Appendix E
2007 First-Year Operation Wildlife Monitoring Report

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Puget Sound Energy
Wild Horse Wind Facility
Post-Construction Avian and Bat Monitoring
First Annual Report
January – December 2007

Prepared for:

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EXECUTIVE SUMMARY

The Wild Horse Wind Facility (Wild Horse) is located in Kittitas County, Washington, approximately 11 miles east of the City of Kittitas. Wild Horse consists of 127 V80 1.8-MW wind turbines with a total nameplate capacity of 229 MW. As part of the conditions for Wild Horse Site Certificate Agreement (SCA) with the Washington State Energy Facility Site Evaluation Council (EFSEC), Puget Sound Energy (PSE) is required to implement a two year operational (post construction) monitoring study to evaluate impacts to avian and bat species. With the assistance of a Technical Advisory Committee, PSE developed a post-construction study plan to monitor impacts to birds and bats over a period of two years. The first year of monitoring surveys were conducted on the site between January and December 2007.

The primary objective of the monitoring study is to estimate the number of avian and bat casualties attributable to collisions with wind turbines and meteorological towers for the entire project on an annual basis. The monitoring study consists of four 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; and (4) a Wildlife Incident Reporting and Handling System for wind project personnel to handle and report casualties found in the project incidentally to the study.

Thirty-two rectangular plots were searched for carcasses. Each plot consisted of two turbines for a total of 64 turbines searched in the monitoring year. Search plots were a minimum of 110 m from the two turbines included in the plot. Surveyors walked parallel transects within the search plot spaced approximately 10-12 meter apart while scanning the ground for fatalities or injured birds or bats. Standardize searches of all plots were conducted once every four week (28 day) period. During the spring and fall migration periods, a sub-set of the selected plots (16 turbines) were searched once a week. For the entire monitoring period, 1088 turbine searches were conducted with over 2500 hours of searching.

A total of 13 searches of all 32 plots and an additional 16 searches of the 8-plot subset were conducted during the first year of study (January-December 2007). Seventy-seven bird fatalities comprised of 29 identified species and three unidentified species were found, and 17 bat fatalities comprised of four species were found. No Federal or State Threatened or Endangered species were found during the study.

The most common bird species found included horned lark (14% of total number), dark-eyed junco (9%), golden-crowned kinglet (9%), and Brewer's sparrow (6.5%). Six raptors were found (4 American kestrels, 1 red-tailed hawk, and 1 great-horned owl). Two of the kestrels and the red-tailed hawk were found incidentally. No increase in fatalities was observed during the spring and fall migration seasons, and there was no strong concentration of avian fatalities within the search plots. The most bird fatalities found at any one turbine was 5 found at J3. Only five other turbines had more than one fatality (4 turbines with 2 fatalities, 1 with 3 fatalities).

Seventeen bat fatalities were found between April 20 and October 10, 2007. Fourteen (82%) of the bat fatalities were found between the months of August and October, which is considered the fall migration season for bats. The remaining three bats (18%) were found in the spring. Hoary bat comprised 58.8% (10 fatalities), little brown bat comprised 23.5% (4 fatalities), and silver-haired bat comprised 17.6% (3 fatalities) of the bat fatalities. There did not appear to be any strong concentrations of bat fatalities within the search plots. The maximum number of bats found at any one turbine was two fatalities found at turbines C15, A1, and M5.

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 2.79 (1.55 per MW per year). The estimated number of small bird fatalities per turbine per year was 2.31 (1.28 per MW per year) and large bird fatalities per turbine per year was 0.48 (0.27 per MW per year). The estimated number of nocturnal migrant fatalities per turbine per year was 1.58 (0.88 per MW per year), and the estimated number of grassland songbird fatalities was 0.52 (0.29 per MW per year). For raptors the number of fatalities per turbine per year was estimated to be 0.17 (0.09 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 first year of study was 0.70 (0.39 per MW per year).

Fatality estimates for birds and bats from the study are similar to other wind projects in the region. 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 Wild Horse to other wind projects with different turbines, the fatality rates were standardized on a per MW capacity basis. For Wild Horse the estimate was 1.55 birds per MW per year. This estimate was lower than the nearby Combine Hills (2.56 bird fatalities per MW) and Stateline (2.90 fatalities per MW) projects, and was also lower than the overall average for new generation wind projects in the U.S of 3.1 fatalities per MW. The Wild Horse bat fatality rate of 0.39 per MW capacity per year is also lower than Combine Hills (1.88 per MW) and Stateline, (1.70 per MW), and lower than the average rate for new generation wind projects in the west and mid-west of 2.10 per MW.

Species composition for bird and bat fatalities was similar to composition at other wind projects in the Pacific Northwest. The raptor fatality rate was comparable to other regional wind projects and similar to what would be predicted based on the pre-project estimation of use defined as the number of raptors observed per 20-minute survey. The estimated fatality rate for nocturnal migrants fell within the range of other wind projects studied in the Pacific Northwest. The observed nocturnal migrant mortality was slightly higher at lit compared to unlit turbines (0.53 compared to 0.38), but not statistically different.

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1.0 INTRODUCTION AND BACKGROUND

The Wild Horse Wind Facility (Wild Horse) is located in Kittitas County, Washington, approximately 11 miles east of the City of Kittitas. Wild Horse consists of 127 V80 1.8-MW wind turbines mounted on 67-m (221-ft) towers with blades 39 m (129 ft) long. Maximum height with the blade fully extended is 107 m (351 ft) with rotors turning at 15.5 rpm. Turbines begin producing electricity at wind speeds of 9 mph, and shut down at constant wind speeds of 56 mph.

As part of the conditions for Wild Horse Site Certificate Agreement (SCA) with the Washington State Energy Facility Site Evaluation Council (EFSEC), Puget Sound Energy (PSE) is required to implement a two year (24 month) operational (post construction) monitoring study to evaluate impacts to avian and bat species. Data was collected according to a detailed monitoring protocol developed in cooperation with the Wild Horse Wind Facility Technical Advisory Committee. The protocol for this monitoring study is described in detail in The Avian and Bat Monitoring Plan (WEST 2006).

The monitoring study for the project consists of the following 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 remained 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 found in the project incidentally to the study.

As part of the overall wind project monitoring effort, avian and bat casualties (fatalities or injured avian and bat species) found incidentally to the monitoring study by wind project personnel or others were handled under the WIRHS protocol described in the monitoring plan (WEST 2006). Casualties found by wind project personnel are included in the overall dataset.

Kittitas County and EFSEC requested a Technical Advisory Committee (TAC) to be convened to provide guidance and oversight of the Wild Horse Wind Facility monitoring studies. The TAC is intended to provide a neutral forum to formulate and review monitoring studies and data; facilitate collaboration among project stakeholders (owners, landowners, agencies, conservation organizations, interested individuals); and make recommendations to EFSEC for changes to the monitoring studies. The TAC membership includes representatives from: Kittitas County, the Washington State Department of Fish and Wildlife, the U.S. Fish and Wildlife Service, the Washington State Department of Natural Resources, the Kittitas County Audubon Society, the State Audubon Society, the Kittitas County Farm Bureau, the Kittitas County Field and Stream Club, the Economic Development Group of Kittitas County, the Friends of Wildlife and Wind Power, the project owner (PSE), and other interested parties.

This report presents the results of the first year of wildlife monitoring at this facility.

1.1 Avian and Bat Fatality Study

The primary objective of the monitoring study is 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 began within one month of the date when the project was fully operational. The study will be conducted for a minimum of two years (24 months), with the WIRHS monitoring program (WEST 2006) in place for the life of the project. The methods of the fatality study are broken into four primary components: (1) standardized carcass searches, (2) searcher efficiency trials, (3) scavenger removal trials, and (4) the WIRHS.

There are three scenarios under which casualties may be found in the wind project: (1) during the standardized searches for the study; (2) while observers are on site but not conducting a standardized search; and (3) by wind plant personnel or others on site for other purposes such as turbine maintenance. The reporting and handling methods for wind plant personnel discoveries is addressed by the WIRHS. Casualties found by study personnel regardless of timing (e.g., during a standard search or not) are recorded by the methods described below. All casualties located in a search plot have been included in the dataset under the broad assumption that each casualty would have been found during standardized searches.

All casualties located within areas surveyed, regardless of species, are recorded and cause of death determined, if possible, based on field inspection of the carcass. Total number of avian and bat carcasses are estimated by adjusting for search frequency, removal bias (length of stay in the field), and searcher efficiency bias (percent found). For carcasses where the cause of death is not apparent, the assumption that the fatality is a wind turbine or met tower collision casualty is made for the analysis. This approach leads to an overestimate of the true number of wind plant-related fatalities, but most projects have used this conservative approach because of the relative high costs associated with obtaining accurate estimates of natural or reference mortality.

2.0 DEFINITIONS AND FIELD METHODS

2.1 Seasons

Seasons are based roughly on the calendar seasons. For analysis purposes and to help with categorizing impacts (e.g., migratory birds) a spring and fall migration period and summer breeding season are also defined.

The following dates are used for defining seasons in the study:

Spring	March 16 – June 15
Spring Migration	March 16 – May 15
Summer	June 16 - September 15
Breeding Season	May 15 – August 15
Fall	September 15 – December 15
Fall Migration	August 16 - October 31
Winter	December 16 - March 15

These dates are used for analysis purposes only and may not cover all potential migrants or breeding residents in the project area.

2.2 Search Plot and Sample Size

Thirty-two rectangular plots were searched for carcasses (Figure 1). Each plot consisted of two turbines for a total of 64 turbines searched in the monitoring year. Search plots were a minimum of 110 m from the two turbines included in the plot (Figure 2). Studies at wind plants with other large turbines, Klondike in Sherman County Oregon (Johnson et al. 2003), and Combine Hills, 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.

2.3 Scheduling/Timing

Standardized searches of all selected plots (64 turbines) were conducted once every four week (28 day) period (Table 1). During the spring and fall migration periods, the search effort was increased at a sub-set of the selected plots (16 turbines) to once a week (Table 2).

2.4 Standardized Carcass Searches

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 10-12 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 a minute along each transect taking approximately 80-120 minutes to search each turbine. Searchers scanned the area on both sides out to approximately 5-6 meters for casualties as they walked each transect.

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 2 or more primaries at one location indicating predation or scavenging.

All carcasses were labeled with a unique number, 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 (see WEST 2006). All casualties were photographed as found and plotted on a detailed map of the study area showing the location of the wind turbines and associated facilities such as overhead power lines and met towers.

Casualties found outside the formal search area by carcass search technicians were treated following the above protocol as closely as possible. Casualties found in non-search areas (e.g., near a turbine not included in the search area) were coded as incidental discoveries and were documented in a similar fashion as those found during standard searches. Casualties found by maintenance personnel and others not conducting the formal searches were documented using the WIRHS.

2.5 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/lithosol and shrub steppe), size of carcass, and season. Estimates of searcher efficiency are used to adjust the total number of carcasses found for those missed by searchers, correcting for detection bias.

Searcher efficiency trials began about the same time as carcass search studies 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 (lithosol/grassland and shrub steppe), approximately 20 carcasses of birds of two different size classes were placed within the search plots. A total of 82 searcher efficiency trial carcasses were placed in 2007 on 10 different dates. Carcasses used for searcher efficiency trials were non-native/non-protected or commercially available species such as house sparrows (*Passer domesticus*), European starlings (*Sturnus vulgaris*), rock pigeons (*Columba livia*), hen mallards (*Anas platyrhynchos*), or hen pheasants (*Phasianus colchicus*). Detection rates for small brown birds (house sparrows) were used to estimate the searchers' ability to detect bats.

All searcher efficiency trial carcasses were placed at random locations within the search area prior to that day's scheduled carcass search. If avian scavengers appeared, attracted by placement of carcasses, the carcasses were distributed before dawn. Carcasses were placed in a variety of postures to simulate a range of conditions. 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 crippled bird (e.g., placed beneath a shrub or bunch grass).

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.

2.6 Carcass Removal Trials

The objective of carcass removal trails was to estimate the average length of time a carcass remained in the study area and was potentially detectable. Carcass removal includes removal by predation or scavenging. Carcass removal studies were conducted during each season, outside of the carcass search plots (i.e., near a turbine that was not included in the standard search plots). 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.

Carcass removal trials began at about the same time that search studies begin. During each season and within two major habitat types (lithosol/grassland and shrub steppe), approximately 10 carcasses of birds of two different size classes (same as searcher efficiency birds) were placed in the study plots, for a total of 80 removal trial carcasses for the entire year. Carcasses were placed on a minimum of four dates during each season for a total of 16 trial initiation dates. As a result, the trials were spread throughout the year to incorporate the effects of varying weather, climatic conditions, and scavenger densities. Small brown birds (house sparrows and starlings) were used during the late summer and fall seasons to simulate bat carcasses.

Removal trial birds were not placed in the standardized search plots in order to minimize the chance of confusing a trial bird with a true casualty. Turbines not included in the standardized searches were randomly selected for inclusion in the removal trials. Trial carcasses were randomly placed at selected turbines within a plot of similar size to the actual search plots. Trial carcasses were placed

in a variety of postures to simulate a range of conditions. 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 crippled bird (e.g., placed beneath a shrub or bunch grass).

Personnel conducting carcass searches monitored the trial birds over a 40-day period, checking the carcasses every day for the first 4 days, and then on day 7, day 10, day 14, day 20, day 30 and day 40. This schedule varied somewhat depending on weather and coordination with the other survey work. Removal trial carcasses were marked discreetly (e.g., with dark electrical tape around one or both legs) for recognition by searchers and other personnel, and left at the location until the end of the carcass removal trial. At the end of the 40-day period any remaining evidence of the carcass was removed.

3.0 STATISTICAL METHODS FOR FATALITY ESTIMATES

Estimates of facility-related fatalities are based on:

(1) Observed number of carcasses found during standardized searches during the first year of monitoring 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 avian and bat fatalities attributed to operation of the facility is based on the number of avian and bat fatalities found at the facility. All carcasses located within areas surveyed, regardless of species and fatality cause, were recorded and, if possible, a cause of death determined based on blind necropsy results. Total number of avian and bat carcasses is estimated by adjusting for removal and searcher efficiency bias.

3.1 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

3.2 Observed Number of Carcasses

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

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

3.3 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:

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

3.4 Estimation of Searcher Efficiency Rates

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

3.5 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:

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

Final estimates were obtained by a weighted average of estimates from the 16 turbines sampled more frequently (7 days in the migration season) and the 48 turbines sampled monthly.

4.0 RESULTS

A total of 13 searches of all 32 plots and an additional 16 searches of the 8-plot subset were conducted during the first year of study (January-December 2007; Table 2), for a total of 1,088 turbine searches and over 2,500 hours of searching. This section describes the number, species, location, and other characteristics of the bird and bat fatalities, and provides fatality estimates adjusted for searcher efficiency and carcass removal biases.

4.1 Bird Fatalities

Bird fatalities found during 2007 are listed in Appendix A. This list includes fatalities observed during standardized plot searches and other fatalities that were not observed during standardized searches (incidental finds). During 2007, a total of 77 bird fatalities were found. All birds found during regularly scheduled searches and most of the incidental finds are plotted in Figure 3. Of the 77 fatalities, 53 were found during regularly scheduled searches, and 24 were documented as incidental fatalities. The most common species found included horned lark (*Eremophila alpestris*; 14% of total number), dark-eyed junco (*Junco hyemalis*; 9%), golden-crowned kinglet (*Regulus satrapa*; 9%), and Brewer's sparrow (*Spizella brewei*; 6.5%) (Table 3). Six raptors were found (4 American kestrels (*Falco sparverius*), 1 red-tailed hawk (*Buteo jamaicensis*), and 1 great-horned owl (*Bubo virginianus*)). Two of the kestrels and the red-tailed hawk were found incidentally.

Given the small number of birds found, no statistical tests were conducted comparing fatalities among different locations (e.g., near springs, away from spring). However, the lack of strong patterns in the locations displayed in Figure 3 suggests no large differences in mortality by location within the wind project. Statistical tests will be conducted after the 2nd year of monitoring is completed.

The most fatalities found at any one turbine was 5 found at J3 (2 American robins (*Turdus migratorius*), one dark-eyed junco, one horned lark, and one Townsend's warbler (*Dendroica townsendi*)). Only 5 other turbines had more than 1 fatality (4 turbines with 2 fatalities, 1 with 3

fatalities).

4.2 Bat Fatalities

Bat fatalities found during 2007 during standardized carcass searches and incidentally are listed in Table 4. A total of 17 bat fatalities were found comprising three different species; 10 hoary bats (*Lasiurus cinereus*), 4 silver-haired bats (*Lasionycteris noctivagans*), and 3 little brown bats (*Myotis lucifugus*), (Figure 4). Of the 17 bat fatalities, 12 were found during regularly scheduled searches and 5 were found incidentally (Appendix A). The silver-haired bats and one of the little brown bats were found in the spring, while the remaining bats were all found in the fall (between August and October; figure 5).

The maximum number of bats found at any one turbine was 2 (C15, A1, M5) and the maximum number of bats found during any one search period was 4 (August 21 – September 18). The bat fatalities were spread out throughout the facility. Given the small number of bats found, no statistical tests were conducted comparing fatalities among different locations (e.g., near springs, away from spring). However, the lack of strong patterns in the locations displayed in Figure 5 suggests no large differences in mortality by location within the wind project. Statistical tests of these patterns will be conducted after the 2nd year of monitoring is completed.

4.3 Searcher Efficiency Trials

A total of 162 carcasses (82 large, 80 small) were placed in the field during 10 searcher efficiency trials. Species used in the trials included rock pigeons, European starlings, mallards, coturnix quail (*Coturnix japonica*), ring-necked pheasants, house sparrows, American robins and Savannah sparrows (*Passerculus sandwichensis*). Observer detection rates were 41% for small birds and 74% for medium to large sized birds (Table 5).

4.4 Carcass Removal Trials

Eight carcasses were placed during each of 16 different removal trials throughout the study period. Thirty-five small birds were used in the trials and consisted of 20 house sparrows, 11 young quail, and 4 European starlings. Forty-five medium to large-sized birds were used in the trials and consisted of 17 rock pigeons, 16 hen mallards and 12 hen pheasants. Approximately 50 percent of the small birds were removed by day 12 while 50 percent of the large birds were removed by day 10. Mean removal time for small birds was 17.7 days and mean removal time for large birds was 19.0 days (Figure 6).

4.5 Fatality Estimates

Unadjusted fatality estimates and estimates adjusted for searcher efficiency and scavenging are provided in Table 6. The small bird adjusted fatality rate is 2.31/turbine/year and 1.28/MW/year. The large bird adjusted fatality rate is 0.48/turbine/year and 0.27/MW/year. Combining the two, the all bird adjusted fatality estimate is 2.79/turbine/year or 1.55/MW/year. The adjusted raptor fatality rate is 0.17/turbine/year or 0.09/MW/year. The nocturnal migrant estimate is

1.58/turbine/year or 0.88/MW/year, and the grassland bird estimate is 0.52/turbine/year or 0.29/MW/year.

The bat adjusted fatality rate is 0.70/turbine per year or 0.39/MW/year.

The observed nocturnal migrant mortality was slightly higher at lit compared to unlit turbines (0.53 compared to 0.38), but not statistically different.

4.6 Incidental Wildlife Observations

Raptors flying within the project area that were observed by biotechnicians while traveling on-site or during searches included: northern harrier (*Circus cyaneus*), red-tailed hawk, rough-legged hawk (*Buteo lagopus*), American kestrel, golden eagle (*Aquila chrysaetos*), bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrines*), merlin (*Falco columbarius*), and prairie falcon (*Falco mexicanus*) (Table 7; Appendix B). Four golden eagles and one bald eagle were observed during the monitoring period. Red-tailed hawk and American kestrel were the most commonly observed raptor species. Beginning in November, all observations of raptors perched on the transmission lines were recorded (Figure 7). During November, there were five observations of raptors perched on transmission line poles (poles G, W, Y, C and H), including one peregrine falcon, one red-tailed hawk, and three unidentified raptors.

One sage grouse was observed 126 meters west of turbine D2 at 1:20PM on September 24$^{th.}$ In addition, a sage grouse nest with five eggs was observed 98 m from turbine E1 (see Figure 8). It appeared the nest had been predated (M. Schroeder pers. comm., pers. comm. Dec 03, 2007). The nest was found hidden beneath a large clump of grass on the west slope of a large wash with abundant sagebrush and grass cover.

Big game observations were recorded by biotechnicians while conducting carcass searches or traveling within the project area, however, this information is largely anecdotal, and may consist of some repeated observations of the same animal. Elk and deer were observed throughout the study period, with Elk observations highest from February to July, and deer observations highest in March and April (Figure 9). Fifty-one groups of mule deer consisting of 207 individuals, and 82 groups of elk consisting of 1,279 individuals were observed near turbine facilities by biotechnicians during the first year of monitoring (Table 9). Elk were typically observed grazing, resting, and walking (see Appendix B), with few observations of running or alarmed behavior noted. Elk were observed on ridges or in ravines and near turbines, or directly underneath turbines. Elk were also observed on ridges and slopes outside the project area, however, the numbers and locations of these individuals were not documented. A complete list of general wildlife observations are presented in Appendix B.

5.0 DISCUSSION

The Wild Horse Wind Facility is located on the northwestern edge of the Columbia Basin

physiographic province, a region with extensive wind power development. Umatilla County, Oregon and Walla Walla County, Washington, roughly 100 miles southeast of the Wild Horse Wind Project, are home to three utility scale wind projects: the Vansycle wind plant (24 MW), the Stateline Wind Project (300 MW), and the Combine Hills Turbine Ranch (41 MW). In addition, the Nine Canyon Wind Project in Benton County, Washington, the Klondike I and II Wind Project in Sherman County, Oregon, the Bighorn Project in Klickitat County, Washington, and the Leaning Juniper Wind Project in Gilliam County Oregon have been monitored using similar protocols. Another project, Condon, is also located in Gilliam County, Oregon, but has not undergone rigorous monitoring studies[1]. Monitoring studies have occurred at these wind projects within the last seven years providing a relatively contemporary pool of data for comparison (Table 8). Studies at the Wild Horse Wind Facility were designed to provide results comparable to these regional studies.

There are numerous factors that could contribute to both positive and negative biases in estimating fatality rates (Erickson 2006). The overall design of this study incorporates several assumptions or factors that affect the results of the fatality estimates. First, all bird casualties found within the standardized search plots during the study were included in the analysis. A few carcasses were found incidentally within a search plot during other activities on-site and 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 possible that some of the fatalities were caused by predators (e.g., raptors, fox) and some of the other casualties may have been due to collisions with vehicles or facility buildings. It is likely that some of the casualties included in the data pool were due to natural causes (background mortality). A few wind facility 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. 2000). 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 Wild Horse. The background estimate for observed mortality would be approximately 0.33 per turbine plot per year, unadjusted for scavenging and searcher efficiency. The background mortality information from Minnesota and Montana suggest that the estimates of bird mortality include some avian fatalities

[1] 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.

not related to turbine collision, and this factor alone would lead to an over-estimate of true avian collision mortality for the study.

There are some other potential negative biases. For example, 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 rectangular in shape, the maximum distance to a turbine within a search plot was 141 m at the corners. The search plot distance for this study was selected based on results of other studies (Higgins et al. 1996, Erickson et al. 2004, Young et al. 2003, Young et al. 2005) where a distance equal to the approximate height of the turbine appeared to capture a very large percentage of fatalities. Based on the distribution of fatalities as a function of distance from turbines (Figure 3), 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 90 m (2) were actual turbine collision fatalities. The distribution of bat fatalities at Wild Horse (see Figure 4) and at other sites (e.g., Erickson et al. 2004, Young et al. 2003, Kerns and Kerlinger 2004) suggest bat casualties fall closer to turbines than bird casualties. No bat carcasses were found beyond 66 m from a turbine and it is unlikely that many bats fell outside the effective search area.

Other potential biases are associated with the experimental carcasses used in searcher efficiency and carcass removal trials and whether or not they are representative of actual carcasses. This may occur if the types of birds used are larger or smaller than the carcasses of fatalities, more or less cryptic in color than the actual fatalities, etc. We used house sparrows, savannah sparrows, American robin, European starlings, rock pigeons, coturnix quail, hen pheasants and hen mallards to represent the range of fatalities expected. We feel this range 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. It is generally not practical or feasible to obtain many of the native bird species in fresh condition for these trials.

Concern has also been raised regarding how the number of carcasses placed in the field for carcass removal trials on a given day could lead to biased estimates of scavenging rates. Hypothetically, this would lead to underestimating true scavenging rates if the scavenger densities are low enough such that scavenging rates for these placed carcasses are lower than for actual fatalities. The logic is that if the trials are based on too many carcasses on a given day, scavengers are unable to get to all trial carcasses, whereas they could get to all wind turbine collisions. If this is the case, and the trial carcass density is much greater than actual turbine fatality density, the trials would underestimate scavenging rates compared to rates on actual fatalities. In our study, we placed approximately 1 carcass for every 1.5 – 2.5 square miles on a given trial day, which we believe is not high enough to create a significant bias.

5.1 Species Composition and Fatality Estimates

Species composition for bird casualties was similar to composition at other sites in the Pacific Northwest, with horned larks comprising the majority of avian fatalities. Species composition for

bats was also very similar to other Pacific Northwest projects with only three species found: silver-haired bat, hoary bat, and little brown bat. The silver-haired bats were found in the spring, which was also the case for the Hopkins Ridge Project in Columbia County, Washington. As supported by this study and by numerous other monitoring studies throughout the US, 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).

The fatality estimates from this study were generally within the range predicted in the permitting documents for the Wild Horse (Section 3.6, Site Certificate Application). The empirical fatality estimates from this study were in the range of predictions for all birds (100-400), bats (100-400), and passerines (100-300). The raptor estimates (21) were higher than what was predicted (approximately 10). The prediction method used regional estimates of fatality rates expressed on a per turbine basis. Since the predictions were made (year 2003), other approaches that use, for example, regional estimates expressed on a per MW basis have been utilized. This approach assumes that mortality is roughly proportional to the MW output of the turbines, which is a surrogate for mortality being proportional to the rotor swept area. Our predictions would have been higher for raptors, had we used the mortality estimates using a per MW basis.

Population estimates for species killed have been derived from breeding bird surveys (Blancher et al. 2007). These estimates can be made for different regions and states within the US, and can provide some perspective on how the level of mortality compares to these broad populations. The raptor fatalities were comprised of the most common raptor species in Eastern Washington (American kestrel, great horned owl, and red-tailed hawk). Using Blancher et al. (2007), it is estimated there are 110,000 American kestrels, 17,000 great-horned owls and 36,000 red-tailed hawks in eastern Washington (Great Basin Bird Conservation Region within Washington) during the summer. These estimates do not account for birds migrating through or wintering in the area from other Bird Conservation Regions. The low level of mortality at this site (estimated 21 total raptors per year) would likely have negligible impacts on the populations defined above.

There are an estimated 1,100,000 horned larks, 500,000 dark-eyed juncos, and 180,000 golden-crowned kinglets in Eastern Washington during the summer. These three species were the most common fatalities and comprised approximately 32% of the fatalities found. We would estimate less than 40 of each species killed each year at this facility.

The overall bird and raptor fatality estimates for Wild Horse fall within the range of estimates reported for other Pacific Northwest Projects (Table 8), and the patterns in fatality locations and species composition were consistent with the other regional projects. No state or federally threatened species were found. There appeared to be a larger diversity in the species found compared to many of the other sites, likely due to the diversity of habitat at Wild Horse. Where horned larks have typically comprised 30-60% of the fatalities at the other Pacific Northwest projects, they only comprised 14% of the fatalities at Wild Horse.

The overall bat fatality rate is towards the lower range of estimates for the other Pacific Northwest Projects (Table 8). There are potential biases in the estimates because we needed to

use surrogates for the experimental trials; however, the results are consistent with the patterns observed at other Pacific Northwest wind projects. Bat fatality estimates at new projects are more variable than bird estimates, with the highest estimates occurring at site in the Eastern US (Nicholson 2003, Kerlinger and Kerns 2004, Arnett 2005). Based on these comparisons, bird and bat mortality at Wild Horse is similar and slightly lower than other newer generation wind projects studied in the Pacific Northwest and the US in general.

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Table 1. List of survey visits and dates.

Visit Number	Dates
1	1/9/07-2/1/07
2	2/6/07-2/26/07
3	3/6/07-3/21/07
4	3/22/07-3/26/07
5	3/27/07-3/29/07
6	3/30/07-4/3/07
7	4/4/07-4/6/07
8	4/4/07-5/2/07
9	4/18/07-4/20/07
10	4/25/07-4/27/07
11	5/2/07-5/4/07
12	5/9/07-5/11/07
13	5/7/07-5/24/07
14	5/29/07-6/12/07
15	6/26/07-7/11/07
16	7/25/07-7/27/07
17	7/24/07-8/16/07
18	8/22/07-8/24/07
19	8/29/07-8/31/07
20	9/5/07-9/7/07
21	8/21/07-9/18/07
22	9/19/07-9/21/07
23	9/26/2007-9/28/07
24	10/3/07-10/5/07
25	9/24/07-10/16/07
26	10/17/07-11/7/07
27	10/31/07-11/2/07
28	11/13/07-11/30/07
29	12/4/07-12/15/07

Table 2. List of plots and number of searches/visits.

Plot ID	# turbines	# searches/visits
A1-A2	2	29
A5-A6	2	13
B1-B2	2	13
C10-C11	2	29
C14-C15	2	13
C2-C3	2	13
C6-C7	2	13
D13-D14	2	13
D17-D18	2	13
D1-D2	2	13
D21-D22	2	13
D25-D26	2	29
D30-D31	2	13
D34-D35	2	13
D5-D6	2	13
D9-D10	2	13
E1-E2	2	29
E5-E6	2	13
E9-E10	2	13
F2-F3	2	13
G2-G3	2	13
G6-G7	2	13
H2-H3	2	29
J3-J4	2	29
K3-K4	2	13
L3-L4	2	13
M1-M2	2	13
M5-M6	2	29
N1-N2	2	13
O2-O3	2	13
P1-P2	2	29
Q3-Q4	2	13

Table 3. List of bird fatalities by species.

Species	# found	% of Total
Birds		
horned lark	11	14.3
dark-eyed junco	7	9.1
golden-crowned kinglet	7	9.1
Brewer's sparrow	5	6.5
unidentified bird	5	6.5
American kestrel	4	5.2
unidentified kinglet	4	5.2
American robin	3	3.9
common nighthawk	3	3.9
yellow-rumped warbler	3	3.9
ruby-crowned kinglet	2	2.6
Townsend's warbler	2	2.6
unidentified passerine	2	2.6
black-billed magpie	1	1.3
gray partridge	1	1.3
great-horned owl	1	1.3
hairy woodpecker	1	1.3
house finch	1	1.3
house wren	1	1.3
magnolia warbler	1	1.3
mallard	1	1.3
mourning dove	1	1.3
northern flicker	1	1.3
red-tailed hawk	1	1.3
rock pigeon	1	1.3
sage sparrow	1	1.3
Vaux's swift	1	1.3
warbling vireo	1	1.3
western grebe	1	1.3
western kingbird	1	1.3
western tanager	1	1.3
Williamson's sapsucker	1	1.3
Total	**77**	**100.0**

Table 4. List of bat fatalities by species.

Species	# found	% of Total
Bats		
hoary bat	10	58.8
silver-haired bat	4	23.5
little brown bat	3	17.6
Total	**17**	**100.0**

Table 5. Carcass detection rates for large and small birds during searcher efficiency trials at the Wild Horse Wind Project, 2007.

	Large		Small	
Date	**# Placed**	**% Found**	**# Placed**	**% Found**
2/16/2007	5	60.00	5	0.00
3/6/2007	5	0.00	5	0.00
3/28/2007	10	90.00	10	80.00
4/19/2007	5	100.00	5	40.00
6/8/2007	4	100.00	5	40.00
7/11/2007	11	100.00	10	40.00
8/23/2007	10	100.00	10	50.00
9/27/2007	10	60.00	10	50.00
11/7/2007	11	45.45	10	20.00
12/12/2007	11	72.73	10	50.00
TOTAL	**82**	**74.39**	**80**	**41.25**

Table 6. Observed and adjusted fatality rates for birds and bats.

	Observed Fatality Rate			Adjusted Fatality Rate	
	# found	#/turbine/yr	#/MW/yr	#/turbine/yr	#/MW/yr
Raptors	5	0.08	0.04	0.17	0.09
all small birds	42	0.66	0.36	2.31	1.28
all large birds	13	0.20	0.11	0.48	0.27
all birds	55	0.86	0.48	2.79	1.55
grassland songbirds	10	0.16	0.09	0.52	0.29
likely nocturnal migrants	27	0.42	0.23	1.58	0.88
Bats	14	0.22	0.12	0.70	0.39

Table 7. Incidental observations of mammals, raptors, sage grouse, and reptiles during the one year study. Not all observations of raptors were recorded.

Species	groups	total
Mammals		
coyote	11	11
elk	82	1279
mule deer	51	207
greater sage grouse	1	1
sage grouse nest	1	1
Raptors		
American kestrel	8	9
bald eagle	1	1
golden eagle	4	4
merlin	1	1
northern harrier	6	6
peregrine falcon	1	1
prairie falcon	1	1
red-tailed hawk	10	11
rough-legged hawk	3	3
unidentified falcon	3	3
unidentified raptor	3	3
Reptiles		
gopher snake	5	5
rattlesnake	4	4
rubber boa	2	2
short-horned lizard	28	49
unidentified lizard	1	1
unidentified snake	2	2
western diamondback	1	1
western yellow-bellied racer	1	1

Table 8. Raptor, all bird, and bat mortality estimates at existing wind energy projects in the Columbia Plateau Ecoregion.

	Fatality Rate (#/MW/year)			
Project	**Raptors**	**All birds**	**Bats**	**Source**
Wild Horse, WA	**0.09**	**1.55**	**0.39**	This Study
Bighorn I, WA	0.15	2.6	1.9	NWC 2008
Combine Hills, OR	0.00	2.6	1.9	Young et al. 2005
Hopkins Ridge, WA	0.14	1.2	0.6	Young et al. 2007
KlondikeI 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	NWC 2007
Nine Canyon, WA	0.05	2.8	2.5	Erickson et al. 2001
Stateline, WA/OR	0.09	2.9	1.7	Erickson et al. 2004
Vansycle, OR	0.00	1.0	1.1	Erickson et al. 2000
Mean	**0.07**	**2.3**	**1.2**	

Figure 1. Location of carcass search plots at the Wild Horse Wind Project.

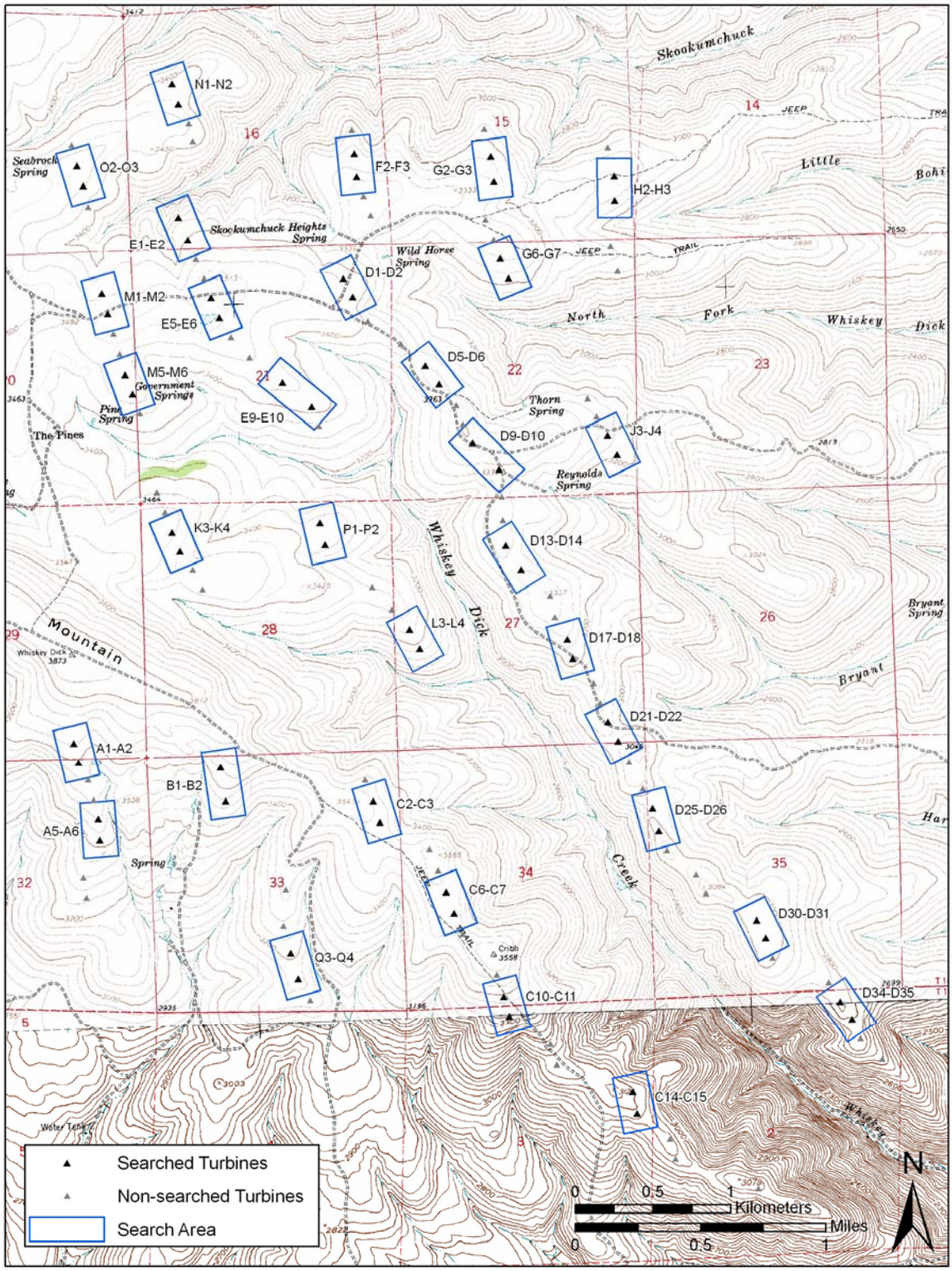


Figure 2. Illustration of search plots and search transects.

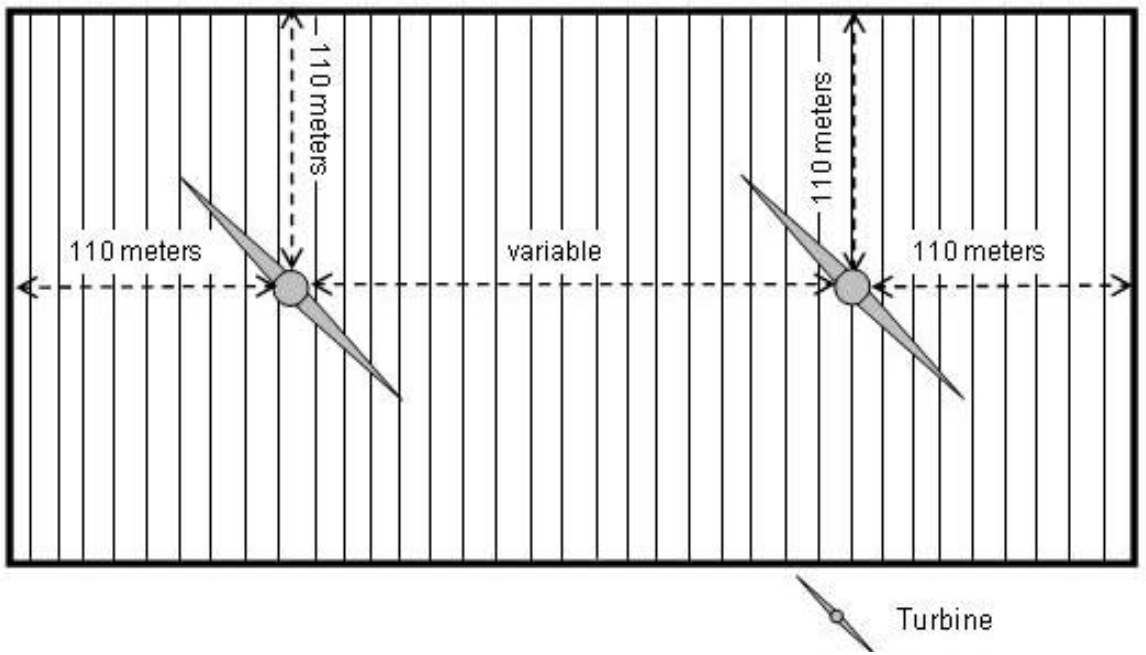


Figure 3. Location of bird fatalities found during 2007 at the Wild Horse Wind Project.

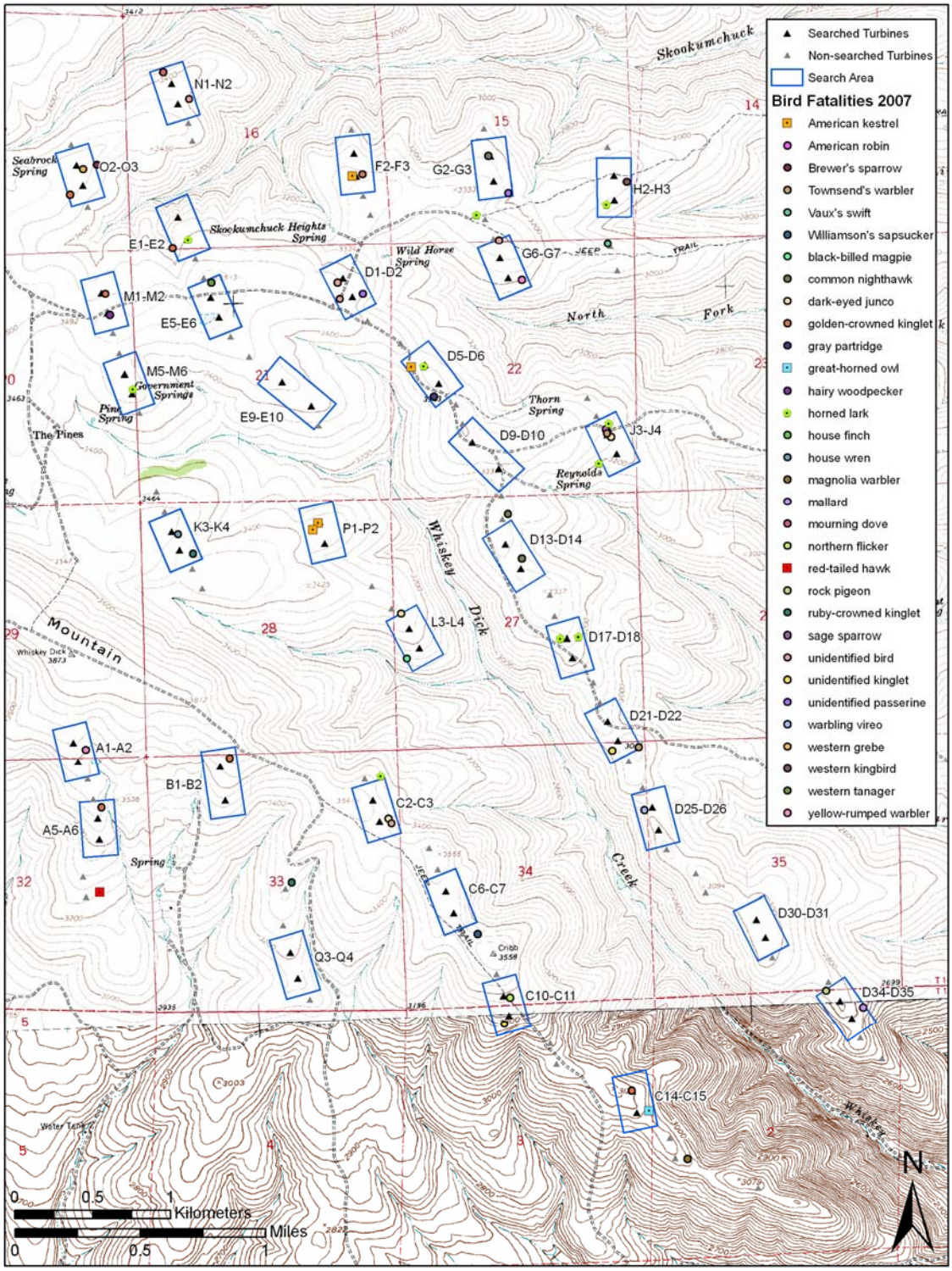
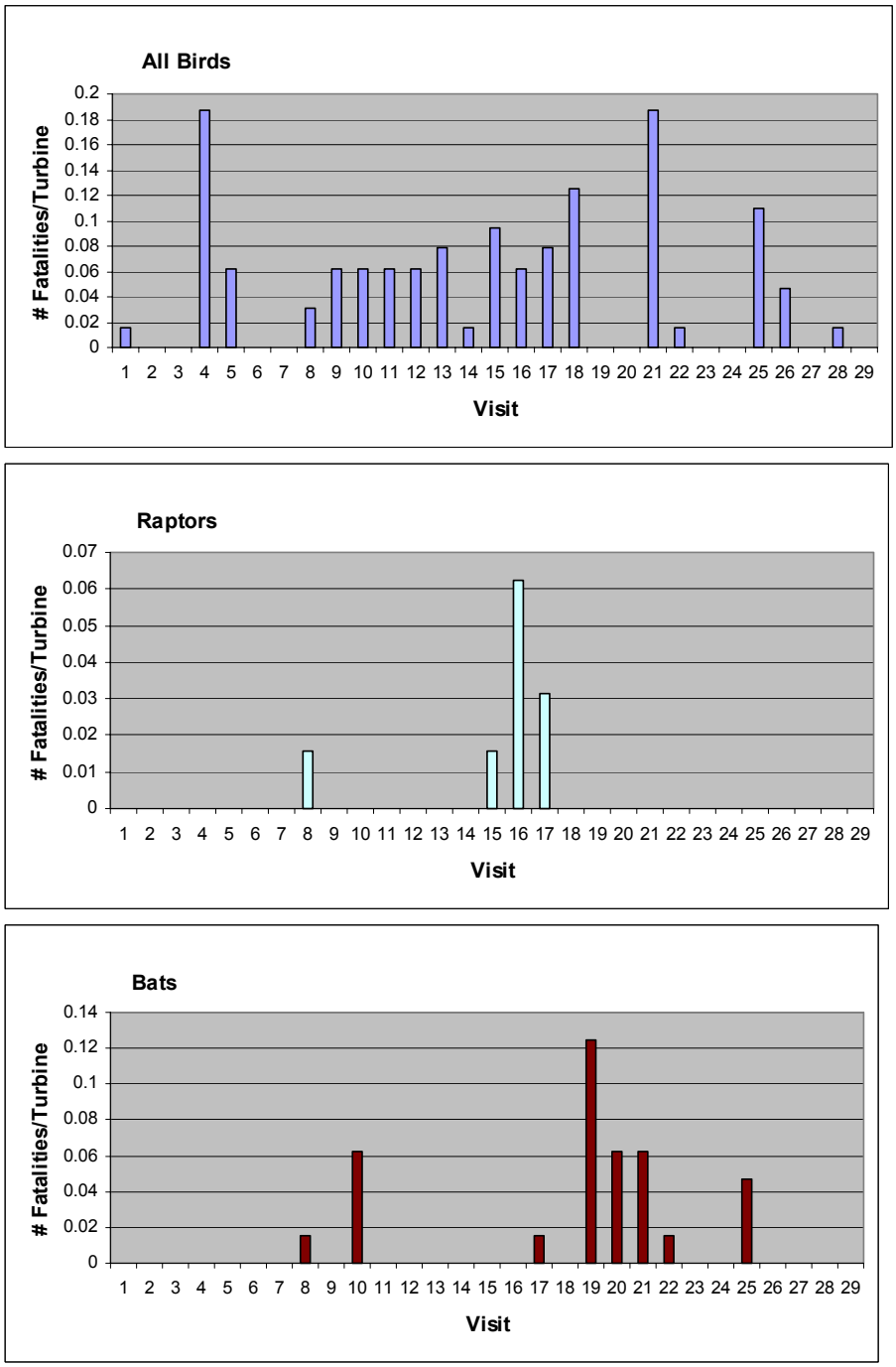


Figure 4. Timing of all bird, raptor and bat mortality at the Wild horse wind project.



Visit	Dates
1	1/9/07-2/1/07
2	2/6/07-2/26/07
3	3/6/07-3/21/07
4	3/22/07-3/26/07
5	3/27/07-3/29/07
6	3/30/07-4/3/07
7	4/4/07-4/6/07
8	4/4/07-5/2/07
9	4/18/07-4/20/07
10	4/25/07-4/27/07
11	5/2/07-5/4/07
12	5/9/07-5/11/07
13	5/7/07-5/24/07
14	5/29/07-6/12/07
15	6/26/07-7/11/07
16	7/25/07-7/27/07
17	7/24/07-8/16/07
18	8/22/07-8/24/07
19	8/29/07-8/31/07
20	9/5/07-9/7/07
21	8/21/07-9/18/07
22	9/19/07-9/21/07
23	9/26/2007-9/28/07
24	10/3/07-10/5/07
25	9/24/07-10/16/07
26	10/17/07-11/7/07
27	10/31/07-11/2/07
28	11/13/07-11/30/07
29	12/4/07-12/15/07

Figure 5. Location of bat fatalities found during 2007 at the Wild Horse Wind Project.

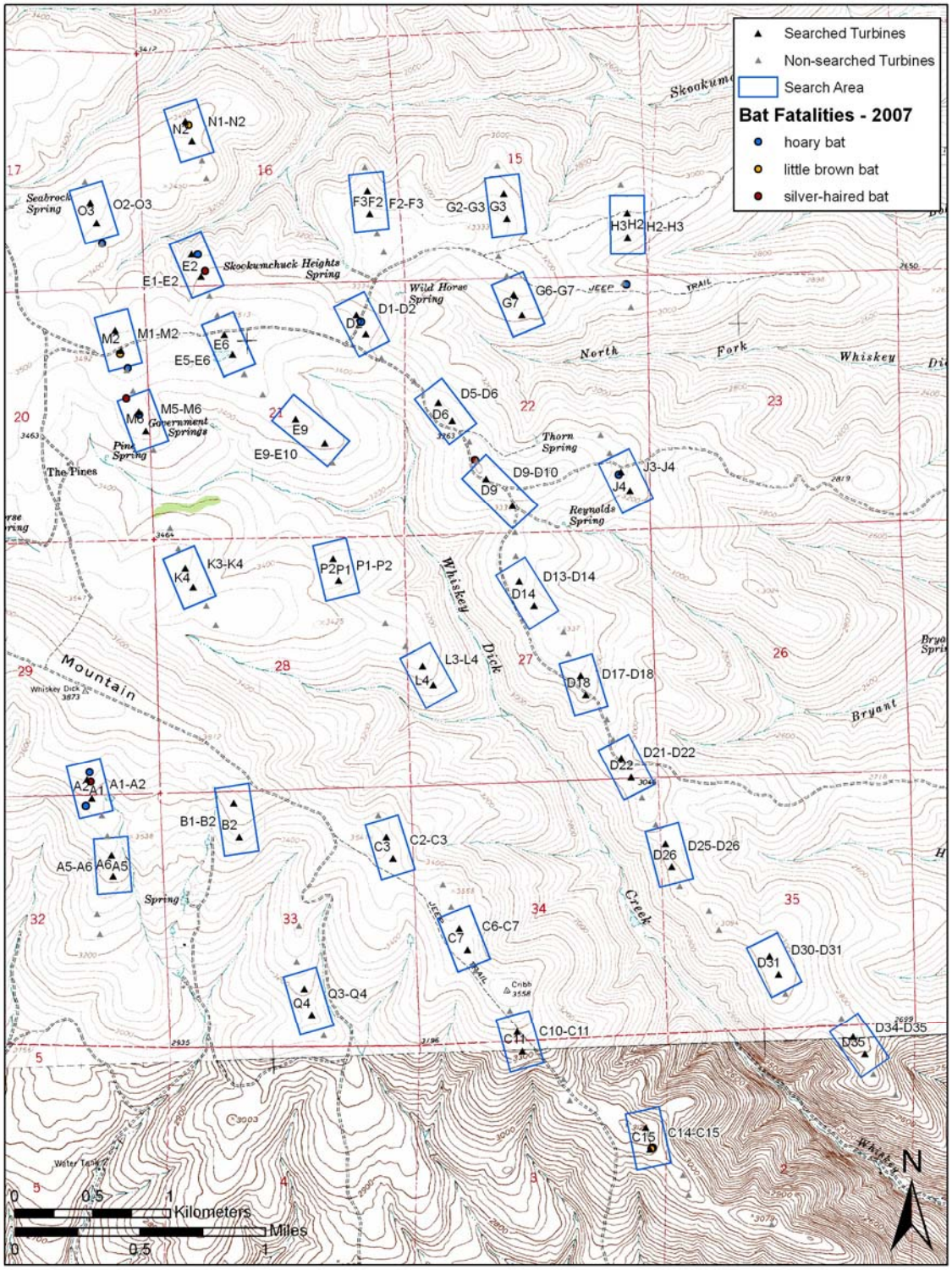


Figure 6. Removal rates for large birds (mallards, ring-necked pheasants, rock pigeons), and small birds (house sparrows, European starling, *Coturnix* quail, mallard chicks).

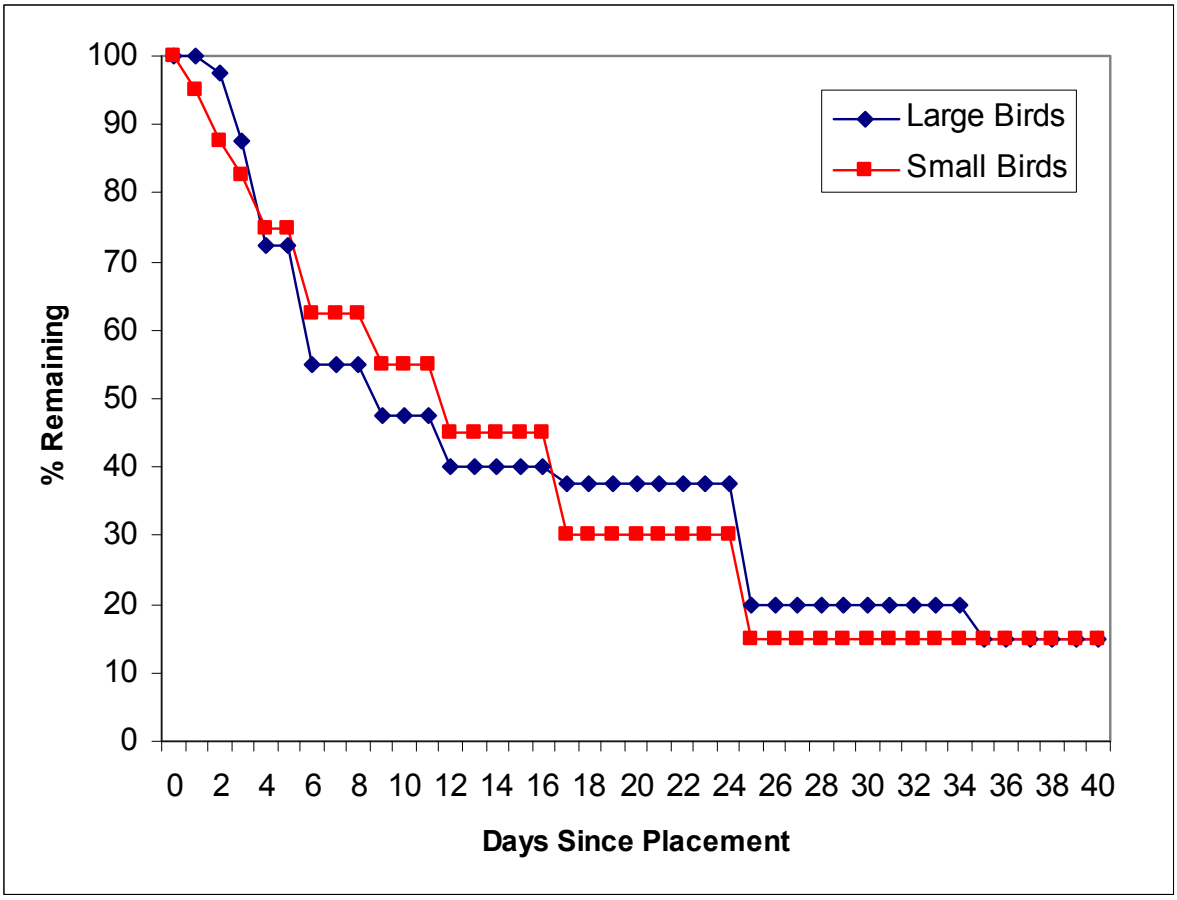


Figure 7. Location of Transmission line poles.

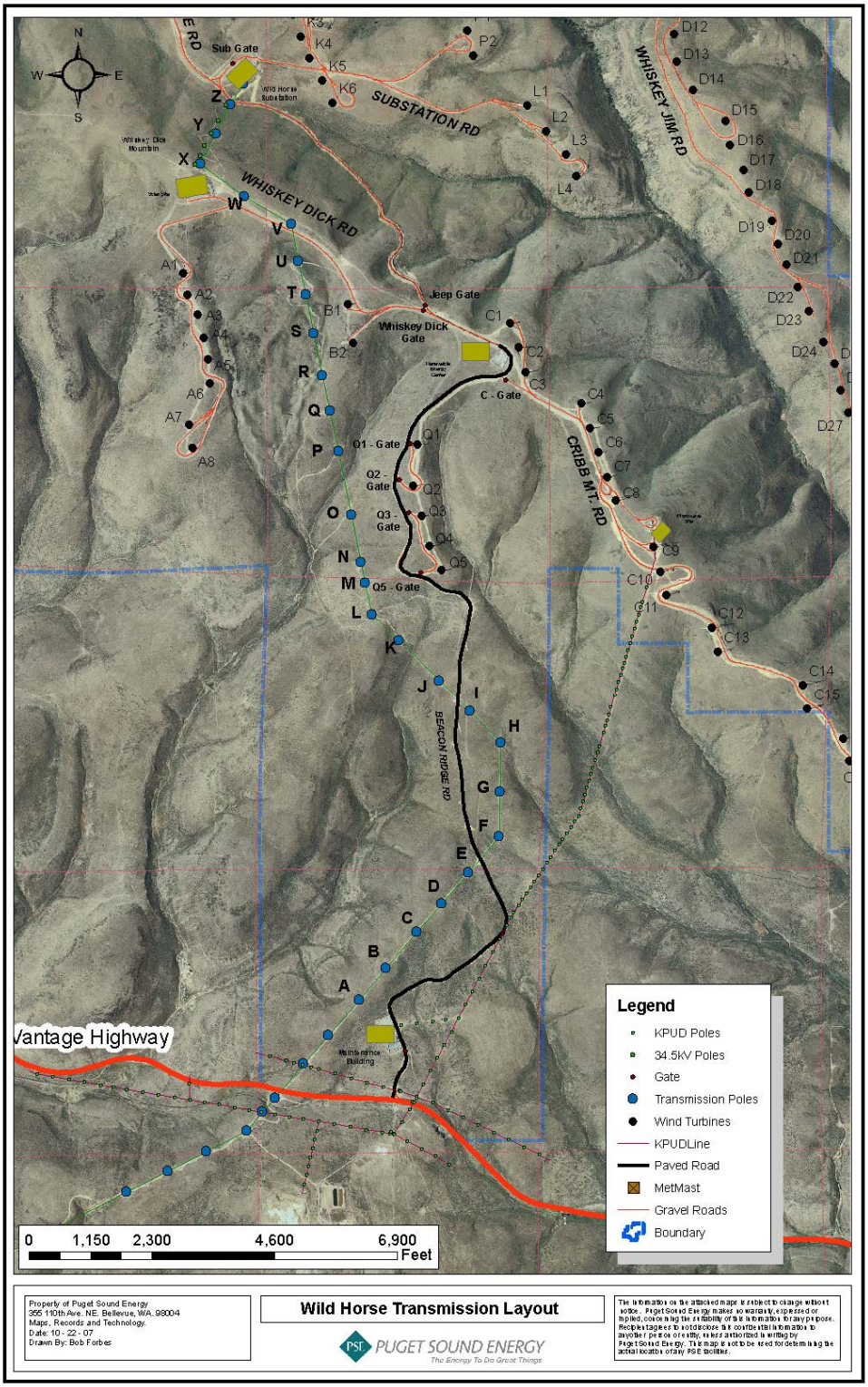
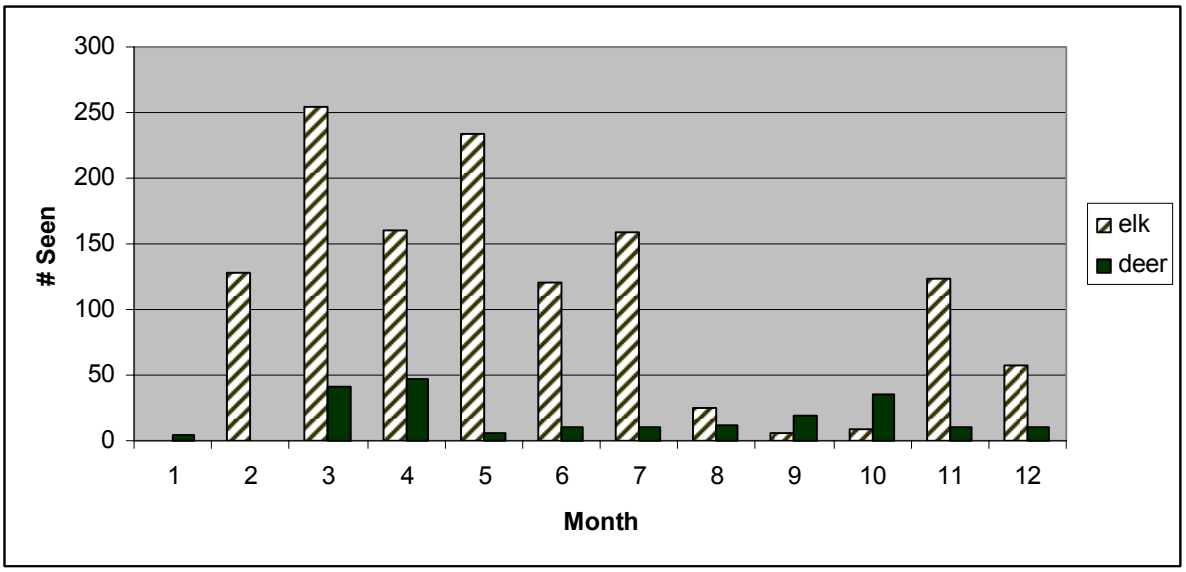


Figure 8. Photograph of sage grouse nest found near turbine E1.

Figure 9. Number of elk and deer observed by month.



APPENDIX A

Sample ID	Date	Taxa ID	Turbine	Plot	Scheduled Search	Condition
AMKE-041207-01	4/12/2007	American kestrel	P1	P1-P2	incidental	intact
AMKE-062107-01	6/21/2007	American kestrel	F3	F2-F3	incidental	intact
AMKE-072407-01	7/24/2007	American kestrel	D5	D5-D6	scheduled search	dismembered
AMKE-072607-01	7/26/2007	American kestrel	P1	P1-P2	scheduled search	feather spot
AMRO-032807-01	3/28/2007	American robin	J3	J3-J4	scheduled search	scavenged
AMRO-082307-01	8/23/2007	American robin	J3	J3-J4	scheduled search	scavenged
AMRO-102907-01	10/29/2007	American robin	O&M building		incidental	intact
BBMA-052207-01	5/22/2007	black-billed magpie	L4	L3-L4	scheduled search	dismembered
BRSP-082407-01	8/24/2007	Brewer's sparrow	O&M building		incidental	intact
BRSP-082407-02	8/24/2007	Brewer's sparrow	O&M building		incidental	scavenged
BRSP-082807-01	8/28/2007	Brewer's sparrow	O2	O2-O3	scheduled search	scavenged
BRSP-082807-02	8/28/2007	Brewer's sparrow	O&M building		incidental	intact
BRSP-100907-01	10/9/2007	Brewer's sparrow	O&M building		incidental	
CONI-070307-01	7/3/2007	common nighthawk	G2	G2-G3	scheduled search	dismembered
CONI-092407-01	9/24/2007	common nighthawk	D12		incidental	feather spot
CONI-092407-02	9/24/2007	common nighthawk	D14	D13-D14	scheduled search	feather spot
DEJU-100807-01	10/8/2007	dark-eyed junco	L2	L3-L4	scheduled search	dismembered
DEJU-100907-01	10/9/2007	dark-eyed junco	C3	C2-C3	scheduled search	feather spot

Sample ID	Date	Taxa ID	Turbine	Plot	Scheduled Search	Condition
DEJU-101007-01	10/10/2007	dark-eyed junco	Interpretive center		incidental	intact
DEJU-101107-01	10/11/2007	dark-eyed junco	J3	J3-J4	scheduled search	intact
DEJU-101507-01	10/15/2007	dark-eyed junco	O&M Building		incidental	intact
DEJU-103007-01	10/30/2007	dark-eyed junco	Interpretive center		incidental	dismembered
DEJU-103107-01	10/31/2007	dark-eyed junco	O&M Building		incidental	intact
GCKI-050107-01	5/1/2007	golden-crowned kinglet	C14	C14-C15	scheduled search	intact
GCKI-091007-01	9/10/2007	golden-crowned kinglet	A5	A5-A6	scheduled search	intact
GCKI-091207-01	9/12/2007	golden-crowned kinglet	E2	E1-E2	scheduled search	intact
GCKI-091807-01	9/18/2007	golden-crowned kinglet	M1	M1-M2	scheduled search	intact
GCKI-092407-01	9/24/2007	golden-crowned kinglet	F3	F2-F3	scheduled search	intact
GCKI-102207-01	10/22/2007	golden-crowned kinglet	O3	O2-O3	scheduled search	feather spot
GCKI-102907-01	10/29/2007	golden-crowned kinglet	B1	B1-B2	scheduled search	feather spot
GHOW-080207-01	8/2/2007	great-horned owl	C15	C14-C15	scheduled search	feather spot
GRPA-072407-01	7/24/2007	gray partridge	D6	D5-D6	scheduled search	feather spot
HAWO-070907-01	7/9/2007	hairy woodpecker	M2	M1-M2	scheduled search	feather spot
HOBA-081407-01	8/14/2007	hoary bat	O4	O2-O3	incidental	intact
HOBA-081407-02	8/14/2007	hoary bat	I1		incidental	intact
HOBA-082707-01	8/27/2007	hoary bat	C15	C14-C15	scheduled search	intact
HOBA-082907-01	8/29/2007	hoary bat	E1	E1-E2	scheduled search	scavenged
HOBA-082907-02	8/29/2007	hoary bat	M5	M5-M6	scheduled search	scavenged

Sample ID	Date	Taxa ID	Turbine	Plot	Scheduled Search	Condition
HOBA-083007-01	8/30/2007	hoary bat	M3		incidental	intact
HOBA-090607-01	9/6/2007	hoary bat	A1	A1-A2	scheduled search	intact
HOBA-091307-01	9/13/2007	hoary bat	A2	A1-A2	scheduled search	intact
HOBA-092007-01	9/20/2007	hoary bat	J3	J3-J4	scheduled search	dismembered
HOBA-092407-01	9/24/2007	hoary bat	D1	D1-D2	scheduled search	intact
HOFI-042507-01	4/25/2007	house finch	O&M Building		incidental	intact
HOLA-032207-01	3/22/2007	horned lark	E2	E1-E2	scheduled search	feather spot
HOLA-032307-01	3/23/2007	horned lark	J4	J3-J4	scheduled search	feather spot
HOLA-041807-01	4/18/2007	horned lark	H3	H2-H3	scheduled search	scavenged
HOLA-050307-01	5/3/2007	horned lark	M6	M5-M6	scheduled search	Intact
HOLA-051007-01	5/10/2007	horned lark	J3	J3-J4	scheduled search	Dismembered
HOLA-051507-01	5/15/2007	horned lark	D17	D17-D18	scheduled search	feather spot
HOLA-062507-01	6/25/2007	horned lark	Q5		incidental	Intact
HOLA-070507-01	7/5/2007	horned lark	C1	C2-C3	scheduled search	Scavenged
HOLA-082407-01	8/24/2007	horned lark	G4		incidental	Dismembered
HOLA-090407-01	9/4/2007	horned lark	D5		incidental	Dismembered
HOLA-091007-01	9/10/2007	horned lark	D17	D17-D18	scheduled search	Scavenged
HOWR-050807-01	5/8/2007	house wren	K3	K3-K4	scheduled search	Intact
LBBA-042007-01	4/20/2007	little brown bat	C15	C14-C15	incidental	Intact
LBBA-082807-01	8/28/2007	little brown bat	N1	N1-N2	scheduled search	Scavenged

Sample ID	Date	Taxa ID	Turbine	Plot	Scheduled Search	Condition
LBBA-091807-01	9/18/2007	little brown bat	M2	M1-M2	scheduled search	Intact
MALL-080707-01	8/7/2007	mallard	D35	D34-D35	scheduled search	feather spot
MGWA-050907-01	5/9/2007	MacGillivray's warbler	C17		incidental	Intact
MODO-080207-01	8/2/2007	mourning dove	D18	D17-D18	scheduled search	Intact
NOFL-032607-01	3/26/2007	northern flicker	C10	C10-C11	scheduled search	feather spot
RCKI-050807-01	5/8/2007	ruby-crowned kinglet	K5	K3-K4	scheduled search	Intact
RCKI-103007-01	10/30/2007	ruby-crowned kinglet	Q1		incidental	Intact
ROPI-061107-01	6/11/2007	rock pigeon	D34	D34-D35	scheduled search	feather spot
RTHA-060907-01	6/9/2007	red-tailed hawk	A8		incidental	Dismembered
SAGS-082307-01	8/23/2007	sage sparrow	O&M Building		incidental	Intact
SHBA-042507-01	4/25/2007	silver-haired bat	A1	A1-A2	scheduled search	Intact
SHBA-050907-01	5/9/2007	silver-haired bat	D8		incidental	Intact
SHBA-101007-01	10/10/2007	silver-haired bat	E2	E1-E2	scheduled search	Scavenged
SHBA-101007-02	10/10/2007	silver-haired bat	M4	M5-M6	scheduled search	Intact
TOWA-091707-01	9/17/2007	Townsend's warbler	D23	D21-D22	scheduled search	Intact
TOWA-092007-01	9/20/2007	Townsend's warbler	J3	J3-J4	scheduled search	Dismembered
UNID-062607-01	6/26/2007	unidentified bird	D1	D1-D2	scheduled search	feather spot
UNID-062607-02	6/26/2007	unidentified bird	D2	D1-D2	scheduled search	feather spot
UNID-092507-01	9/25/2007	unidentified bird	N2	N1-N2	scheduled search	feather spot
UNID-100907-02	10/9/2007	unidentified bird	C3	C2-C3	scheduled search	feather spot

Sample ID	Date	Taxa ID	Turbine	Plot	Scheduled Search	Condition
UNID-102207-01	10/22/2007	unidentified bird	G5	G6-G7	scheduled search	feather spot
UNKL-091407-02	9/14/2007	unidentified kinglet	C11	C10-C11	scheduled search	feather spot
UNKL-091707-01	9/17/2007	unidentified kinglet	D22	D21-D22	scheduled search	feather spot
UNPA-012507-01	1/25/2007	unidentified passerine	G3	G2-G3	scheduled search	feather spot
UNPA-050807-01	5/8/2007	unidentified passerine	D2	D1-D2	scheduled search	feather spot
VASW-081407-01	8/14/2007	Vaux's swift	I1		incidental	scavenged
WAVI-091407-01	9/14/2007	warbling vireo	D25	D25-D26	scheduled search	intact
WEGR-111307-01	11/13/2007	western grebe	O2	O2-O3	scheduled search	intact
WEKI-082207-01	8/22/2007	western kingbird	H2	H2-H3	scheduled search	scavenged
WETA-050907-01	5/9/2007	western tanager	E4		incidental	dismembered
WISA-031907-01	3/19/2007	Williamson's sapsucker	C8		incidental	intact
YRWA-042507-01	4/25/2007	yellow-rumped warbler	A2	A1-A2	scheduled search	intact
YRWA-091707-01	9/17/2007	yellow-rumped warbler	G7	G6-G7	scheduled search	dismembered
YRWA-121107-01	12/11/2007	yellow-rumped warbler	O&M Building		incidental	intact

APPENDIX B – INCIDENTAL WILDLIFE OBSERVATIONS

Species	Date	No.	Location	Notes
coyote	2/23/2007	1	M1, M2	act= trotting
coyote	5/14/2007	1	W of Q string, 200m	act= running. turbines running
coyote	5/21/2007	1	C10, C11	act= running. turbines running
coyote	5/29/2007	1	200m W of O string	act= running. turbines running
coyote	5/31/2007	1	water hole N of substation	act= walking.
coyote	8/8/2007	1	ON PLOT E9-E10	running
coyote	8/23/2007	1	CROSSING MAINLINE RD	running
coyote	9/27/2007	1	300 S Q5	running; turbinenotrunning
coyote	11/19/2007	1	300 m W, C14	turbine not running. turbine not running.
coyote	11/27/2007	1	100 m E, M2	turbine running.
coyote	11/27/2007	1	100 m E, D17	turbine not running.
elk	2/15/2007	10	1500m N of D18	
elk	2/16/2007	13	near turbine F3	act = grazing
elk	2/22/2007	30	east of turbine D-15	
elk	2/22/2007	75	approx. 100m from K6	1 antlered bull. act = grazing, bedding
elk	3/8/2007	11	ridge E of D25	act= resting
elk	3/8/2007	17	ridge E of D21	act = resting
elk	3/8/2007	23	ridge NW of F1	act = resting
elk	3/8/2007	20	D26	act= resting
elk	3/9/2007	25	G1	act = resting, grazing
elk	3/12/2007	100	crossing road near D1	act = walking
elk	3/12/2007	50	ridge N of N1	
elk	3/15/2007	4	moving W to E under D8	act= walking
elk	3/19/2007	2	near P1-P2	
elk	3/26/2007	1	300 m W, D4	turbine running
elk	3/29/2007	2	on ridge near C-string	both bulls observed from d25
elk	4/3/2007	5	A1, A2	act = resting. ran off when they saw me
elk	4/4/2007	10	ridge N of E1	act= resting
elk	4/6/2007	3	ridge W of D21	act= grazing
elk	4/9/2007	30	valley N of M1	act = grazing, walking
elk	4/10/2007	16	800m W of turbine A3	act= grazing
elk	4/10/2007	3	N of visitor's center	act= grazing

Species	Date	No.	Location	Notes
elk	4/10/2007	3	near turbine D15	act= running
elk	4/10/2007	8	near L4	act= grazing, bedding
elk	4/10/2007	20	near Q-string	act= walking
elk	4/13/2007	5	SE of J4	act= grazing
elk	4/16/2007	15	W of D8	
elk	4/16/2007	12	E of L1	act= grazing
elk	4/23/2007	9	near F2	
elk	4/24/2007	9	100m from E8	
elk	4/26/2007	13	200m W of M6	act= grazing
elk	5/2/2007	3	200m from EI	act= grazing. turbines running.
elk	5/3/2007	15	800m from P1	act= bedded. turbines not running
elk	5/3/2007	13	800m from J4	act= bedded. turbines running.
elk	5/7/2007	10	800m from F3	act= grazing. turbines running.
elk	5/8/2007	50	N1, N2	turbines running
elk	5/10/2007	5	J3, J4	act= grazing. turbines not running
elk	5/10/2007	4	800m from interp. Center	act= running
elk	5/14/2007	27	P1, P2	act= grazing. turbines running
elk	5/15/2007	20	800m E of P2	act= bedded.turbines not running
elk	5/18/2007	15	400m W of O1	act= bedded. turbines running
elk	5/21/2007	8	800m E of D7	act= grazing. turbines running
elk	5/22/2007	3	200m NW of B1	act= grazing. turbines running
elk	5/22/2007	20	50m from L2	turbines running
elk	5/29/2007	5	300m of O string	act= walking. turbines running
elk	5/29/2007	13	N1, N2	act= bedded. turbines running
elk	5/30/2007	7	100m from J1	act= grazing. turbines running
elk	5/30/2007	1	E1, E2	act= grazing. turbines running
elk	5/31/2007	9	J3, J4	act= grazing. turbines running
elk	5/31/2007	6	200m S of E9	act= grazing. turbines running

Species	Date	No.	Location	Notes
elk	6/5/2007	2	300m W, L4	act= grazing. turbines running
elk	6/7/2007	8	400m W O2	act= grazing. turbines running
elk	6/18/2007	4	300m W D6	act= bedded. turbines running
elk	6/18/2007	30	200m W M-string	turbines running
elk	6/18/2007	1	300m S substation	act= grazing
elk	6/26/2007	1	F2, F3	act= running. turbines running
elk	6/27/2007	4	300m E mainline Rd	act= bedded
elk	6/27/2007	8	at H2O tank near F string	turbines running
elk	6/28/2007	7	200m W K6	act= bedded. turbines running
elk	6/29/2007	32	200m W M6	turbines running
elk	6/29/2007	2	D5, D6	act= crossing road. turbines running
elk	6/29/2007	2	150m W D4	act= bedded. turbines running
elk	6/30/2007	20	100m W mainline Rd	
elk	7/1/2007	17	100 M FROM F5	turbine running; grazing bedded
elk	7/1/2007	31	100 M W OF F3	turbine running; grazing bedded
elk	7/4/2007	1	SITTING BENEATH M4 STARIS	turbine running; bedded
elk	7/7/2007	40	CORAL 200 M W M6	turbine running; various activities
elk	7/26/2007	30	100M NW P1	turbine running; various activities
elk	7/27/2007	40	WATER TROUGHT AT MAINLINE RD	bedded/grazing
elk	8/31/2007	25	200 M E M2	turbine running; crossing road
elk	9/13/2007	6	300 M S OF P1	grazing. turbine running
elk	10/4/2007	7	400 JOF E-10	turbine not running; walking
elk	10/8/2007	2	400 S G6	turbine running; grazing
elk	11/1/2007	1	300 m W, D4	turbine running.
elk	11/3/2007	70	100 m N, Interpretive Center	
elk	11/3/2007	30	100 m W, Substation	
elk	11/21/2007	1	400 m W, D3	turbine not running.

Species	Date	No.	Location	Notes
elk	11/26/2007	1	300 m S, Substation	
elk	11/27/2007	20	400 m W, D29	turbine running.
elk	12/6/2007	40	100 m E of E-String	turbines not running.
elk	12/10/2007	9	200 m E, Turbine G2	turbine not running.
elk	12/10/2007	7	200 m E, Turbine G2	turbines not running.
elk	12/10/2007	2	100 m E of E-String	turbines not running.
mule deer	1/11/2007	4	300 m W, C18	turbine running.
mule deer	3/13/2007	5	within the .66-.67 plot	act= grazing
mule deer	3/13/2007	12	underneath M6	act= grazing
mule deer	3/14/2007	4	on ridge W of L3	
mule deer	3/19/2007	5	near J3	act = grazing
mule deer	3/21/2007	6	near G1	act = grazing
mule deer	3/22/2007	6	near F5	act = grazing
mule deer	3/27/2007	3	on ridge N of E1	act= running
mule deer	4/9/2007	5	near visitor's center	act= grazing
mule deer	4/9/2007	9	along E-string	act= walking
mule deer	4/10/2007	2	ridge W of Dstring	
mule deer	4/12/2007	8	near G-string	act= grazing
mule deer	4/13/2007	6	near visitor's center	act= grazing
mule deer	4/25/2007	3	E1, E2	act= grazing
mule deer	4/25/2007	10	100m from G3	act= grazing
mule deer	4/30/2007	4	B1, B2	
mule deer	5/10/2007	2	S of plot J3, J4, 800m	act= grazing
mule deer	5/14/2007	1	800m from turbine K8	act= walking. turbine running.
mule deer	5/15/2007	1	B1, B2	act= grazing. turbines running
mule deer	5/22/2007	1	underneath D3	act= running. turbines running
mule deer	5/31/2007	1	P1, P2	act= bedded. turbines running
mule deer	6/7/2007	2	D9, D10	act= grazing. turbines running
mule deer	6/28/2007	1	P1, P2	act= bedded. turbines running
mule deer	6/29/2007	3	100m W L3	act= running. turbines running
mule deer	6/29/2007	2	150 W F String	act= running. turbines running
mule deer	6/29/2007	2	D20-21	act= crossing road. turbines running
mule deer	6/30/2007	1	50m W C4	act= grazing. turbines running
mule deer	7/2/2007	2	MAINLINE RD NEAR SUB STAT	running

Species	Date	No.	Location	Notes
mule deer	7/3/2007	1	SITTING BENEATH D8 STAIR	turbine running, activity bedded
mule deer	7/4/2007	1	400 m S, K6	turbine running
mule deer	7/4/2007	2	SITTING BENEATH P1 STAIRS	turbine running; bedded
mule deer	7/24/2007	1	300 M W F2	turbine running; grazing
mule deer	7/28/2007	3	200M W OF L1	turbine running; grazing
mule deer	8/3/2007	4	200M W H3	turbine running; grazing
mule deer	8/15/2007	4	150 M E OF D6	turbine running; grazing
mule deer	8/21/2007	4	150M E OF D6	turbine running; grazing
mule deer	9/2/2007	3	150 M N OF C1	turbine running
mule deer	9/6/2007	4	200 M OF D5	grazing. turbine running
mule deer	9/19/2007	3	100 W G-STRING	running; turbine running
mule deer	9/21/2007	1	50 N OF D5	running; turbine running
mule deer	9/21/2007	3	200 M N INTERP CENTER	running
mule deer	9/21/2007	1	100 S OF SUBSTATION	grazing
mule deer	9/24/2007	4	100 M W OF SUBSTATION	grazing
mule deer	10/1/2007	1	400 W OF HZ	turbine running; crossing road
mule deer	10/3/2007	4	300 M S G3	grazing; turbine running
mule deer	10/3/2007	3	300 E E-STRING	turbine not running; grazing
mule deer	10/4/2007	5	300 W K-STRING	turbine not running; grazing
mule deer	10/5/2007	2	300 S SUBSTATION	turbine not running; running
mule deer	10/5/2007	2	100 D8	turbine not running; running
mule deer	10/8/2007	2	300 W L4	turbine running; running
mule deer	10/24/2007	7	ON PLOT M5-M6	turbine running; running
mule deer	10/25/2007	3	300 W G-STRING	turbine running; walking

Species	Date	No.	Location	Notes
mule deer	10/29/2007	1	400 W M6	turbine running; walking
mule deer	10/30/2007	2	400 S K6	turbine running; drinking
mule deer	10/31/2007	4	100 S F5	turbine not running; grazing
mule deer	11/2/2007	1	200 m S, K6	turbine running.
mule deer	11/8/2007	1	300 m W, F1	turbine not running.
mule deer	11/14/2007	7	On plot M5 - M6	turbines running.
mule deer	11/14/2007	2	Crossing main road	
mule deer	12/4/2007	6	50 m W, Substation	
mule deer	12/10/2007	4	100 m W, Turbine G5	turbine not running.
greater sage grouse	9/24/2007	1	10T 0712713/5213366; 126 M W D2	turbine running
sage grouse nest	11/14/2007	1	10T 07116647, 5213881 UTM NAD27, 98 m, E1	possible grsg nest. pictures taken. egg fragments collected.
American kestrel	3/6/2007	1	approx. 200 m from substation	
American kestrel	3/19/2007	1	near substation	
American kestrel	4/2/2007	1	near M6	
American kestrel	4/10/2007	1	near turbine D6	
American kestrel	4/13/2007	1	near E-string	
American kestrel	4/13/2007	2	near B1	
American kestrel	4/16/2007	1	near D2	
American kestrel	4/17/2007	1	near H-string	
bald eagle	3/22/2007	1	above Q, string heading W	
golden eagle	2/8/2007	1	Near 01	west of o1 500 meters
golden eagle	5/30/2007	1	soaring over E-string	turbines running
golden eagle	9/7/2007	1	150 W OF D25	turbine running
golden eagle	12/10/2007	1	100 m E, Turbine G7	turbine not running.
merlin	12/5/2007	1	100 m N, Turbine E1	turbine running.
northern harrier	3/6/2007	1	flying under turbine J4	
northern harrier	3/7/2007	1	approx. 300m from MS	
northern harrier	3/9/2007	1	near E5	
northern harrier	3/22/2007	1	within plot E1-E2	
northern harrier	3/23/2007	1	near turbine P2	
northern harrier	3/27/2007	1	near E2	
peregrine falcon	11/22/2007	1	Perched on pole "W"	
prairie falcon	4/13/2007	1	near Q5	
red-tailed hawk	2/16/2007	1	300 m West of M6	
red-tailed hawk	3/7/2007	1	hoovering under E8	
red-tailed hawk	3/19/2007	1	flying within plot C6 -C7	
red-tailed hawk	3/26/2007	1	above C7	

Species	Date	No.	Location	Notes
red-tailed hawk	3/29/2007	2	near turbine C10	
red-tailed hawk	4/3/2007	1	valley W of D-string	
red-tailed hawk	4/6/2007	1	near substation	
red-tailed hawk	4/6/2007	1	near visitor's center	
red-tailed hawk	4/12/2007	1	canyon N of E1	
red-tailed hawk	11/8/2007	1	Perched on pole "G"	
rough-legged hawk	2/8/2007	1	Near D9	tree. l.h.
rough-legged hawk	2/22/2007	1	near main office	
rough-legged hawk	3/9/2007	1	on telephone pole by substation	
unidentified falcon	4/2/2007	1	near substation	
unidentified falcon	4/9/2007	1	near M1	
unidentified falcon	11/15/2007	1	Perched on pole "Y"	
unidentified raptor	10/31/2007	1	PERCHE ON POWERPOLE E OF MAIN ROAD BELOW HILL	
unidentified raptor	11/16/2007	1	Perched on pole "C"	
unidentified raptor	11/22/2007	1	Perched on pole "H"	
gopher snake	5/11/2007	1	0714478, 5212666	act= basking. turbines running
gopher snake	6/4/2007	1	D13, D14	act= basking. turbines running
gopher snake	6/26/2007	1	F-string road	act= basking. turbines running. moved him off of road
gopher snake	6/28/2007	1	J3, J4	act= basking. turbines running
gopher snake	8/3/2007	1	ON PLOT G2-G3	turbine running; basting
rattlesnake	7/7/2007	1	COILED IN ROCKS BASE G1	aggravated. 0913 am, sunny light breeze, turbine running
rattlesnake	7/26/2007	1	60M E J3, PLOT J3-J4	aggrevated, hiding in sage, 0958 am turbine running
rattlesnake	8/13/2007	1	ON ROAD 30 M C16	turbine running; basking
rattlesnake	9/17/2007	1	ON PLOT G6-G7	basking turbine running
rubber boa	5/16/2007	1	0711658, 5213842	act= basking. turbines running
rubber boa	5/29/2007	1	N1, N2	act= moving. turbines running

Species	Date	No.	Location	Notes
short-horned lizard	4/6/2007	1	near C11 within plot C10-C11	act= basking. photographs taken
short-horned lizard	4/18/2007	1	within plot E1-E2	act= running
short-horned lizard	4/27/2007	1	Q3, Q4	act= basking
short-horned lizard	5/14/2007	1	G2, G3	
short-horned lizard	5/15/2007	2	A5, A6	act= running. turbines running
short-horned lizard	5/16/2007	2	on M5, M6	act= running. turbines running
short-horned lizard	5/18/2007	2	O2-O3	act= running. turbines running
short-horned lizard	5/22/2007	1	on plot B1, B2	act= running. turbines running
short-horned lizard	5/24/2007	1	D30, D31	act= running. turbines running
short-horned lizard	6/6/2007	1	G6, G7	act= basking. turbines running
short-horned lizard	6/11/2007	2	D17, D18	act= basking. turbines running
short-horned lizard	6/12/2007	1	A5, A6	act= running. turbines running
short-horned lizard	6/27/2007	4	H2, H3	act= running. turbines running
short-horned lizard	8/7/2007	2	ON PLOT D30-D31	turbine running; crawling
short-horned lizard	8/23/2007	2	300 M W J3	turbine running
short-horned lizard	8/23/2007	2	ON PLOT M5-M6	turbine running; crawling
short-horned lizard	8/24/2007	3	ON PLOT A1-A2	turbine running
short-horned lizard	8/29/2007	2	ON PLOT M5-M6	turbine running
short-horned lizard	8/29/2007	2	ON PLOT H2-H3	turbine running
short-horned lizard	8/30/2007	2	ON PLOT J3-J4	turbine running
short-horned lizard	8/31/2007	2	ON PLOT C10-C11	turbine running
short-horned lizard	9/4/2007	1	ON PLOT D1-D2	turbine running
short-horned lizard	9/4/2007	2	ON PLOT D13-D14	turbine running
short-horned lizard	9/5/2007	3	ON PLOT H2-H3	turbine running
short-horned lizard	9/5/2007	2	ON PLOT E1-E2	turbine running
short-horned lizard	9/7/2007	2	ON PLOT C10-C11	turbine running
short-horned lizard	9/11/2007	1	ON PLOT D30-D31	turbine running
short-horned lizard	9/12/2007	1	ON PLOT M5-M6	turbine running
unidentified lizard	5/10/2007	1	711127, 5210563	
unidentified snake	5/18/2007	1	D25-26	act= basking. turbines running
unidentified snake	5/31/2007	1	J3, J4	act= moving. turbines running

Species	Date	No.	Location	Notes
western diamondback rattlesnake	6/4/2007	1	D13, D14	act= basking. turbines running
western yellow-bellied racer	8/16/2007	1	ON PLOT D25-D26	turbine running