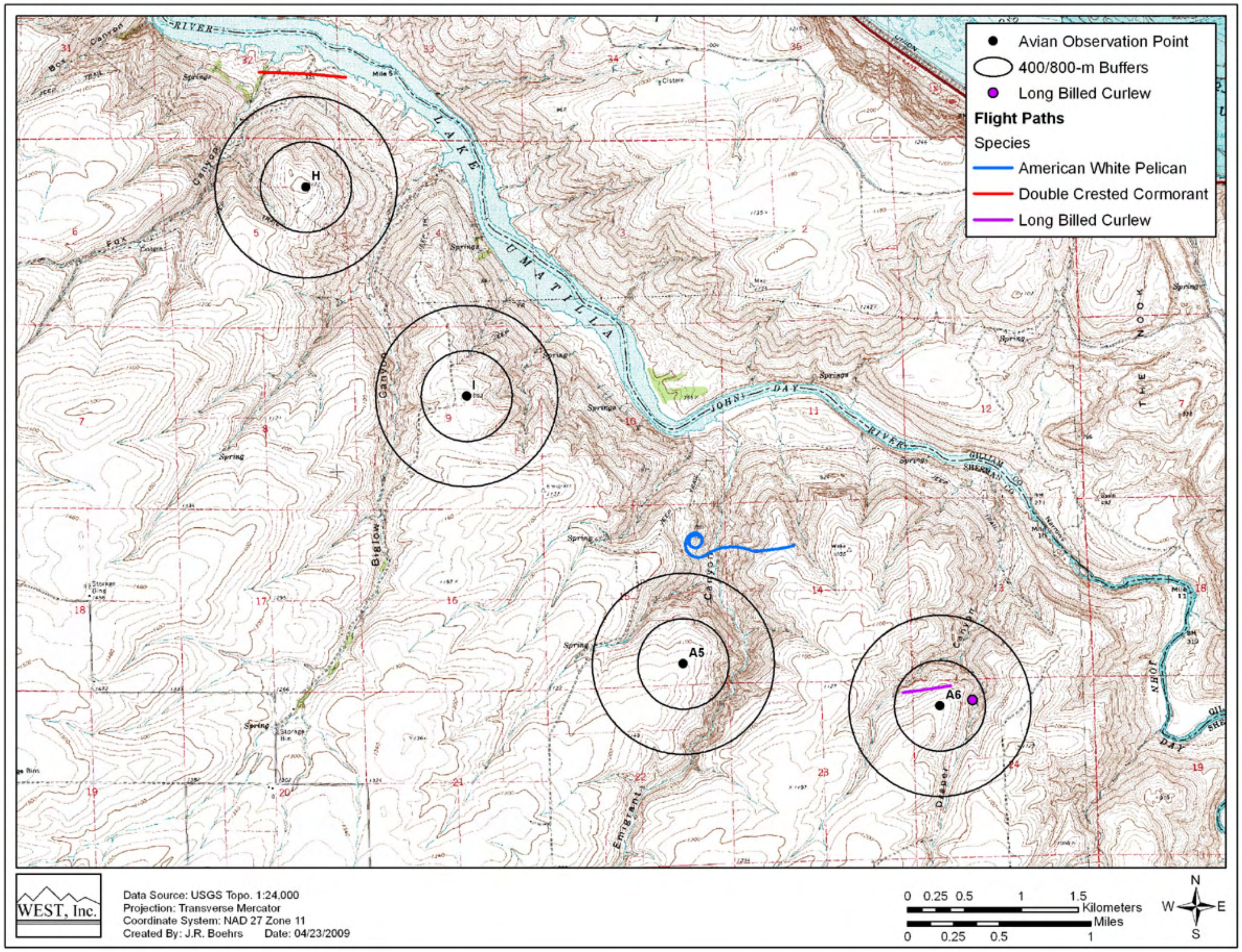


Figure 18a. Mapped flight paths in relation to fixed bird stations (John Day Canyon 800-m) for waterbirds at the Biglow Canyon Wind Farm, Phase I, January 17 through December 18, 2008.

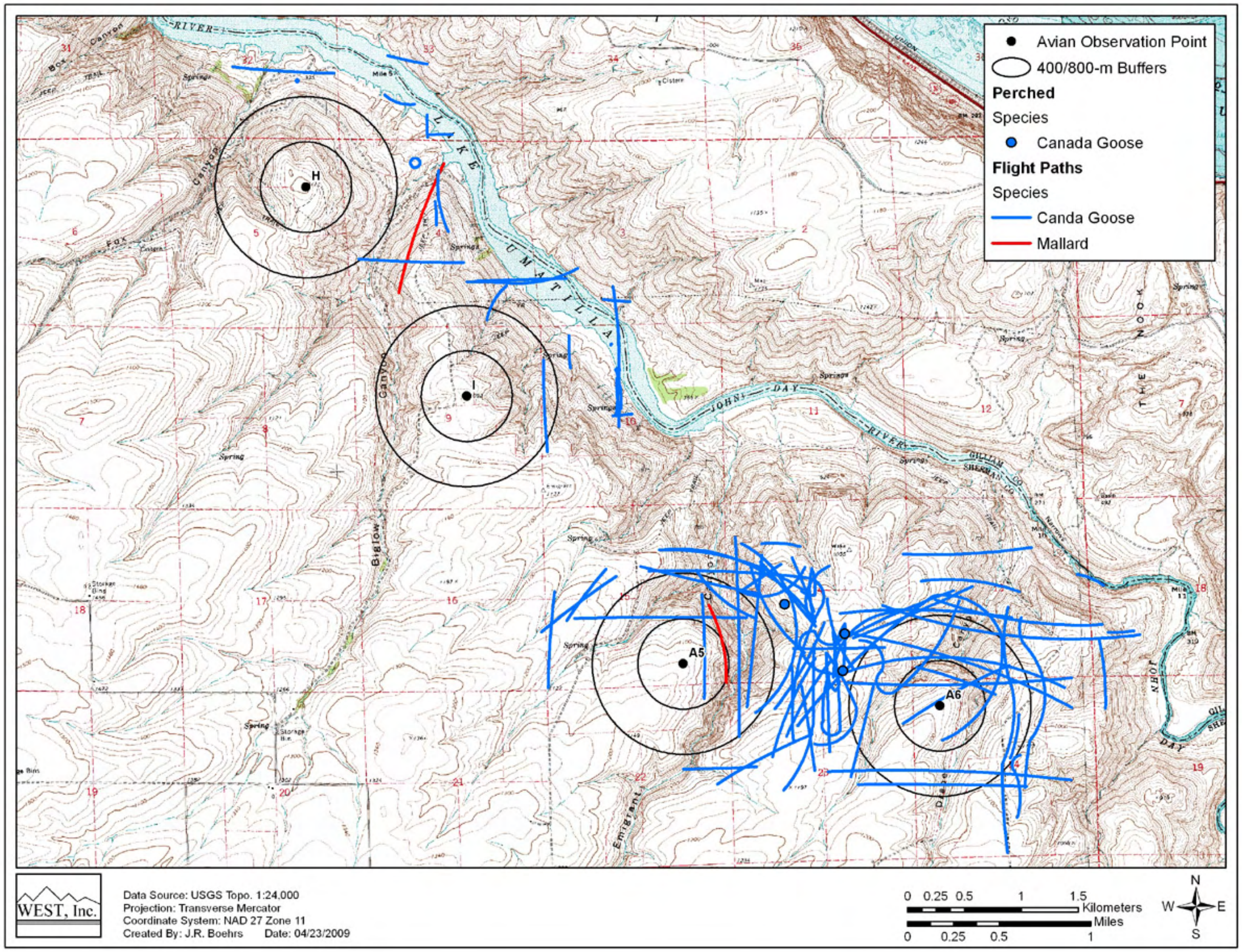


Figure 18b (*continued*). Mapped flight paths in relation to fixed bird stations (John Day Canyon 800-m) for waterfowl at the Biglow Canyon Wind Farm, Phase I, January 17 through December 18, 2008.

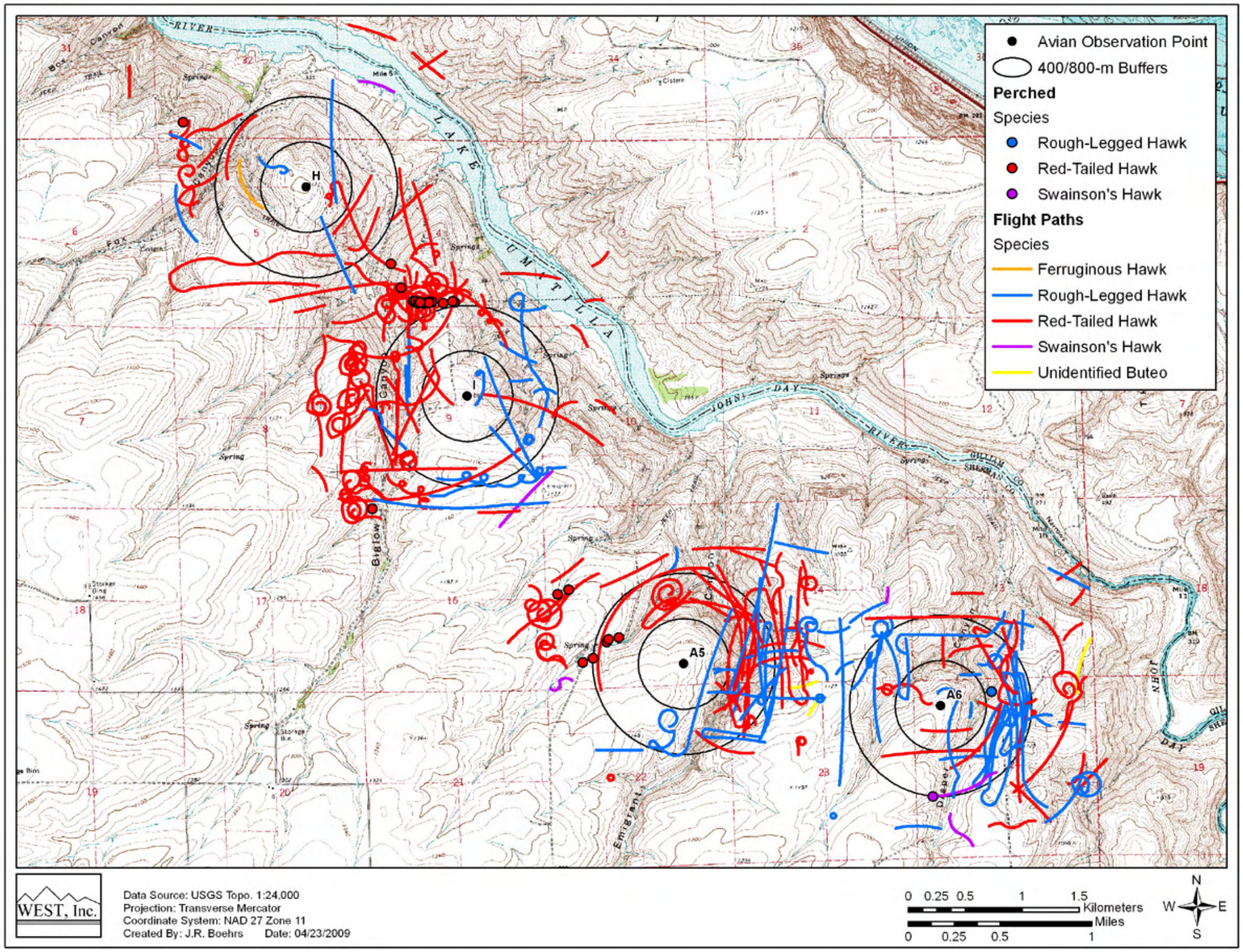


Figure 18c (*continued*). Mapped flight paths in relation to fixed bird stations (John Day Canyon 800-m) for buteos (*Buteo spp*. hawks) at the Biglow Canyon Wind Farm, Phase I, January 17 through December 18, 2008.

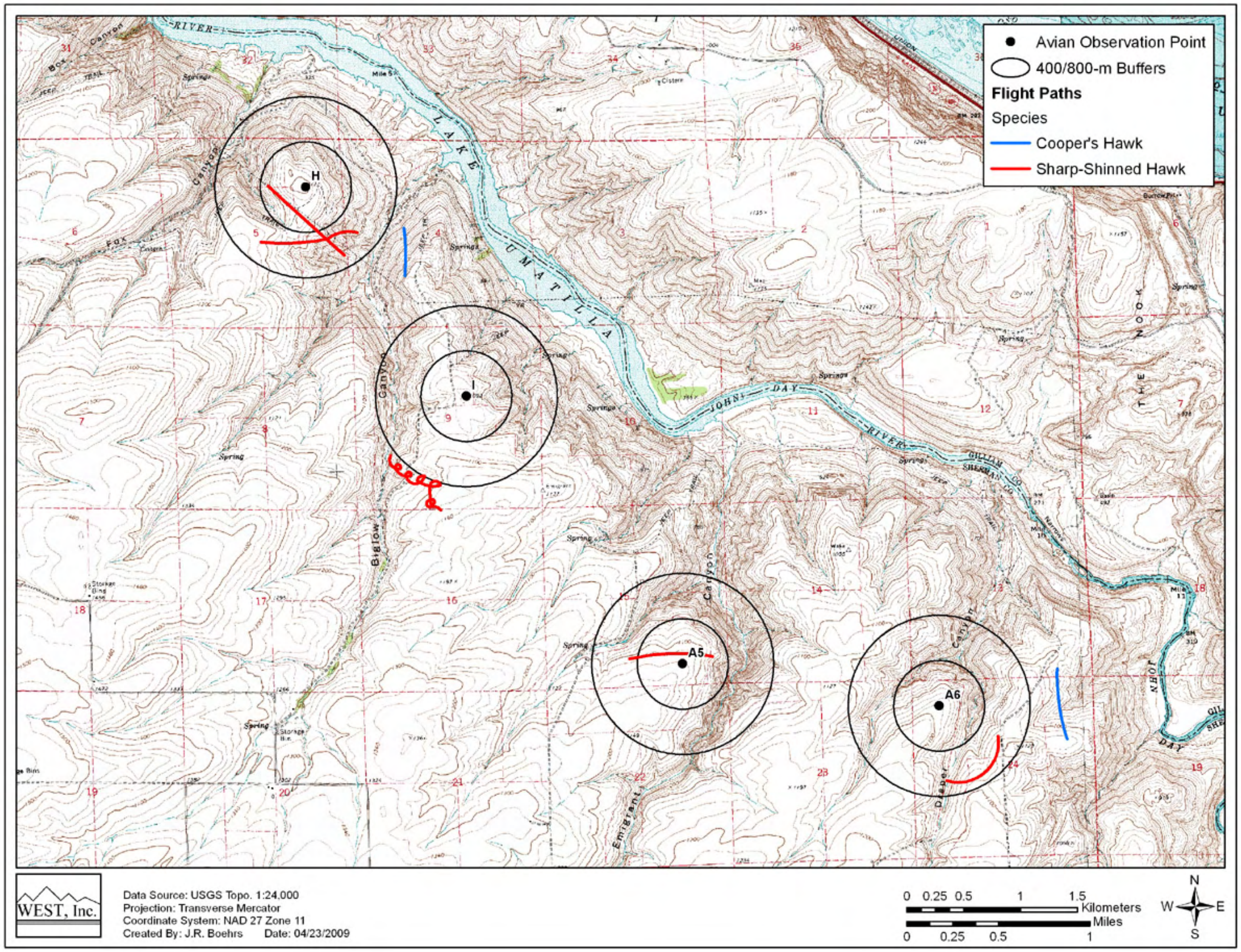


Figure 18d (*continued*). Mapped flight paths in relation to fixed bird stations (John Day Canyon 800-m) for accipiters at the Biglow Canyon Wind Farm, Phase I, January 17 through December 18, 2008.

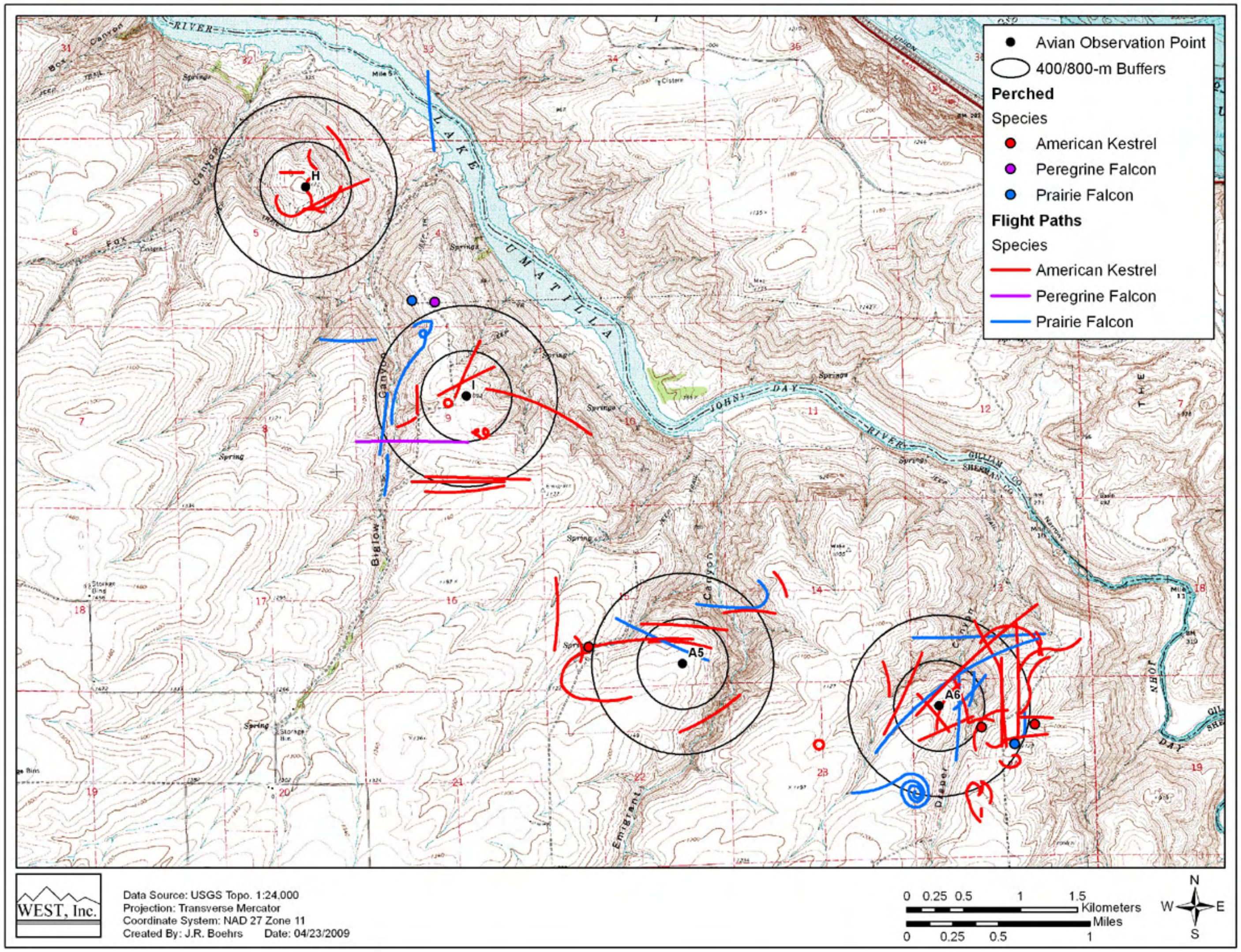


Figure 18e (*continued*). Mapped flight paths in relation to fixed bird stations (John Day Canyon 800-m) for falcons at the Biglow Canyon Wind Farm, Phase I, January 17 through December 18, 2008.

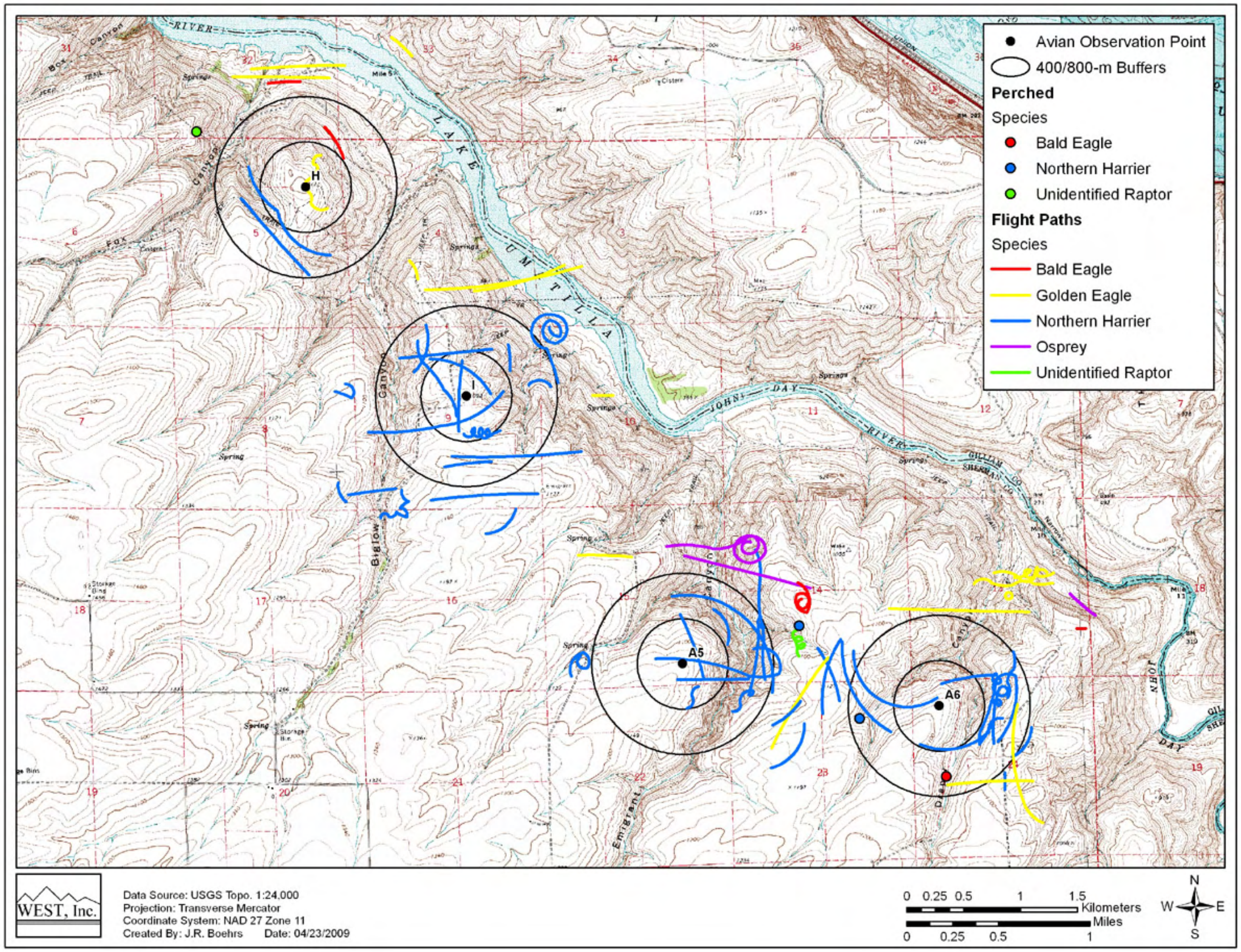


Figure 18f (*continued*). Mapped flight paths in relation to fixed bird stations (John Day Canyon 800-m) for eagles and other raptors at the Biglow Canyon Wind Farm, Phase I, January 17 through December 18, 2008.

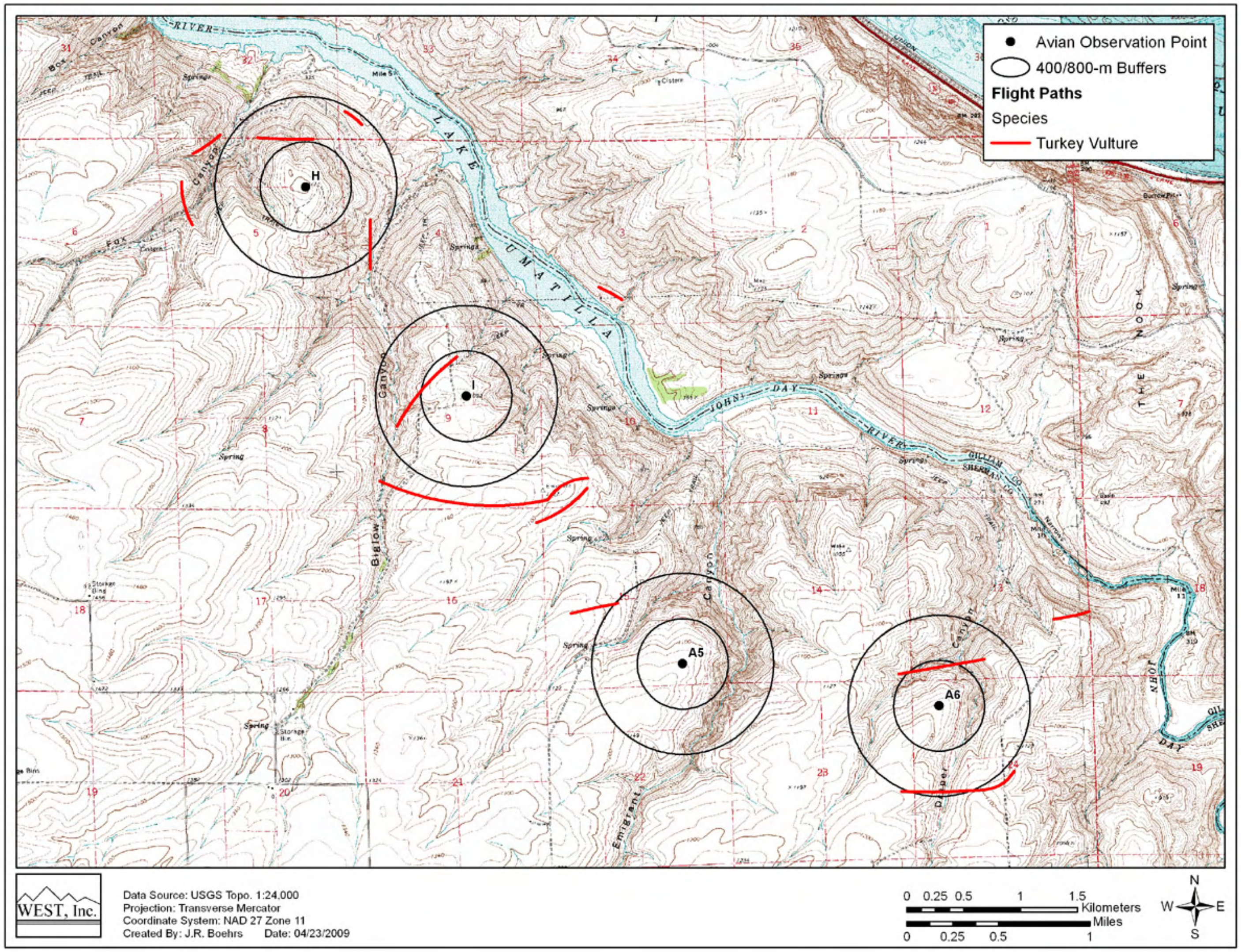


Figure 18g (*continued*). Mapped flight paths in relation to fixed bird stations (John Day Canyon 800-m) for turkey vultures at the Biglow Canyon Wind Farm, Phase I, January 17 through December 18, 2008.

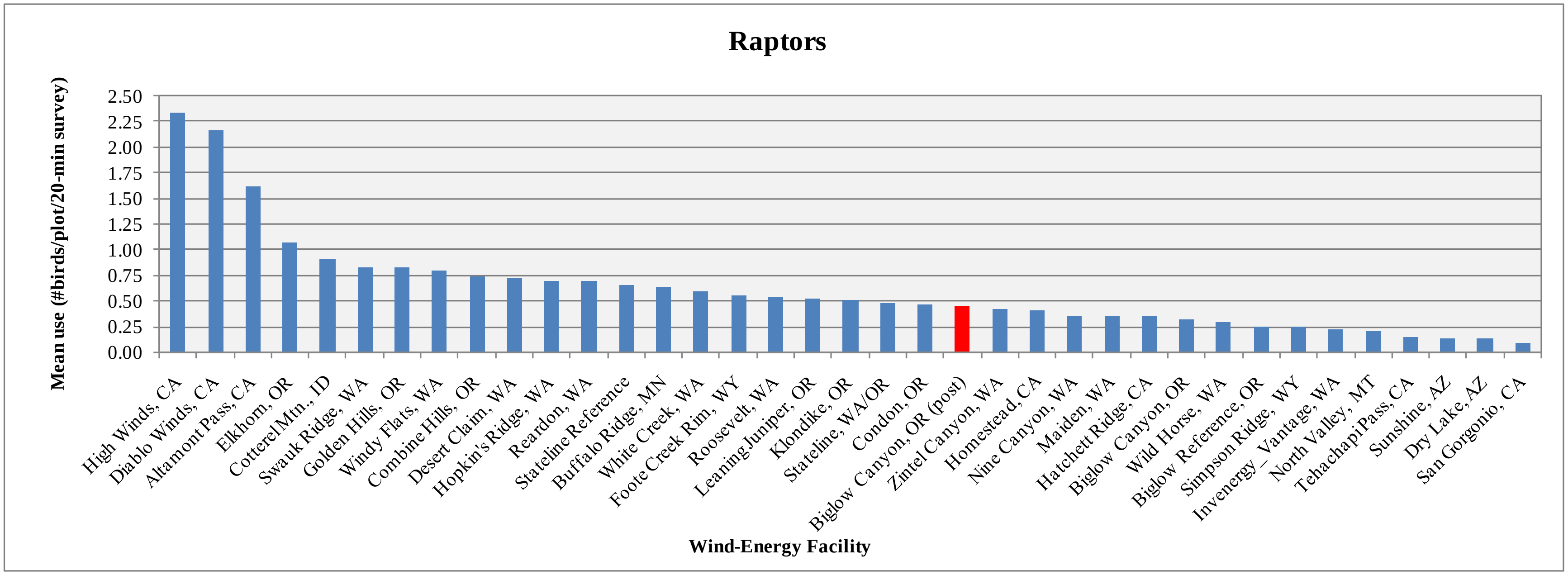
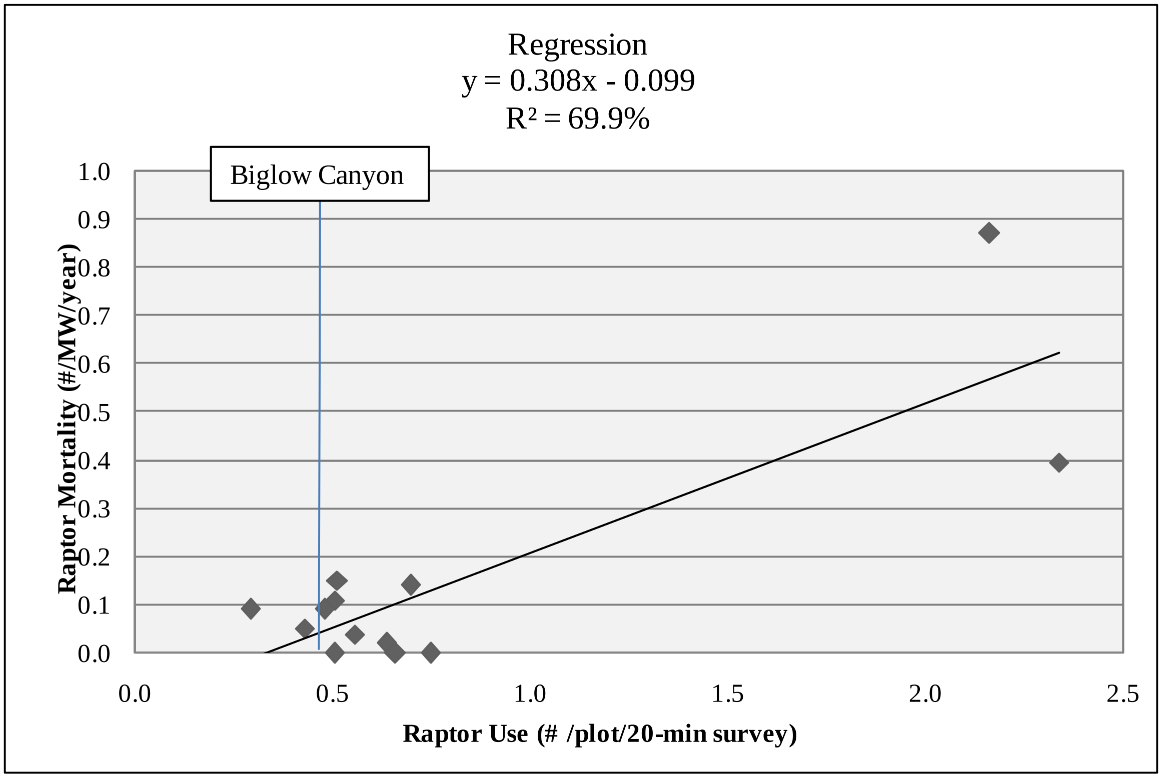


Figure 19. Comparison of annual raptor use between the Biglow Canyon Wind Farm, Phase I and other US wind-energy facilities.

Data from the following sources:

Biglow Canyon, OR (post)	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 2005e
Elkhorn, OR	WEST 2005b	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 2005e
Swauk Ridge, WA	Erickson et al. 2003a	Leaning Juniper, OR	NWC and WEST 2005b	Simpson Ridge, WY	Johnson et al. 2000b
Golden Hills, OR	Jeffrey et al. 2008	Klondike, OR	Johnson et al. 2002a	Invenergy_Vantage, WA	WEST 2007b
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. 2003d	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 2005c	Nine Canyon, WA	Erickson et al. 2001b	San Gorgonio, CA	Erickson et al. 2002b



Biglow Canyon (John Day Canyon study area) Overall Raptor Use 0.45
Predicted Fatality Rate 0.04/MW/year
90.0% Prediction Interval (0, 0.30/MW/year)

Figure 20. Regression analysis comparing raptor use estimations versus estimated raptor mortality.

Data from the following sources:

Study and Location	Raptor Use (birds/plot/ 20-min survey)	Source	Raptor Mortality (fatalities/MW/yr)	Source
Buffalo Ridge, MN	0.64	Erickson et al. 2002b	0.02	Erickson et al. 2002b
Combine Hills, OR	0.75	Young et al. 2003d	0.00	Young et al. 2005
Diablo Winds, CA	2.161	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. 2002a	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

Appendix A. Bird and Bat Casualties Found During the Study at the Biglow Canyon Wind Farm, Phase I.

Sample ID	Date	Species	Turbine	Scheduled Search	Condition
CHUK-070708-01TG	7/7/2008	chukar	28	scheduled search	feather spot
DOWO-082808-01CB	8/28/2008	downy woodpecker	67	scheduled search	intact
GCKI-101308-01TG	10/13/2008	golden-crowned kinglet	65	scheduled search	intact
GCKI-102008-01CB	10/20/2008	golden-crowned kinglet	40	scheduled search	scavenged
GCSP-101608-01CB	10/16/2008	golden-crowned sparrow	15	scheduled search	intact
GRPA-011708-01CB	1/17/2008	gray partridge	11	scheduled search	feather spot
HOLA-041308-01CB	4/13/2008	horned lark	64	scheduled search	feather spot
HOLA-051408-01CB	5/14/2008	horned lark	65	scheduled search	feather spot
HOLA-051408-02CB	5/14/2008	horned lark	64	scheduled search	scavenged
HOLA-052808-01CB	5/28/2008	horned lark	1	scheduled search	feather spot
HOLA-060208-01CB	6/2/2008	horned lark	15	scheduled search	scavenged
HOLA-031908-01CB	3/19/2008	horned lark	61	incidental	dismembered
HOLA-032708-01TG	3/27/2008	horned lark	66	scheduled search	feather spot
HOLA-071808-01TG	7/18/2008	horned lark	67	scheduled search	feather spot
HOLA-090408-01CB	9/4/2008	horned lark	17	scheduled search	feather spot
HOLA-091708-01CB	9/17/2008	horned lark	17	scheduled search	feather spot
HOLA-101908-01CB	10/19/2008	horned lark	47	scheduled search	scavenged
HOLA-122208-01	12/22/2008	horned lark	7	incidental	feather spot
HOLA-020309-01JK	2/3/2009	horned lark	38	incidental	intact
HOLA-020409-01CB	2/4/2009	horned lark	46	scheduled search	intact
HOLA-080408-01CB	8/4/2008	horned lark	O&M building	incidental	scavenged
HOSP-032108-01CB	3/21/2008	house sparrow	O&M building	incidental	injured
HOSP-111208-01CB	11/12/2008	house sparrow	53	incidental	intact
OCWA-090408-01CB	9/4/2008	orange-crowned warbler	17	scheduled search	scavenged
RCKI-101708-01CB	10/17/2008	ruby-crowned kinglet	19	scheduled search	intact
RLHA-032008-01CB	3/20/2008	rough-legged hawk	39	incidental	dismembered
RNPH-040408-01CB	4/4/2008	ring-necked pheasant	47	scheduled search	scavenged
RNPH-042408-01	4/24/2008	ring-necked pheasant	60	incidental	dismembered
RNPH-070108-01TG	7/1/2008	ring-necked pheasant	60	incidental	scavenged
RNPH-070108-02TG	7/1/2008	ring-necked pheasant	59	scheduled search	scavenged
RNPH-090308-01CB	9/3/2008	ring-necked pheasant	57	scheduled search	feather spot
RNPH-101708-01CB	10/17/2008	ring-necked pheasant	34	scheduled search	dismembered
RNPH-081108-01TG	8/11/2008	ring-necked pheasant	47	scheduled search	feather spot

Appendix A. Bird and Bat Casualties Found During the Study at the Biglow Canyon Wind Farm, Phase I.

Sample ID	Date	Species	Turbine	Scheduled Search	Condition
ROPI-041308-01CB	4/13/2008	rock pigeon	64	scheduled search	feather spot
ROPI-120108-01CB	12/1/2008	rock pigeon	34	scheduled search	feather spot
RTHA-042208-01CB	4/22/2008	red-tailed hawk	45	incidental	dismembered
SAVS-090408-01CB	9/4/2008	savannah sparrow	17	scheduled search	intact
SOSP-101708-01CB	10/17/2008	song sparrow	O&M building	incidental	scavenged
TOWA-082808-01CB	8/28/2008	Townsend's warbler	76	scheduled search	scavenged
TOWA-090808-01CB	9/8/2008	Townsend's warbler	45	scheduled search	scavenged
UNPA-050808-01CB	5/8/2008	unidentified bird	76	scheduled search	feather spot
UNID-080408-01CB	8/4/2008	unidentified passerine	15	scheduled search	dismembered
WCSP-041608-01CB	4/16/2008	white-crowned sparrow	19	scheduled search	intact
WEME-041008-01TG	4/10/2008	western meadowlark	67	scheduled search	intact
WEME-112408-01CB	11/24/2008	western meadowlark	56	scheduled search	scavenged
HOBA-061708-01TG	6/17/2008	hoary bat	6	incidental	intact
HOBA-082308-01TG	8/23/2008	hoary bat	35	scheduled search	intact
HOBA-082408-01CB	8/24/2008	hoary bat	36	scheduled search	intact
HOBA-082508-01CB	8/25/2008	hoary bat	40	scheduled search	dismembered
HOBA-082508-02CB	8/25/2008	hoary bat	42	scheduled search	intact
HOBA-082608-01CB	8/26/2008	hoary bat	49	scheduled search	scavenged
HOBA-082708-01TG	8/27/2008	hoary bat	69	scheduled search	intact
HOBA-090208-01TG	9/2/2008	hoary bat	62	scheduled search	intact
HOBA-090908-01CB	9/9/2008	hoary bat	32	incidental	intact
HOBA-091008-01TG	9/10/2008	hoary bat	68	scheduled search	intact
HOBA-091008-02TG	9/10/2008	hoary bat	76	scheduled search	intact
HOBA-091008-03TG	9/10/2008	hoary bat	75	scheduled search	intact
HOBA-091108-01CB	9/11/2008	hoary bat	11	scheduled search	intact
HOBA-091608-01CB	9/16/2008	hoary bat	55	scheduled search	scavenged
HOBA-091608-02CB	9/16/2008	hoary bat	56	scheduled search	intact
HOBA-091908-01CB	9/19/2008	hoary bat	36	scheduled search	scavenged
HOBA-092508-01TG	9/25/2008	hoary bat	9	scheduled search	intact
HOBA-092508-01CB	9/25/2008	hoary bat	8	incidental	scavenged
HOBA-100208-01CB	10/2/2008	hoary bat	19	scheduled search	scavenged
HOBA-100308-01CB	10/3/2008	hoary bat	29	scheduled search	intact
HOBA-100308-02CB	10/3/2008	hoary bat	31	incidental	intact

Appendix A. Bird and Bat Casualties Found During the Study at the Biglow Canyon Wind Farm, Phase I.

Sample ID	Date	Species	Turbine	Scheduled Search	Condition
HOBA-101308-01TG	10/13/2008	hoary bat	65	scheduled search	intact
HOBA-101408-01TG	10/14/2008	hoary bat	61	scheduled search	intact
HOBA-101708-01CB	10/17/2008	hoary bat	28	scheduled search	intact
HOBA-082208-01TG	8/22/2008	hoary bat	21	scheduled search	intact
SHBA-042908-01TG	4/29/2008	silver-haired bat	22	incidental	intact
SHBA-051608-01CB	5/16/2008	silver-haired bat	15	scheduled search	intact
SHBA-062308-01	6/23/2008	silver-haired bat	3	incidental	scavenged
SHBA-090608-01CB	9/6/2008	silver-haired bat	36	scheduled search	intact
SHBA-090708-01CB	9/7/2008	silver-haired bat	47	scheduled search	intact
SHBA-090708-02CB	9/7/2008	silver-haired bat	40	scheduled search	intact
SHBA-090808-01TG	9/8/2008	silver-haired bat	42	scheduled search	intact
SHBA-090808-02CB	9/8/2008	silver-haired bat	43	scheduled search	scavenged
SHBA-090908-01CB	9/9/2008	silver-haired bat	69	scheduled search	intact
SHBA-090908-02CB	9/9/2008	silver-haired bat	31	incidental	scavenged
SHBA-091008-01CB	9/10/2008	silver-haired bat	67	scheduled search	scavenged
SHBA-091008-02CB	9/10/2008	silver-haired bat	67	scheduled search	intact
SHBA-091008-03TG	9/10/2008	silver-haired bat	74	scheduled search	scavenged
SHBA-091008-04CB	9/10/2008	silver-haired bat	74	scheduled search	scavenged
SHBA-091608-01TG	9/16/2008	silver-haired bat	58	scheduled search	intact
SHBA-091808-01TG	9/18/2008	silver-haired bat	23	scheduled search	dismembered
SHBA-091908-01CB	9/19/2008	silver-haired bat	35	scheduled search	intact
SHBA-091908-02CB	9/19/2008	silver-haired bat	36	scheduled search	intact
SHBA-091008-05CB	9/10/2008	silver-haired bat	70	incidental	scavenged
SHBA-092308-01CB	9/23/2008	silver-haired bat	54	incidental	intact
SHBA-100908-01CB	10/9/2008	silver-haired bat	21	incidental	scavenged
SHBA-101608-02TG	10/16/2008	silver-haired bat	62	incidental	intact
SHBA-101608-01TG	10/16/2008	silver-haired bat	59	scheduled search	scavenged
SHBA-081908-01TG	8/19/2008	silver-haired bat	2	scheduled search	intact
SHBA-082108-01TG	8/21/2008	silver-haired bat	58	scheduled search	scavenged

Appendix B. Incidental Wildlife Observations at the Biglow Canyon Wind Farm, Phase I.

Date	Species	No.	Distance	Location	Notes
1/10/2008	white-tailed jack rabbit	1	2	686862/5058103	72 M FROM 67/BURROW
1/18/2008	white-tailed jack rabbit	1	50	686843/5057729	110 M FROM 68
1/24/2008	great-horned owl	1	20	688676/5058757	NW
1/30/2008	Cooper's hawk	1	50	688213/5057965	E
1/31/2008	great-horned owl	1	20	688680/5058947	WEST
2/14/2008	rough-legged hawk	1	50	684124/5058880	WEST; NEAR TURBINES
2/21/2008	northern shrike	1	45	685613/5060865	10 M BEFORE HELMS RD
2/22/2008	great-horned owl	1	75	688029/5057769	.25 M E FROM BIGLOW/HERIM LN INTERSECTION; ON EGGS IN HISTORIC RTHA STICK NEST, 8 M UP IN DETR
2/26/2008	golden eagle	1	220	TURBINE 58	TURBINE RD 14-T 58
2/29/2008	red-tailed hawk	2	74		.12 M FROM BIGLOW/HERIN LN INTERSECTION; MALE AND FEMALE TOGETHER;
2/29/2008	pronghorn	7	200	686932/5056887	FEEDING; AAAA=PRON
3/4/2008	white-tailed jack rabbit	1	100	T 45	SITTING; FOUND BY TARA GRAHAM
3/4/2008	white-tailed jack rabbit	1	32	T46	SITTING; FOUND BY TARA GRAHAM
3/4/2008	white-tailed jack rabbit	1	25	T 46	SITTING; FOUND BY TARA GRAHAM
3/13/2008	white-tailed jack rabbit	1	45	67	95 M E OF T 67
3/26/2008	golden eagle	1	70		ROAD TO T'S 40-46 ON TOP OF RIDGE
3/26/2008	rough-legged hawk	1	70		ROAD TO T'S 40-46 ON TOP OF RIDGE
3/26/2008	red-tailed hawk	2	73	T 40	OVER T 40
4/2/2008	red-tailed hawk	2	350	0687702/5057364	260 DEG FROM UTMS; MALE AND FEMALE IN NEST
4/4/2008	prairie falcon	1	32	0687595/5057793	FLEW FAST N
4/13/2008	prairie falcon	1	150	T64	STOOPED ON HOLA
4/13/2008	sandhill crane	2	500	T63	
4/21/2008	white-tailed jack rabbit	2	30	HERIN RD T14	
4/21/2008	mule deer	4	450	T44	
5/2/2008	red-tailed hawk	1	300	T34	
5/2/2008	mule deer	4	200	T28	
5/5/2008	red-tailed hawk	2	470	0685678/5060995	
5/5/2008	northern harrier	1	20	685128/5062431	

Appendix B. Incidental Wildlife Observations at the Biglow Canyon Wind Farm, Phase I.

Date	Species	No.	Distance	Location	Notes
5/5/2008	red-tailed hawk	1	37	685204/5058809	
5/14/2008	northern harrier	1	62		306M S OF HELMS/FOX RD
5/14/2008	mule deer	5	205		306M S OF HELMS/FOX RD
5/15/2008	rattlesnake	1	2	T57	WESTERN RATTLESNAKE
5/15/2008	mule deer	10	450	T55	
5/16/2008	gopher snake	1	2		
5/16/2008	gopher snake	1	2		200 M FROM COLLAPSED BARN
5/16/2008	mule deer	12	123		1000M S OF PT
5/16/2008	mule deer	2	30	0686173-5054242	MOVING WEST ON KLONDIKE RD
5/17/2008	white-tailed jack rabbit	2	4	T21	62 M FROM T 21
5/18/2008	white-tailed jack rabbit	1	7	T23	
5/19/2008	gopher snake	1	0	T31	
5/21/2008	mule deer	10	50	0686941/5060625	
5/22/2008	American kestrel	1	75	ST 5	200 M N OF A-5
5/27/2008	mule deer	1	300	E OF T 76 &75	
5/29/2008	mule deer	1	40	E T65	
5/30/2008	mule deer	1	500	S T58	
6/3/2008	white-tailed jack rabbit	5	36		SITTING; 5 WTJR, 1 AD, 4 JUV + 1 DEAD AD
6/4/2008	mule deer	1	110	ET28	
6/4/2008	mule deer	1	20	0686804/5057895	
6/10/2008	mule deer	2	76		204DEG FROM T25
6/11/2008	American kestrel	1	100		FEMALE
6/13/2008	red-tailed hawk	1	150	CORNER OF BEACON RD	
6/13/2008	mule deer	1	107	T46/45	
6/13/2008	white-tailed jack rabbit	1	150	T49	
6/13/2008	mule deer	1	400	.25M S OF BIGLOW RD	FEEDING
6/14/2008	northern harrier	2	212	BIGLOW RD/ HERIN RD	
6/18/2008	mule deer	1	100	S T 44	
6/18/2008	mule deer	0	1	0686972/506742	YOUNG FAWN DEAD
6/18/2008	white-tailed jack rabbit	1	20	0686967/5060625	
6/18/2008	mule deer	5	215	E END OF EMIG. SPGS RD	RESTING

Appendix B. Incidental Wildlife Observations at the Biglow Canyon Wind Farm, Phase I.

Date	Species	No.	Distance	Location	Notes
6/19/2008	mule deer	8	90	E END OF EMIGRANT SPGS RD	MALES
6/23/2008	pronghorn	2	700	SW OF T66	
6/25/2008	white-tailed jack rabbit	1	1	AT BASE T1	BASKING IN GRAVEL
6/25/2008	mule deer	1	500	DUE N OF O&M OFFICE	
6/25/2008	white-tailed jack rabbit	1	10	60M W OF T65	I FLUSHED IT OUT AS I WALKED BY
6/26/2008	white-tailed jack rabbit	1	15	100M E T64	SITTING
6/27/2008	ring-necked pheasant	1	150	250M SE OF T68	FEMALE FLUSHED OUT AS I WALKED BY
6/27/2008	mule deer	4	350	NW OF T55	
6/30/2008	mule deer	5	150	250M SE OF T68	
6/30/2008	mule deer	3	150	250M SE OF T68	RESTING
6/30/2008	coyote	1	50	CORNER OF BIGLOW AND HERIN RD	MOVING N
7/1/2008	racer	1	1	0688203/5059924	BASKING IN GRAVEL; ON RD BY T-59
7/1/2008	white-tailed jack rabbit	0	1	0686271/5059581	DEAD ON ROAD BY T51; BROKEN FOOT
7/7/2008	northern harrier	1	15	30M NW OF T50	TOOK OFF IN FLIGHT AS I DROVE BY
7/8/2008	great-horned owl	2	25	588512/5058314	
7/11/2008	mule deer	1	50	0686946/5060703	
7/11/2008	mule deer	1	50	0686946/5060703	
7/11/2008	mule deer	5	200	300M SE OF T44	
7/18/2008	ring-necked pheasant	1	15	0686860/5057696	
7/18/2008	ring-necked pheasant	1	15	0686860/5057696	
7/23/2008	gopher snake	0	2	15M NW OF POND BY OFFICE	DEAD ON HERIN RD
7/24/2008	loggerhead shrike	1	15	693438/5056580	
7/24/2008	red-tailed hawk	1	100	692565/5056073	
7/24/2008	nest	0	125	687743/5062197	STICK NEST; SOUTH OF TRANS TOWER
7/28/2008	mule deer	14	1000	200M S OF HERIN RD AND RD 14	
8/1/2008	ring-necked pheasant	1	1	50M NE OF T59	FLUSHED OUT
8/1/2008	unidentified mouse	0	1	6M SW OF T59	DEAD
8/11/2008	ring-necked pheasant	1	5	115M E OF T39	FLUSHED OUT

Appendix B. Incidental Wildlife Observations at the Biglow Canyon Wind Farm, Phase I.

Date	Species	No.	Distance	Location	Notes
8/14/2008	white-tailed jack rabbit	1	15	80M SW OF T67	FLUSHED OUT
8/15/2008	white-tailed jack rabbit	1	5	20M S OF T73	FLUSHED OUT
8/19/2008	white-tailed jack rabbit	1	20	150M SW OF T65	FLUSHED OUT
8/20/2008	gopher snake	1	0	T61	BASKING
8/21/2008	mule deer	5	800	T57	
8/21/2008	white-tailed jack rabbit	1	61	T59	
8/22/2008	mule deer	7	230	HELMS LANE	FEEDING
8/23/2008	mule deer	4	100	135M SE OF T28	
8/23/2008	mule deer	12	85	120 DEG FROM T23	CB
8/26/2008	mule deer	17	759	187 DEG T46	FEEDING
8/28/2008	white-tailed jack rabbit	1	16	24M S OF T66	FLUSHED OUT
8/29/2008	white-tailed jack rabbit	1	37	183DEG T7, 63M	FLUSHED
9/1/2008	mule deer	5	121	121M E T65	FEEDING MOVED E
9/3/2008	prairie falcon	1	211	17/18	
9/3/2008	mule deer	9	800	270DEG FROM T56	FEEDING
9/3/2008	coyote	1	51	800E OF HERIN/BIGLOW CORNER	
9/3/2008	coyote	1	103	600M NW OF A5	
9/4/2008	sharp-shinned hawk	1	36	600M E OF HERIN/BIGLOW	
9/4/2008	American kestrel	1	83	AT END OF EMIGRANT SPRINGS	
9/4/2008	white-tailed jack rabbit	1	5	130M SW OF T15	HIDING; FLUSHED OUT RAN N
9/4/2008	mule deer	8	115	1000M S A6	
9/9/2008	mule deer	5	431	35DEG NE OF T49	FEEDING
9/10/2008	white-tailed jack rabbit	1	3	73 M SE OF T67	FLUSHED OUT
9/10/2008	white-tailed jack rabbit	1	10	75M NW OF T74	FLUSHED OUT
9/10/2008	coyote	1	475	89 DEG FROM T68	VOCAL
9/11/2008	mule deer	3	450	27DEG T7	FEEDING
9/16/2008	coyote	1	2000	T56	VOCAL
9/17/2008	red-tailed hawk	2	32	N OF WIER RD	
9/17/2008	red-tailed hawk	1	20	5 MI E OF WIER RD	

Appendix B. Incidental Wildlife Observations at the Biglow Canyon Wind Farm, Phase I.

Date	Species	No.	Distance	Location	Notes
9/17/2008	pronghorn	6	312	75MI N OF EMIGRANT RD	FEEDING
9/17/2008	white-tailed jack rabbit	1	5	25M NW OF T15	FLUSHED OUT RAN E
9/21/2008	merlin	1	2	50M W ON HERIN RD	
9/22/2008	white-tailed jack rabbit	1	15	25M S OF T45	FLUSHED OUT, RAN N
9/23/2008	prairie falcon	1	36	2ND UTILITY POLE FROM HOUSE ON N END OF WIER RD	
9/23/2008	red-tailed hawk	1	101	25M FROM W END OF EMIGRANT RD	
9/23/2008	red-tailed hawk	1	17	T46	HIDING
9/23/2008	mule deer	5	146	1M E OF OM ON BIGLOW RD	
9/23/2008	mule deer	5	241	25M N OF EMIGRANT	
9/23/2008	mule deer	3	211	250M N T47	FEEDING
9/23/2008	mule deer	3	800	321 DEG T51	FEEDING
9/24/2008	red-tailed hawk	2	27	25M N OF EMIGRANT SPGS RD ON WIER RD	
9/24/2008	red-tailed hawk	2	67		.25 MILES N OF EMIGRANT RD ON WIER RD
9/26/2008	mule deer	3	120	300M SE OF T66	
9/26/2008	western toad	1	1	SW T65	WESTERN TOAD HOPPING
9/29/2008	mule deer	3	250	250M W OF T64	
9/29/2008	white-tailed jack rabbit	1	6	30M SW OF T62	FLUSHED OUT
9/30/2008	gopher snake	1	1	130M NW OF T60	BASKING
9/30/2008	coyote	2	1700	1700M NE OF T61	
9/30/2008	mule deer	2	100	150M W OF T60	
10/1/2008	white-tailed jack rabbit	1	5	20M SW OF T13	
10/1/2008	mule deer	1	400	167 DEG FROM T59	FEEDING
10/4/2008	gopher snake	1	0	56M NW OF T39	RESTING
10/5/2008	mule deer	10	960	197 DEG FROM T42	
10/6/2008	white-tailed jack rabbit	1	1	8M SW OF T45	SITTING
10/6/2008	mule deer	1	500	500M SE OFT46	
10/6/2008	white-tailed jack rabbit	1	1	88M SW OF T46	

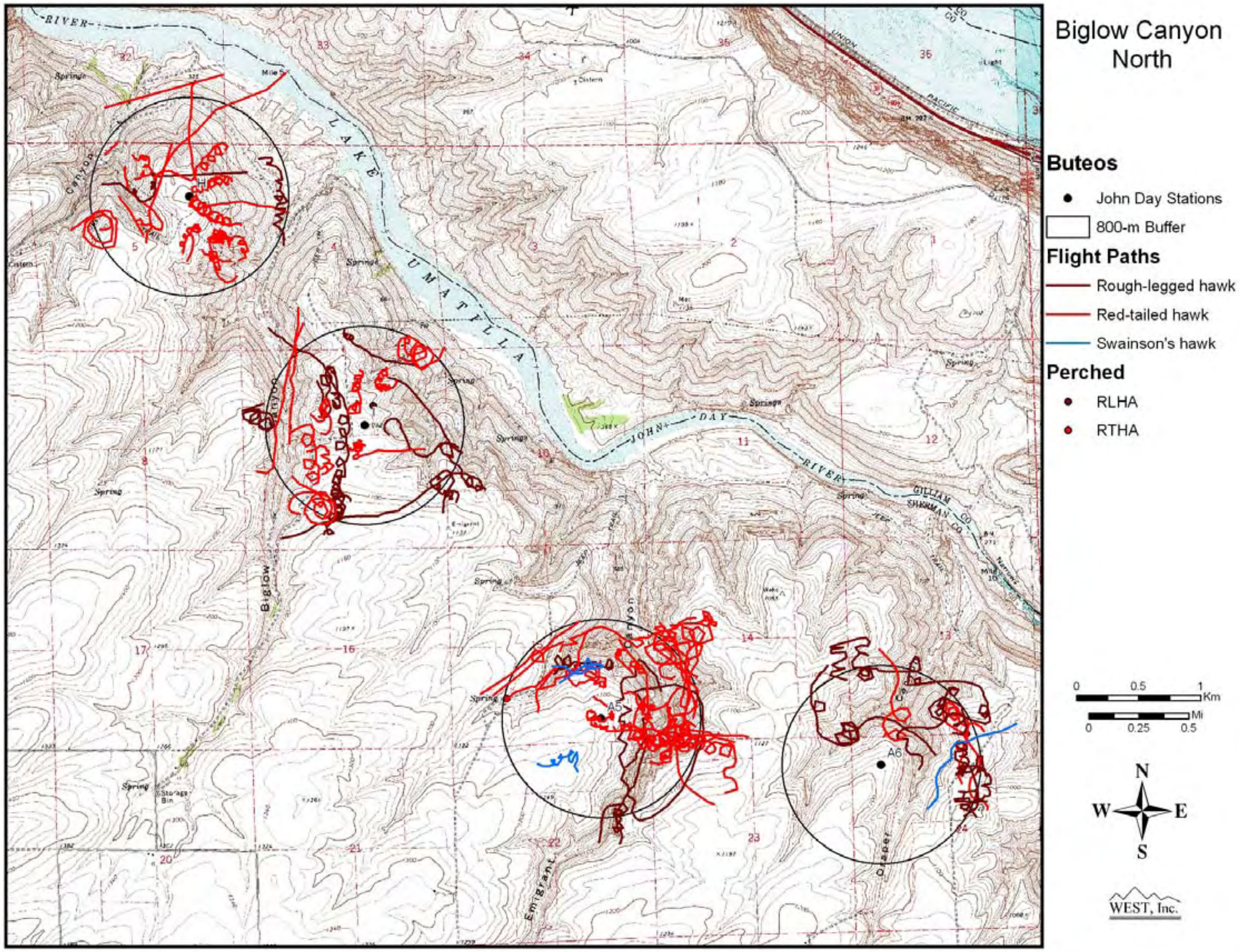
Appendix B. Incidental Wildlife Observations at the Biglow Canyon Wind Farm, Phase I.

Date	Species	No.	Distance	Location	Notes
10/8/2008	American kestrel	1	19		AT RAYBURN
10/8/2008	American kestrel	1	17	UTILITY WIRE	
10/13/2008	gopher snake	1	1	95M N, NE OF T64	BASKING
10/13/2008	mule deer	6	200	500M W OF T34	
10/14/2008	chipping sparrow	12	12	121M N OF T40	
10/14/2008	golden-crowned kinglet	9	12	121M N OF T40	
10/14/2008	yellow-rumped warbler	4	12	121M N OF T40	
10/14/2008	savannah sparrow	1	12	121M N OF T40	
10/14/2008	American pipit	7	12	121M N OF T40	
10/14/2008	house finch	12	12	121M N OF T40	
10/14/2008	American goldfinch	15	12	121M N OF T40	
10/14/2008	dark-eyed junco	11	12	121M N OF T40	
10/14/2008	red-tailed hawk	1	56		
10/14/2008	mule deer	4	1000	1000M NW OF T62	STANDING
10/15/2008	prairie falcon	1	75	450M E T59	
10/15/2008	great-horned owl	1	137		.25 MILES S OF HERIN/BIGLOW CORNER
10/15/2008	mule deer	6	900	900M NW OF T57	
10/20/2008	white-tailed jack rabbit	1	7	BASE OF T45	
10/22/2008	northern harrier	1	46	.25 MILES W OF EMIGRANT	
10/22/2008	northern harrier	1	96	25MILES W OF EMIGRANT RD	
10/22/2008	mule deer	2	150	100M E T8	RAN E
10/29/2008	red-tailed hawk	1	120	25M E BIGLOW/ HERIN	
10/29/2008	rough-legged hawk	1	200	EIGRANT SPGS	
10/30/2008	northern harrier	1	20	200M SE OF T34	
11/8/2008	mountain bluebird	1	46	126M AT 46 DEG T40	
11/8/2008	sharp-shinned hawk	1	103	161M AT 52 DEG T40	
11/8/2008	prairie falcon	1	23	50M W OF WEIR RD ON EMIGRANT SPGS	
11/12/2008	gopher snake	1	0	24M FROM T63	SUN
11/12/2008	white-tailed jack rabbit	1	21	43 DEG AT 96M FROM T41	

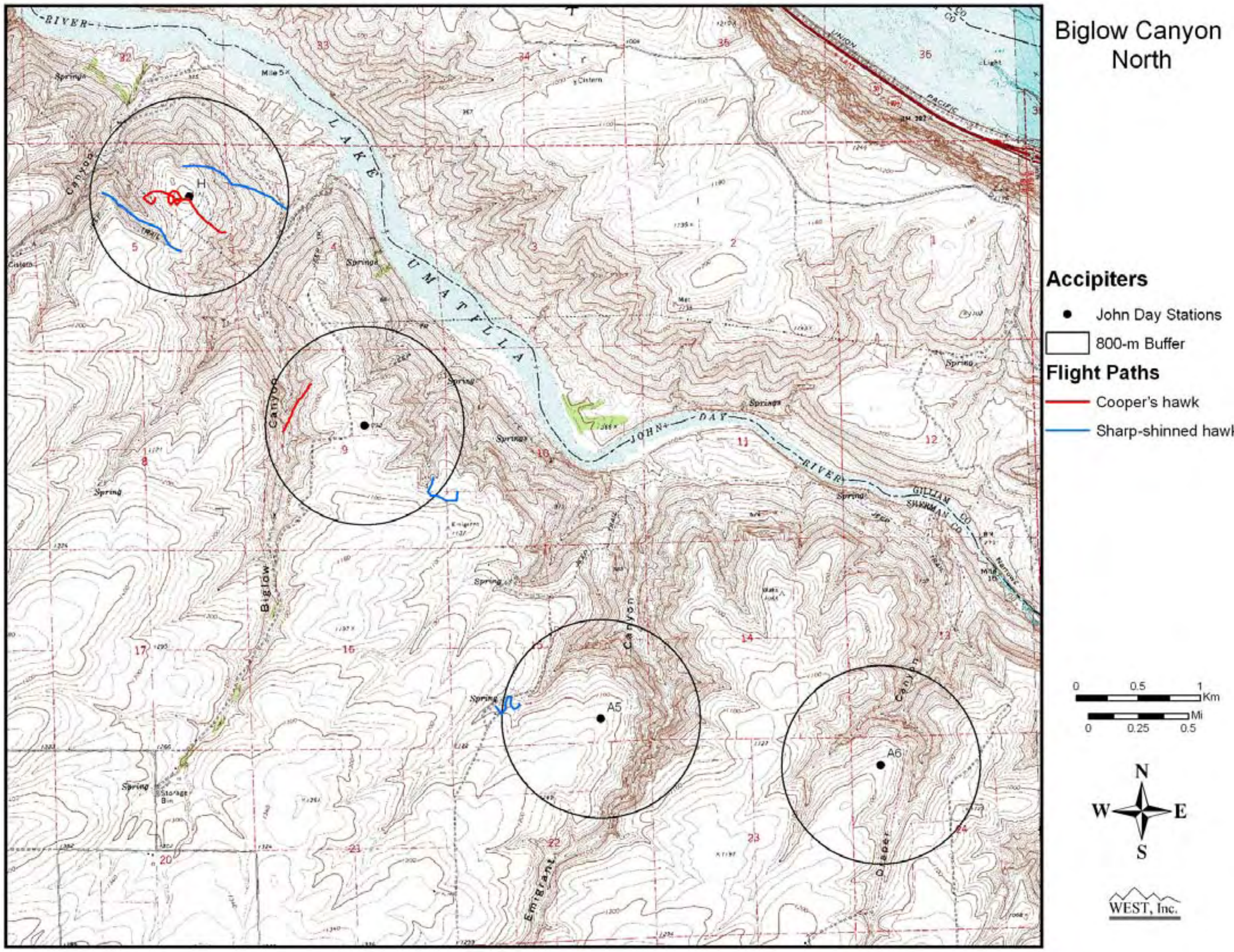
Appendix B. Incidental Wildlife Observations at the Biglow Canyon Wind Farm, Phase I.

Date	Species	No.	Distance	Location	Notes
11/14/2008	red-tailed hawk	1	50	150M N OF BEACON RD	
11/14/2008	red-tailed hawk	1	20	200M N OF EMIGRANT ON WEIR RD	
11/15/2008	red-tailed hawk	1	270	270M S OF T45	
11/15/2008	red-tailed hawk	1	110	HERIN/BIGLOW CORNER	
12/1/2008	coyote	1	20	300M NE OF T17	CROSSING HERIN RD MOVING S
12/2/2008	mule deer	0	1	100M E OF T28	DEAD MALE AT BOTTOM OF DRAW, COMPLETELY SCAVENGED
12/8/2008	mule deer	0	10	70M SE OF T42	DEAD MALE; FRESHLY KILLED (<1 WEEK)
12/9/2008	deer mouse	0	1	35M NE OF T45	DEAD; SKULL EXPOSED
1/26/2009	northern shrike	1	61	180DEG FROM T35 700M	
1/27/2009	rough-legged hawk	1	364	78 DEG FROM T5	
1/29/2009	golden eagle	1	350	275 DEG FROM T25	
1/29/2009	pronghorn	4	900	T-20, 900M W	
1/30/2009	Canada goose	43	500	T28 500M N	
1/30/2009	coyote	2	400	T29 1000M E	VOCAL
2/2/2009	rough-legged hawk	1	50	T36 120M S	
2/4/2009	coyote	2		T69 150M S	
2/9/2009	northern harrier	1	196	98DEG FROM T58	
2/9/2009	mule deer	4	246	360M N OF T59	

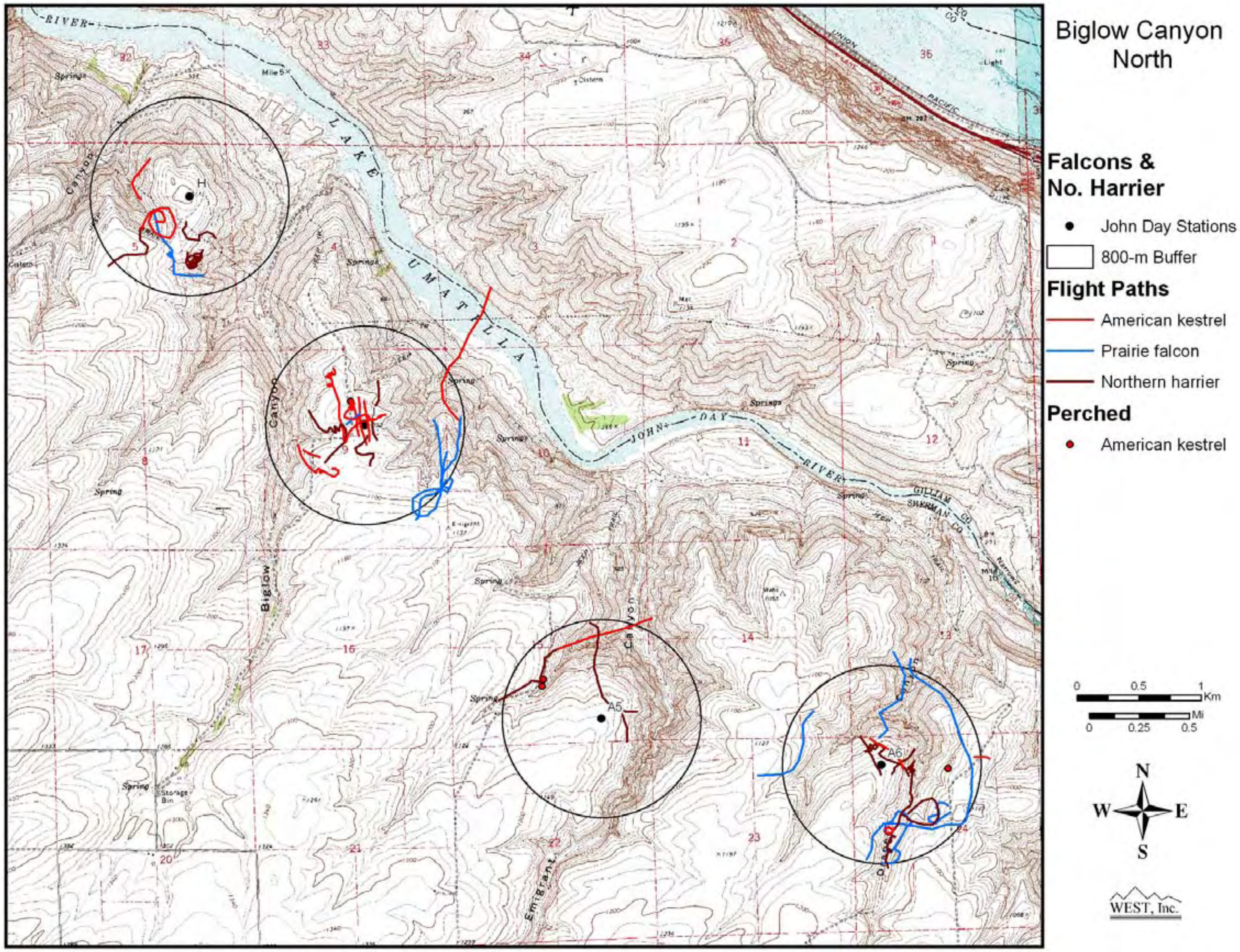
Appendix C. Pre-construction John Day Canyon 800-m fixed point bird survey flight paths, September 2005 – August 2006 (WEST 2005a, 2007a).



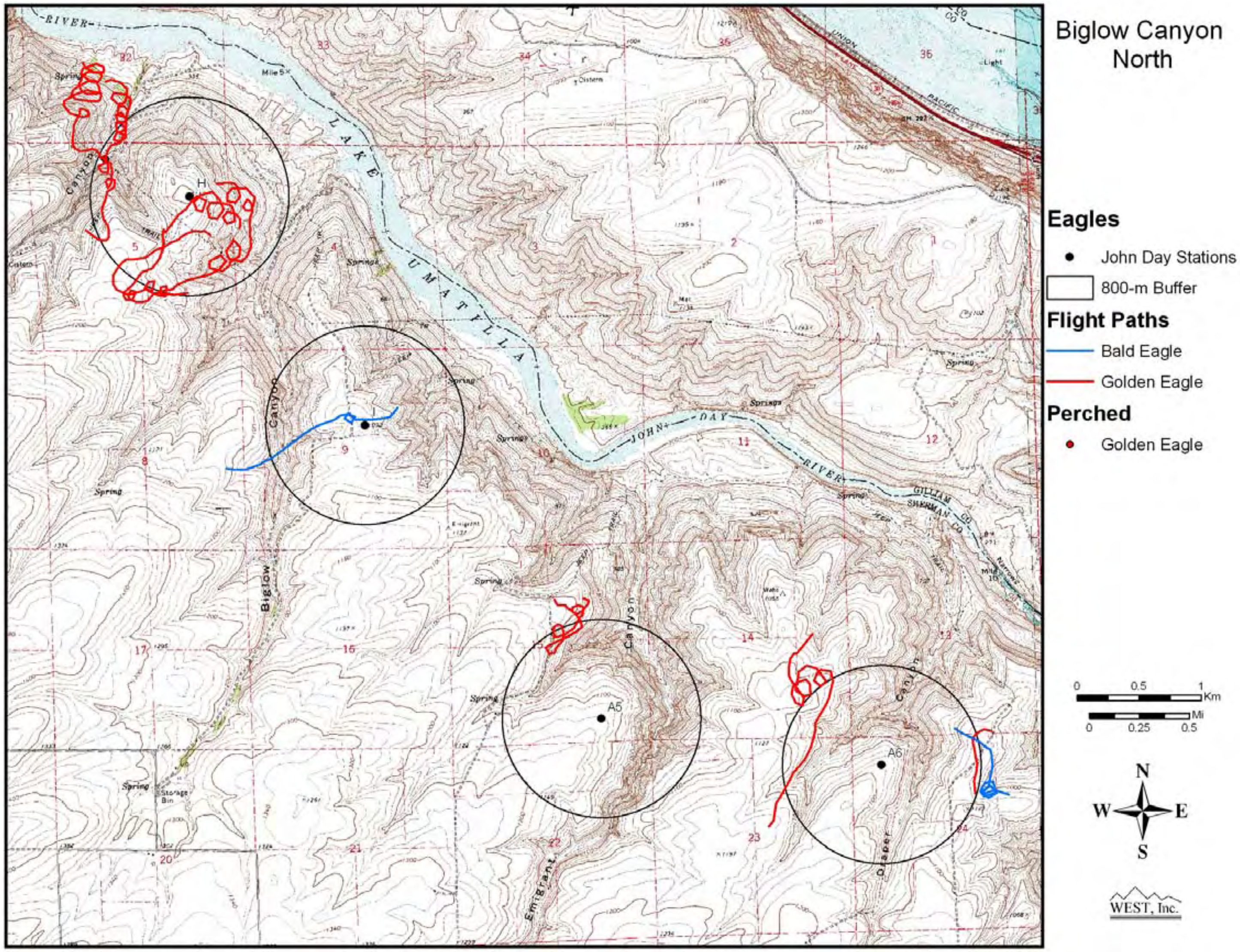
Appendix C-1. Mapped flight paths in relation to fixed bird stations (John Day Canyon 800-m) for Buteos (Buteo spp. hawks), September 15, 2005 through August 8, 2006.



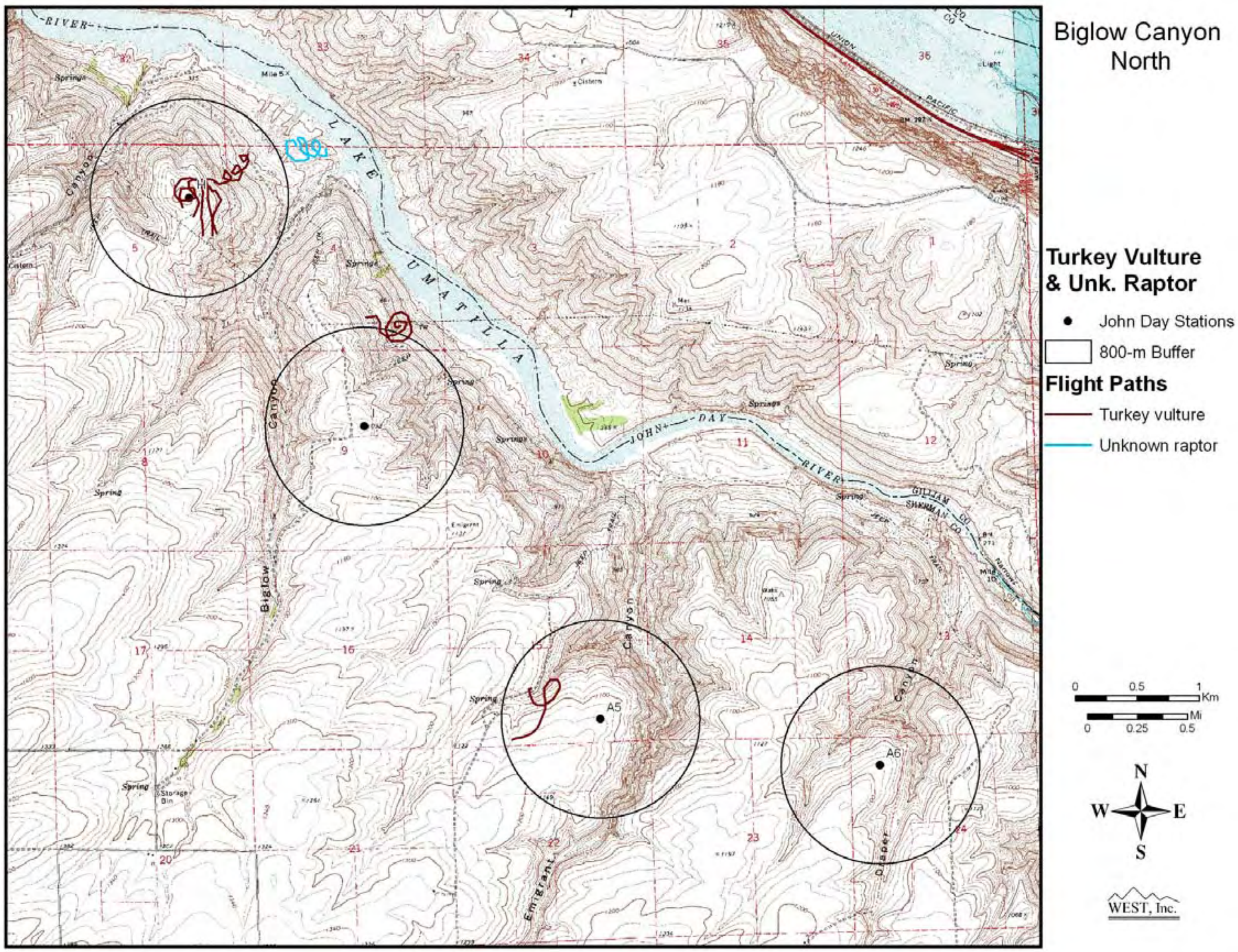
Appendix C-2. Mapped flight paths in relation to fixed bird stations (John Day Canyon 800-m) for accipiters, September 15, 2005 through August 8, 2006.



Appendix C-3. Mapped flight paths in relation to fixed bird stations (John Day Canyon 800-m) for falcons and harriers, September 15, 2005 through August 8, 2006.



Appendix C-4. Mapped flight paths in relation to fixed bird stations (John Day Canyon 800-m) for eagles, September 15, 2005 through August 8, 2006.



Appendix C-5. Mapped flight paths in relation to fixed bird stations (John Day Canyon 800-m) for turkey vulture and unidentified raptor, September 15, 2005 through August 8, 2006.