POST-CONSTRUCTION AVIAN AND BAT FATALITY MONITORING AND GRASSLAND BIRD DISPLACEMENT SURVEYS AT THE JUDITH GAP WIND ENERGY PROJECT, WHEATLAND COUNTY, MONTANA

Prepared for

Judith Gap Energy, LLC
Chicago, Illinois

Prepared by

TRC Environmental Corporation
Laramie, Wyoming

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EXECUTIVE SUMMARY

Judith Gap Energy, LLC operates the Judith Gap Wind Energy Project (JGWEP) in Wheatland County, Montana. The Farm Service Agency and the Montana State Lands Department were cooperating agencies for the preparation of an environmental assessment for the project. One of the stipulations for the Finding of No Significant Impact was a commitment to monitor avian and bat fatalities during operations. The *Avian and Bat Monitoring Plan, Judith Gap Wind Energy Project, Wheatland County, Montana* (TRC 2006) presented a detailed protocol for monitoring bird and bat fatalities at the JGWEP. Studies were conducted during the fall 2006 and spring 2007 migration periods, and this report presents the results and fatality estimates for birds and bats at JGWEP. A grassland bird displacement study was also conducted, and comparisons were made between point counts of breeding grassland birds before and after construction and operations of the JGWEP.

The JGWEP consists of 90 turbines, 20 of which were selected for monthly carcass searches. Estimates of total fatalities and fatalities per turbine were calculated based on the number of carcasses found after adjusting for searcher efficiency and scavenger removal rates. Thirty-five bat and 15 avian carcasses were found during carcass searches, and one bat and 11 avian carcasses were found incidentally. Searcher efficiency estimates were 17% for small birds (42% when adjusted for carcass placement-searcher efficiency trial time gap) and 77% for large birds. Estimated mean carcass residency time was 9.07 days for small birds and 15.43 days for large birds. Based on the number of carcasses found, and adjusting for searcher efficiency and scavenger removal rates, estimated turbine-related fatalities at JGWEP during the study period were 1,206 bats (13.40/turbine) and 406 birds (4.52/turbine). Bird fatality estimates were further broken down into small birds (344 fatalities; 3.83/turbine) and large birds (62 fatalities; 0.69/turbine). Bird fatalities were fairly uniformly spread over the study period, but 97% of the bat fatalities were recorded during fall migration (71% in August). One raptor fatality, a short-eared owl, was recorded during the study period. The results of the grassland bird displacement study suggested that construction of the windfarm did not negatively impact numbers of breeding grassland birds. Point counts performed in 2003 before construction of the windfarm were

replicated in 2007, and there was a 54% increase in numbers of birds detected in the vicinity of the turbines compared to a 20% increase in control plots with no turbines.

1.0 INTRODUCTION

Judith Gap Energy, LLC (JGE) operates a 135-megawatt (MW) wind energy facility consisting of 90 turbines on approximately 8,000 acres (3,237 ha) in Wheatland County, Montana (Figure 1.1). The turbines are GE 1.5SLE 1.5-MW models with a 262-ft (80-m) hub height, 253-ft (77-m) blade diameter, and a rotor-swept area of 50,129 ft^2 (4,657 m^2). The facility became operational in November 2005 and all turbines were on-line by January 2006. The Judith Gap Wind Energy Project (JGWEP) interconnects with NorthWestern Energy's transmission lines and provides as much as 8% of NorthWestern's electric supply.

Studies at existing wind farms in California have suggested that wind power development may detrimentally impact birds and bats due to mortality from collisions with turbine rotors and collisions with or electrocution by associated transmission lines (McCrary et al. 1986; Howell and DiDonato 1991; Orloff and Flannery 1992). Birds also may be negatively impacted by displacement resulting from habitat loss and disturbance (Leddy et al. 1999; Strickland 2004). In general, studies conducted at wind energy facilities outside California have found lower rates of avian and bat fatalities (Higgins et al. 1996; Erickson et al. 2000; Young et al. 2003; Erickson 2004); however, studies conducted at wind farms located on mountain ridgetops in the eastern U.S. have reported high fatality rates for migrating bats (Kerns and Kerlinger 2004; Fiedler et al. 2007). This suggests that local species composition and abundance, geographic area, topography, and turbine type and placement all contribute to the potential for avian and bat fatalities at individual wind farms.

Prior to construction of the JGWEP, the Farm Service Agency and the Montana State Lands Department prepared an environmental assessment (EA) of the proposed project. Given the JGWEP's proposed location, there was concern that the topography north of the project area--a gap between two mountain ranges--might funnel migratory birds and bats through the project area, thereby elevating the potential for avian and bat collisions with wind turbines during the migration period. Although preconstruction surveys suggested that mortality rates would not exceed those documented at other western wind farms, JGE committed to monitoring avian and

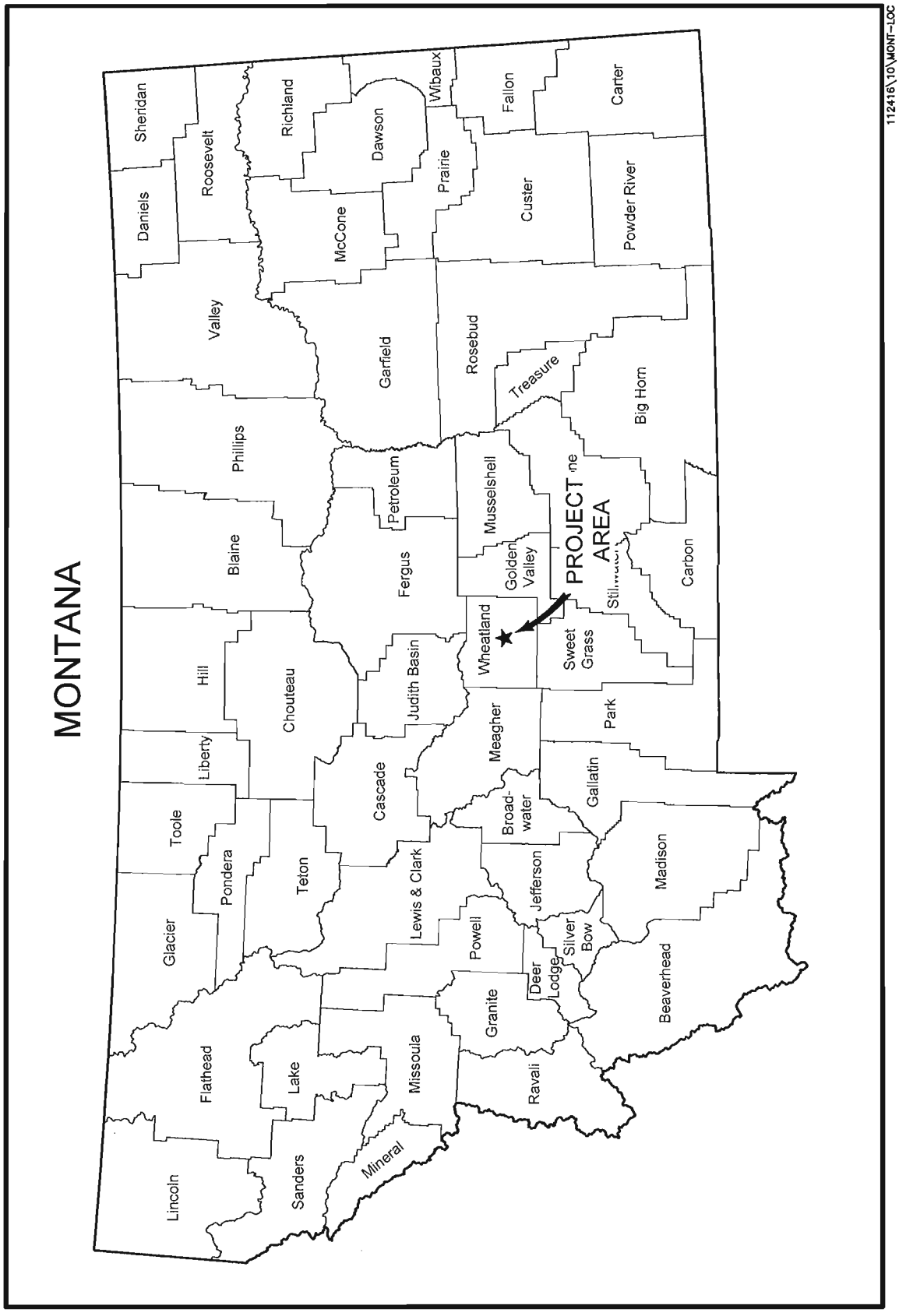

Figure 1.1 Project Location.

bat fatalities during its operation as part of the stipulations in the Decision Record and Finding of No Significant Impact for the EA. JGE representatives met with the U.S. Fish and Wildlife Service and NorthWestern Energy on April 11, 2006, and agreed to a monitoring plan that incorporated the primary concerns of the involved parties and focused on the as-built project, which included 30 fewer turbines than the original project evaluated in the EA. The monitoring plan, which involved conducting fatality searches during bird migration periods, was also agreed upon by a Technical Advisory Committee (TAC) comprised of agency, energy, and consultant personnel. The monitoring plan included estimating the number of avian and bat fatalities attributable to the project based on avian and bat fatalities documented during migration periods. Fatality estimates were calculated by adjusting for two potential sources of bias: 1) the amount of time carcasses remained on-site (scavenger removal bias) and 2) differences in detection abilities by observers (searcher efficiency rates) (Morrison 2002).

Migrant and resident birds may be killed by colliding with wind turbines and associated energy-related structures, and resident birds may be displaced from wind facilities by loss of habitat or disturbance in the immediate vicinity of the turbines during and after construction (Leddy et al. 1999; Strickland 2004). To evaluate the potential displacement of resident birds by the JGWEP, point-count surveys were conducted from April-June 2007 along transects located both within the wind farm and in control areas outside the wind farm. Results of these point counts were compared to preconstruction point counts that were conducted along the same transects in 2003, and the results are presented in Appendix A.

2.0 METHODS

2.1 PROJECT AREA LOCATION

The JGWEP straddles north/south-trending State Highway 191 between the towns of Judith Gap (located 6.2 mi [10.0 km] north of the site) and Harlowtown (located 7.5 mi [12.0 km] south of the site) in Wheatland County, Montana. Topographically, the project area lies less than 10.0 mi (16.0 km) south of a 10 to 15-mi (16 to 24-km) wide gap between the Big Snowy Mountains and the Little Belt Mountains. The project area and its surroundings consist of rolling hills, ridges, and flat benches dissected by broad valleys at an elevation of approximately 4,500-4,600 ft (1,372-1,402 m). Wind turbines are located in Sections 1, 4, 5, 6, 7, 8, 9, 12, 17, and 18, T9N, R16E, and Sections 29, 30, 31, 32, and 33, T10N, R16E. Vegetation in the project area consists of native short-grass prairie, located primarily on the west side of Highway 191; cultivated dryland agriculture, located primarily east of the highway; and Conservation Reserve Program (CRP) grassland, located primarily east of Highway 191 and north of east/west-trending Oxford Road (Figure 2.1). Sixteen of the 90 turbines are located in cropland, 51 are in CRP, and 23 are in short-grass prairie.

2.2 FATALITY STUDIES

2.2.1 Standardized Carcass Searches

Monthly carcass searches were conducted in the project area during the fall (August-October 2006) and spring (February-May 2007) migration seasons to enable estimation of the number of avian and bat fatalities attributable to collision with the wind turbines. Searches were conducted on survey plots that were established at 20 of the 90 wind turbines. The number of turbine plots that were sampled was based on an examination of the estimated confidence intervals attained under different sampling scenarios. Assuming a fatality rate of 4.5 fatalities per turbine per year (U.S. Farm Service Agency and Montana Department of State Lands 2004), and with a desired confidence level of 90%, it was determined that a sample size of 20 turbines would enable fatality estimates with a margin of error of approximately ±74 birds/bats per year (18%).

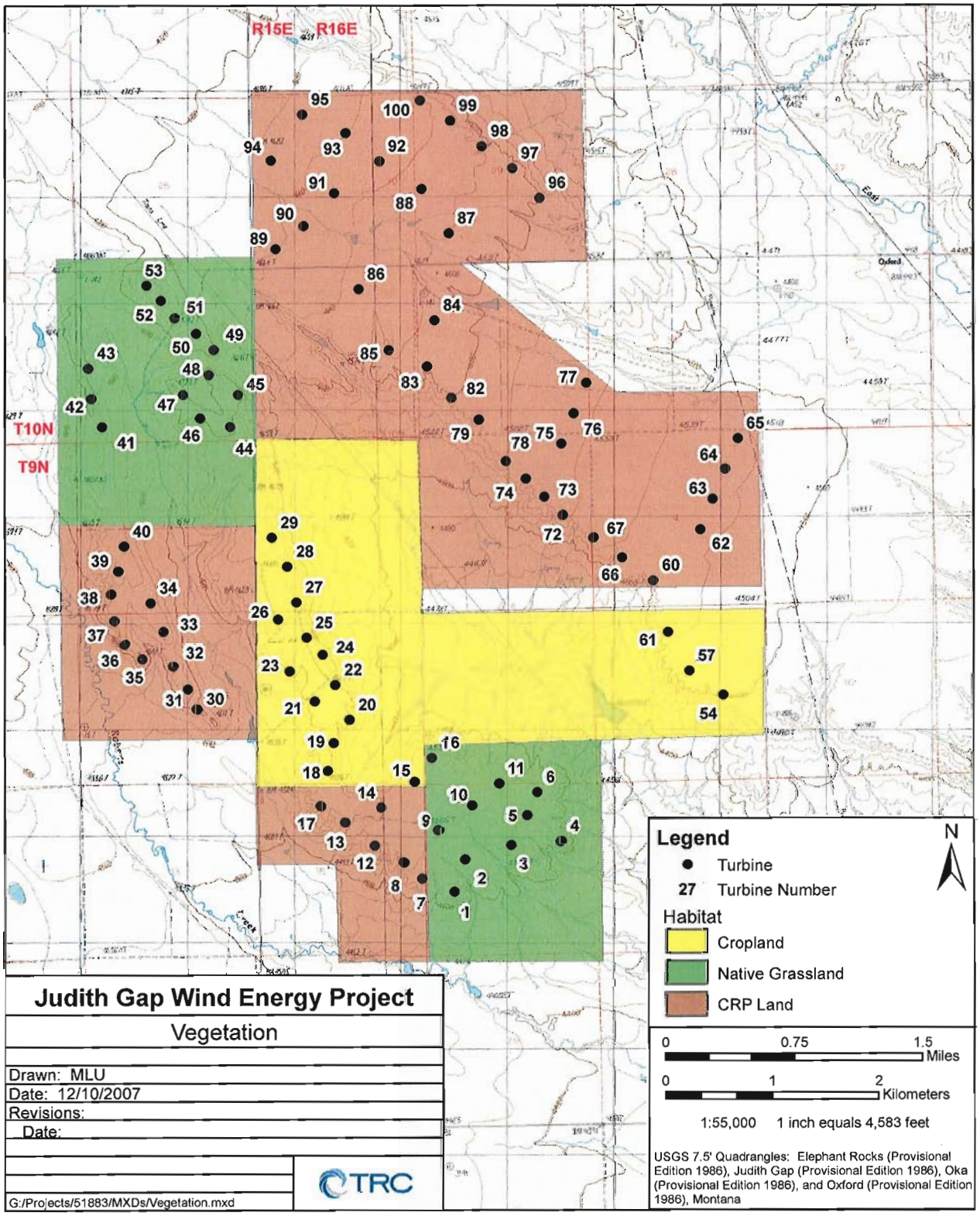

Figure 2.1 Turbine Locations and Habitat Association at the Judith Gap Wind Energy Project.

Six of the sampled turbines were located in native grassland habitat and 14 were in CRP. No turbine plots were located in cropland because walking transects in these areas would have damaged crops. Data collected during carcass searches at other wind energy sites have shown that nearly all birds and bats that strike turbines fall within 207 ft (63 m) of the tower (Erickson et al. 2000; Johnson et al. 2002; Young et al. 2003); therefore, plot sizes at JGWEP were conservatively set at 623 x 623 ft (190 x 190 m) to ensure that birds and bats that struck a turbine fell within the search plot. Square plots (rather than circular plots) were used to facilitate marking the plot boundaries while conducting the searches. The long axis of each plot (i.e., the diagonal axis connecting two nonadjacent corners) was oriented east/west so that the maximum distances searched coincided with the direction of the prevailing winds.

To locate avian and bat carcasses, trained searchers walked along unmarked linear transects spaced approximately 20-33 ft (6-10 m) apart across the entire survey plot. Spacing of transects varied depending on the season, topography, and type of vegetation because these factors affected visibility. Searchers typically searched for birds along both sides of each transect out to approximately 13-16 ft (4-5 m), and spent approximately two hours searching each of the 20 turbine plots.

Carcasses found on turbine plots were assumed to have been killed by striking turbines unless evidence indicated otherwise (e.g., if the carcass was a juvenile bird that was too young to fly). This protocol results in a conservative estimate of wind project fatalities, and has become standard methodology for wind energy and other collision-related mortality studies (e.g., Erickson et al. 2003; Young et al. 2003; Erickson et al. 2000) because of the high costs associated with obtaining accurate estimates of natural and reference mortality rates.

The location of each carcass was recorded using a global positioning system (GPS) unit. Carcasses (or carcass remains) were photographed as they were found, marked with spray paint so they would not be counted again if they were relocated during a future search, and left on site. Searchers filled out a Fatality/Injured Wildlife Data Form (Appendix C) for every carcass found. Recorded data included turbine/survey plot number; carcass species; sex and age, if they

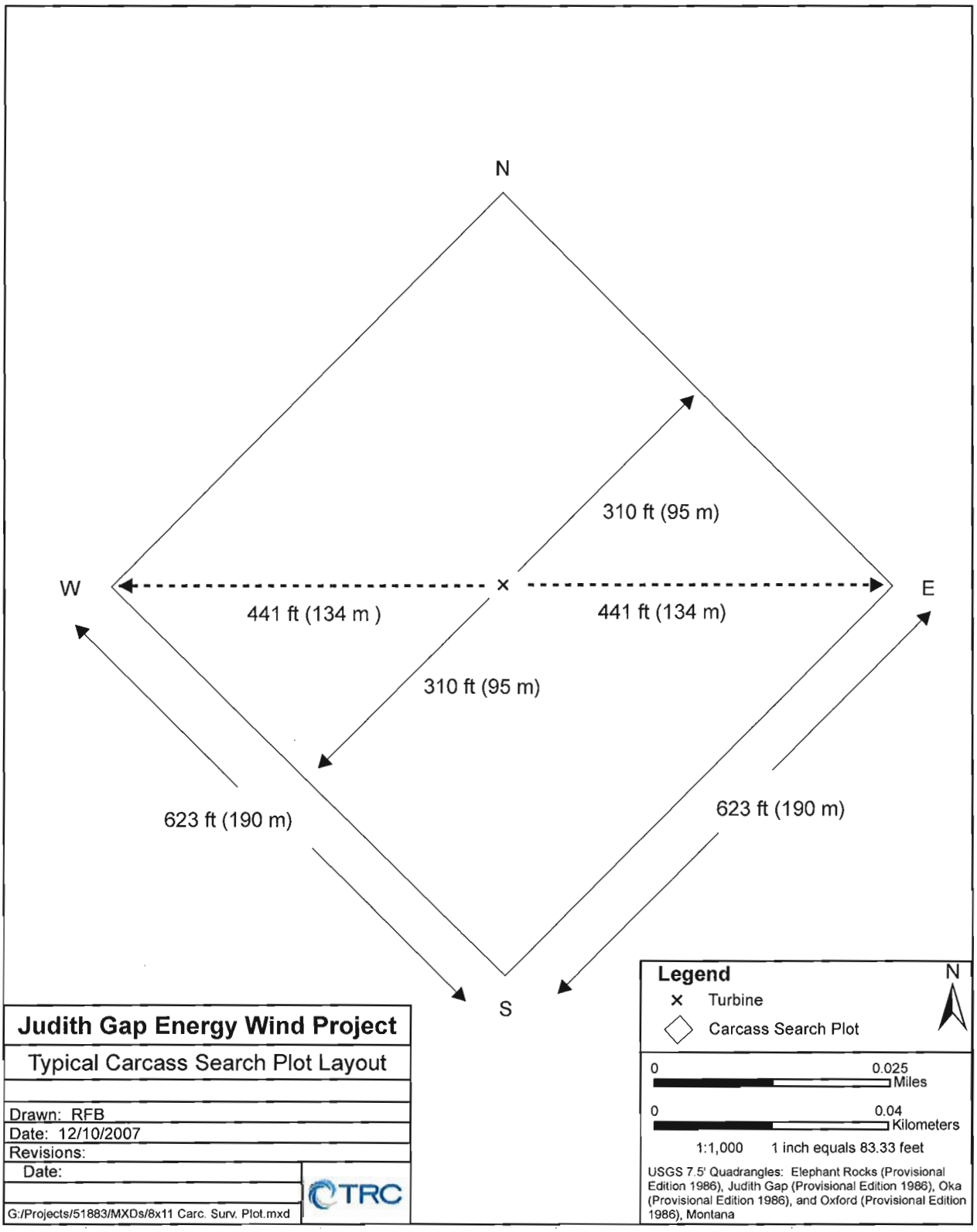

Figure 2.2 Carcass Search Plot Layout.

could be determined; date and time the carcass was located; condition of the carcass; approximate time since death; and, if the animal was estimated to have been dead less than one week, weather conditions that occurred at or before the estimated time of death. When in-field identification of carcass species was not possible, identification was made later using the photographs. Distances of carcasses from the search tower were calculated later in a geographic information system (GIS) using the carcass GPS location and the Measure function in ArcMap (ArcGIS 9.2). The condition of the carcass was categorized as follows.

- **Intact:** An intact carcass that was not badly decomposed and showed little or no signs of being fed upon by a predator or scavenger.
- **Scavenged:** An entire carcass that showed signs of being fed upon by a predator or scavenger, or a dismembered carcass (carcass remains such as wings, skeletal remains, or legs).
- **A feather spot:** Ten or more feathers or two or more primaries (flight feathers) present, indicating predation or scavenging of the carcass.

U.S. Fish and Wildlife Service enforcement personnel were notified by e-mail when a migratory bird was located during a carcass search survey or incidentally in the project area. Bats were collected and frozen for DNA analysis at the request of the Montana Fish Wildlife and Parks Department.

2.2.2 Incidental Carcass Finds

Fatalities found within search plots but outside designated search times and fatalities found outside designated search plots were treated as incidental discoveries and were not included in fatality estimates. Fatalities documented by operations and maintenance personnel and others not conducting the standardized carcass searches were photographed to facilitate future identification and recorded on the Fatality/Injured Wildlife Data Form (Appendix C). Recorded data included location of the carcass; date and time the carcass was located; carcass species, if determined; condition of the carcass; distance and bearing of the carcass from the nearest turbine or structure; approximate time since death; and, if the animal was estimated to have been dead less than one week, weather conditions that occurred at or before the estimated time of death.

2.2.3 Searcher Efficiency Trials

The objective of the searcher efficiency trials was to evaluate the searchers' detection abilities. Searcher efficiency trials were conducted on the same survey plots as the carcass searches and provided an estimate of the proportion of actual avian and bat carcasses that were likely to be detected by searchers. Searcher efficiency trials were conducted to evaluate searcher efficiency by season, habitat, and carcass size. The searcher efficiency rates were then used to adjust the estimated avian and bat fatality rates for searcher bias.

Searcher efficiency was anticipated to be low in CRP habitat because of vegetation reducing carcass visibility. However, it was decided not to improve detection of carcasses by mowing CRP search areas because mowing would have increased the turbine footprint, reduced available cover for grassland birds, and possibly increased carcass scavenging rates.

Six searcher efficiency trials were conducted: one in each month that turbine plots were searched, except in February when weather conditions and safety issues with the turbines disrupted a portion of the monitoring work. Searchers did not know when trials were being conducted, nor on which survey plots searcher efficiency carcasses had been placed. During each of the six searcher efficiency trials, 10 bird carcasses (five large and five small) were placed on randomly selected survey plots. Large bird carcasses were represented by hen pheasants, and small bird and bat carcasses were represented by small quail. Both carcass types were purchased from a game farm. Because no naturally occurring pheasants or quail were observed on-site, the use of these species for searcher efficiency trials prevented feathers scattered by scavengers from being erroneously recorded as turbine-strike fatalities. Searcher efficiency trials conducted previously (Johnson et al. 2003; Young et al. 2003) suggested that searcher efficiency rates were similar for bats and small birds. Therefore, small birds were used to determine the searcher efficiency rates for both small birds and bats in this study.

Carcasses were placed in random locations on the selected plots. Prior to placement, each carcass was marked discreetly so that it could be identified as a searcher efficiency carcass rather than a turbine-strike carcass. Because of personnel limitations and travel distances to the wind

farm, turbine plots containing searcher efficiency carcasses sometimes were not surveyed until several days after the carcasses had been placed. Each searcher efficiency carcass that was found was recorded, and searcher efficiency rates for large and small carcasses, CRP and grasslands, and fall and spring migration periods were calculated.

2.2.4 Carcass Removal Trials

Carcass removal trials were conducted to determine how long carcasses typically remained on the search plots (i.e., the length of time that they were available for detection). Carcass removal included removal by predators, scavengers, or any other means. Estimates of carcass removal were factored into overall fatality estimates to account for removal bias (i.e., turbine-strike fatalities being removed from the search area before they could be located by searchers).

Carcass removal trials were conducted six times during the monitoring study--three times during the fall migration period (August, September, and October) and three times during the spring migration period (February, March, and May)--to accommodate variations in weather, vegetation conditions, and scavenger densities and activities. Plots that were designated as carcass-search plots were excluded from scavenger removal trials because the presence of additional carcasses may have led to increased scavenger activity on the carcass-search plots. Each carcass removal trial consisted of monitoring the fate of bird carcasses that were placed in the project area. Ten bird carcasses (five large and five small) were distributed within 623 x 623-ft (190 x 190-m) plots (the same size as those used in the carcass searches) around randomly selected turbines. Large bird carcasses were represented by pheasants, and small bird and bat carcasses were represented by small quail. Trials conducted with bats in other studies (Young et al. 2003; Erickson et al. 2004; Fiedler 2004) suggested that carcass removal rates were similar for bats and small birds. Therefore, small birds were used to determine carcass removal rates for both small birds and bats at JGWEP.

To avoid attracting additional scavengers to a particular plot and to maintain the independence of the data, only one carcass was placed in a plot. Carcasses were monitored every day for the first 4 days post-placement, and then on days 7, 10, 14, and 20 post-placement. The presence or

absence of carcasses or carcass remains was noted each time the carcasses were monitored. Carcasses were categorized as Present/Unscavenged, Present/Scavenged, or Absent. After the 20-day carcass removal trial, all remaining carcasses were removed from the study plots and were recorded as having been present 21 days.

2.2.5 Statistical Analyses for Determining Fatality Rates

The estimated total number of wind turbine-related fatalities at the JGWEP was based on four components: 1) the number of carcasses found; 2) the number of turbines searched compared to total number of turbines at the facility; 3) the searcher efficiency rate expressed as the proportion of planted carcasses found by searchers; and 4) the scavenger removal rate, which was expressed as the mean length of time a carcass remained in the study area and was indicative of the length of time fatalities might be available for detection by searchers.

2.2.5.1 Number of Carcasses Documented During Carcass Searches

The average number of carcasses detected per turbine was:

$$\bar{c} = \frac{\sum_{i=1}^{k} c_i}{k}$$

where c_i was the number of carcasses detected at turbine i for the period of study and k was the number of turbines searched.

2.2.5.2 Estimation of Searcher Efficiency

Searcher efficiency was expressed as p, the estimated proportion of placed (trial) carcasses found by searchers. Searcher efficiency rates were estimated by major habitat type, carcass size, and season.

2.2.5.3 Estimation of Scavenger Removal Rates

Carcass removal rates were expressed as the mean length of time that a trial carcass remained in the study area ($\bar{t}$) before it was removed and was calculated as:

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

where t_i = the length of time a trial carcass remained in the study area before it was removed, s = the number of carcasses used in the scavenging trials, and s_c = the number of trial carcasses still present at 20 days. This estimator was used due to the right-censoring of data caused by removal of trial carcasses at 20 days.

2.2.5.4 Estimation of the Total Number of Facility-related Fatalities

Estimation of total mortality for bats and birds (large, small, and combined) at JGWEP involved an extrapolation of the number of carcasses found during searches, and incorporated other factors such as searcher efficiency and scavenger removal rates. The formula used to calculate total turbine-related fatalities (m) was:

$$m = \left(\frac{N*I*C}{k*t*p}\right)\left(\frac{e^{I/t} - 1 + p}{e^{I/t} - 1}\right)$$

where N = the total number of turbines at JGWEP, I = the interval time between searches in days, C = total number of carcasses found, k = the number of turbines searched, t = the mean carcass residency time in days (i.e., mean number of days that carcasses remained on scavenger removal plots), and p = the searcher efficiency for the category (birds/bats) being calculated.

Ninety percent confidence intervals and a standard error of the fatality estimate were calculated using bootstrapping, a computer program that simulates repeated sampling (with replacement) of the collected data. A total of 5,000 iterations were used, and the confidence intervals were based on the 5th and 95th percentiles of the 5,000 bootstrap iterations. The standard deviation of the 5,000 iterations was used as the standard error of the estimated mortality.

3.0 RESULTS

A total of 62 carcasses was found at the JGWEP between July 2006-May 2007 (Figure 3.1; Table 3.1), including 36 (58% of total carcasses) bats and 26 (42%) birds. Fifty (81%) carcasses were found during carcass searches and 12 (19%) were found incidentally. Thirty-nine (78%) of the 50 carcasses found during searches were ≤223 ft (68 m) from the search turbine, three (6%) were 236-282 ft (72-86 m) from the turbine, and eight (16%) were ≥318 ft (97 m) from the turbine. The average distance of a carcass from the search turbine was 154 ft (47 m), with a range of 13 to 489 ft (4 to 149 m).

3.1 CARCASS SEARCH SURVEYS

3.1.1 Avian Carcass Finds

Fifteen avian carcasses, comprising at least seven species, were found in the 20 turbine plots that were searched monthly from August 2006 through October 2006 and February 2007 through May 2007--an average of 0.75 birds per turbine (Table 3.2). This represents 30% (15 of 50) of the total number of carcasses found on the study area during carcass searches, with the other 70% being bat carcasses. Avian carcasses were located an average of 210 ft (64 m) away from turbines, with a range of 56 to 489 ft (17 to 149 m) (Figure 3.1). Avian fatalities were documented at 11 (55%) of the 20 turbines that were searched monthly (Table 3.2). Two avian carcasses apiece were found at turbines 2, 32, 73, and 83, and one carcass was found at the other seven towers at which avian carcasses were found. No avian carcasses were found at turbines 6, 30, 40, 47, 53, 63, 66, 84, and 87.

Ten small birds (passerines) and five large birds (waterfowl and raptors) were found. Horned lark (four birds, 27% of all birds found) was the most common avian species located, followed by eared grebe and Wilson's warbler (two of each species, 13% of all birds found) (Table 3.1; Appendix B, Table B.1). One raptor, a short-eared owl carcass, was found. More bird carcasses (four) were found during August and September than in any other months (Figure 3.2). Avian carcasses were found in every month except February. A mean of 2.5 birds per month was found

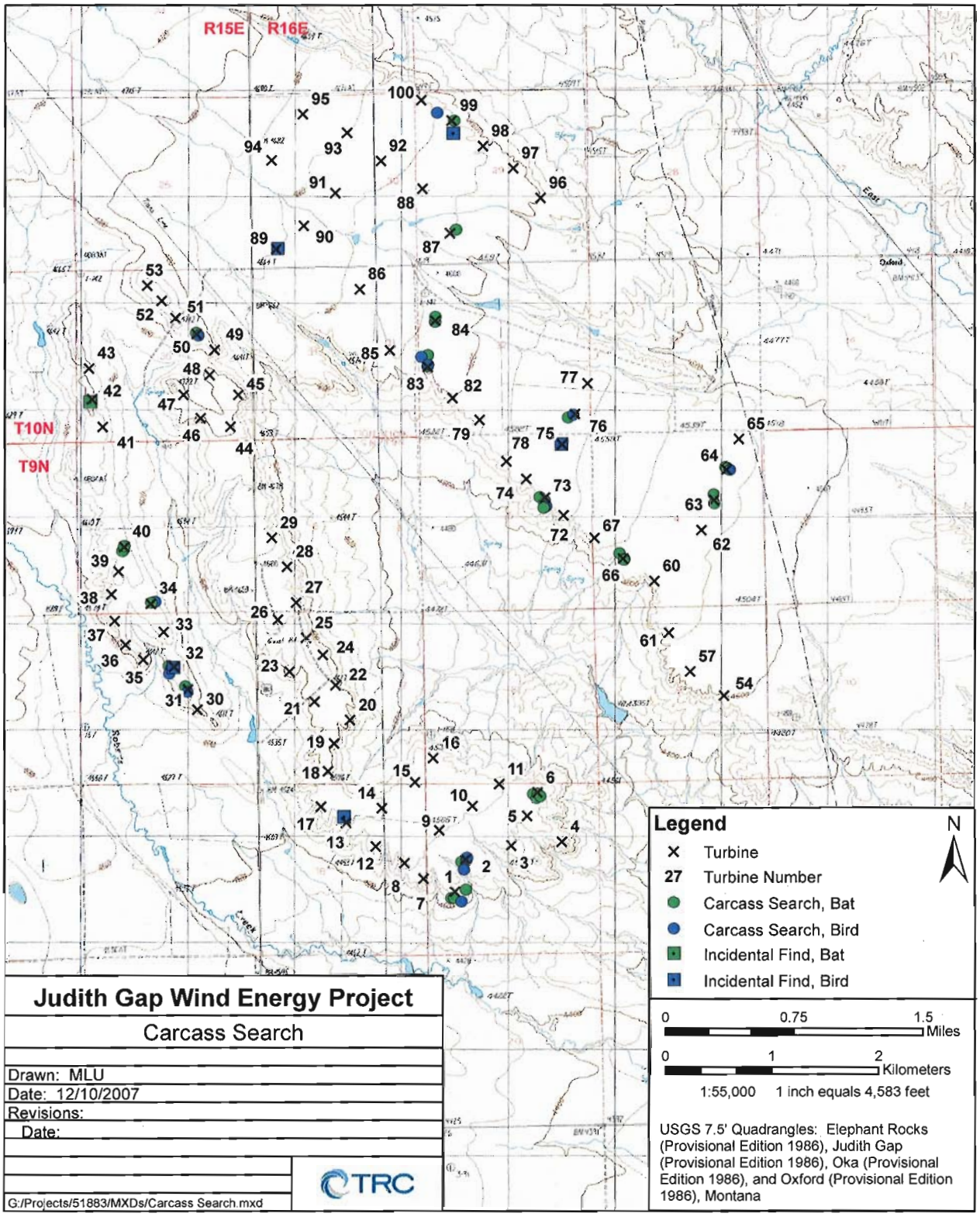

Figure 3.1 Distribution of Carcasses Found During Carcass Searches and Incidentally at the Judith Gap Wind Energy Project.

Table 3.1 Number and Species of Bird and Bat Carcasses Found During Carcass Searches and Incidentally at the Judith Gap Wind Energy Project, July 2006-May 2007.

Common Name	Scientific Name	Number of Carcasses
Birds		
Eared grebe	*Podiceps nigricollis*	5[1]
Western grebe	*Aechmophorus occidentalis*	2[2]
Mallard	*Anas platyrhynchos*	1
Unidentified waterfowl	--	1[3]
Merlin	*Falco columbarius*	1
Sharp-tailed grouse	*Tympanuchus phasianellus*	1
American coot	*Fulica americana*	4[4]
Short-eared owl	*Asio flammeus*	1
Horned lark	*Eremophila alpestris*	4[5]
Wilson's warbler	*Wilsonia pusilla*	2
White-crowned sparrow	*Zonotrichia albicollis*	1
Western meadowlark	*Sturnella neglecta*	1
Unidentified passerine	--	2
Subtotal Birds		26
Bats		
Hoary bat	*Lasiurus cinereus*	17[6]
Silver-haired bat	*Lasionycteris noctivagans*	4[7]
Unidentified bat	--	15
Subtotal Bats		36
Total Carcasses		62

[1] Identification of one eared grebe was tentative. Alternatively, the bird may have been a horned grebe.
[2] Identification of western grebes was tentative. Alternatively, the birds may have been Clark's grebes.
[3] Tentative identification based on feather remains.
[4] Identification of one American coot was tentative and was based on minimal feather remains.
[5] Identification of two horned larks was tentative and was based on photographs of the scavenged carcass.
[6] Identification of one hoary bat was tentative and was based on photographs of pelage remnants.
[7] Identification of three silver-haired bats was tentative and was based on photographs of carcasses.

Table 3.2 Number and Type of Species Found at Turbine Plots During Carcass Searches at the Judith Gap Wind Energy Project, August-October 2006 and February-May 2007.[1]

Species	Turbine Number																				Total Number of Carcasses
	1	2	6	30	31	32	34	40	47	50	53	63	64	66	73	76	83	84	87	99	
Birds																					
Eared grebe	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Unidentified waterfowl	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
American coot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1[2]	1
Short-eared owl	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Horned lark	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	4
Wilson's warbler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
White-crowned sparrow	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Western meadowlark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Unidentified passerine	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2
Subtotal Large Birds	0	1	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	5
Subtotal Small Birds	1	1	0	0	0	1	1	0	0	1	0	0	0	0	2	1	2	0	0	0	10
Subtotal Birds	1	2	0	0	1	2	1	0	0	1	0	0	1	0	2	1	2	0	0	1	15
Bats																					
Hoary bat	3	2	2	0	0	1	0	1	0	1	0	0	2	0	2	0	1	2	0	0	17
Silver-haired bat	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	4
Unidentified bat	0	0	2	0	1	0	0	2	0	0	0	1	1	2	2	0	1	0	1	1	14
Subtotal Bats	3	2	4	0	1	1	1	3	0	1	0	2	3	3	4	1	2	2	1	1	35
Total Carcasses	4	5	4	0	2	3	2	3	0	1	0	2	4	3	6	2	4	2	1	2	50

[1] All turbine plots were searched seven times each (once a month) except for turbine 6, which was searched five times, and turbines 30, 31, 32, 34, 40, and 64, which were searched six times each. A total of 132 turbine-plot searches were conducted.

[2] An additional two American coots were found incidentally on the access road near turbine 99.

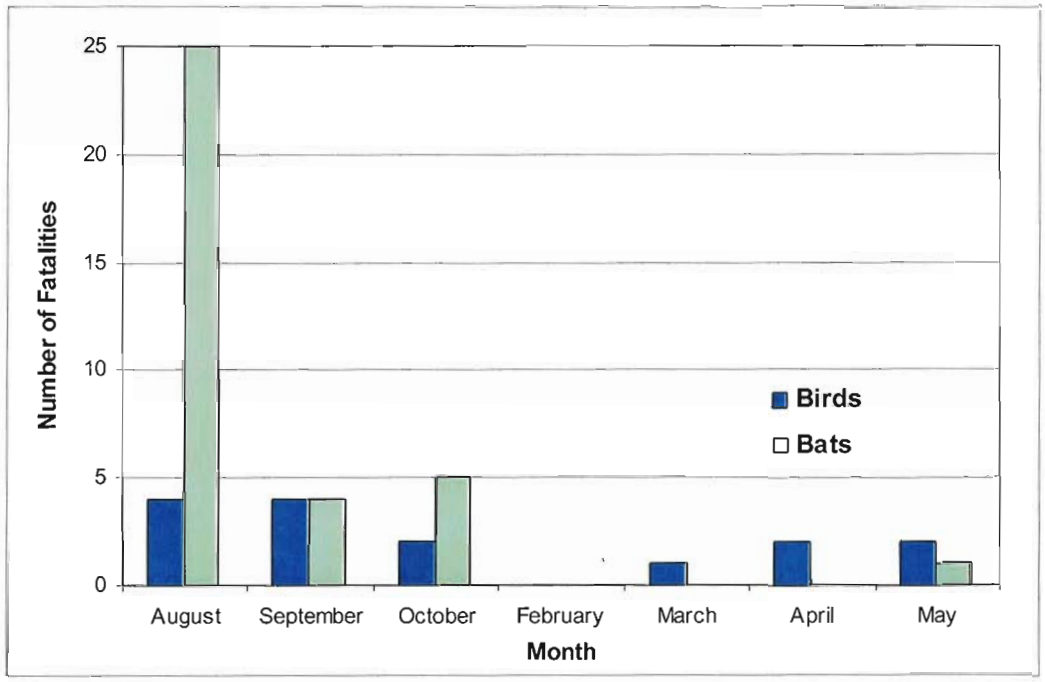

Figure 3.2 Number of Bird and Bat Carcasses Found by Month During Carcass Searches, August 2006-October 2006 and February 2007-May 2007.

during carcass surveys in the other six survey months excluding February. Carcass surveys were disrupted by weather and turbine safety issues during February; therefore, birds may have struck turbines during February but were not found. Mortality was higher in the fall (September and October) with an average of 3.0 avian carcasses found per month compared to an average of 1.7 avian carcasses found per month during spring (or an average of 1.3 carcass per month in the spring if February was included).

3.1.2 Bat Carcass Finds

Thirty-five bat carcasses, comprising at least two species, were found in the 20 turbine plots that were searched between August 2006-October 2006 and February-May 2007 (Table 3.2). This represents 70% (35 of 50) of the carcasses found in the study area during carcass searches, or 56% (35 of 62) of the total number of carcasses found in the project area from July 2006-May 2007. Hoary bat (17 carcasses, 49% of bat carcasses) was the most common species located, followed by unidentified bat (14, 40%) and silver-haired bat (4, 11%). A mean of 1.75 bats was

found per turbine during the carcass surveys. Bat carcasses were located an average of 131 ft (40 m) away from turbines, with a range of 13 to 354 ft (4 to 108 m). Bat fatalities were documented at 17 (85%) of the 20 turbines that were searched monthly. Four bat carcasses each were found at turbines 6 and 73, and three bat carcasses each were found at turbines 1, 40, 64, and 66. No bat carcasses were found under turbines 30, 47, and 53, nor were any avian fatalities recorded at these three towers (see Table 3.2).

Substantially more bat carcasses were found in August (25, 71%) than in any other month, and more bat fatalities were documented in the fall (34, 97%) than in the spring (1, 3%) (see Figure 3.2).

3.2 INCIDENTAL FINDS

3.2.1 Incidental Avian Finds

Eleven avian carcasses (18% of the 62 bird and bat carcasses and 42% of the 26 bird carcasses found on the study area) were found incidentally (Table 3.3; Appendix B, Table B.1). All of the incidental bird finds were large birds (waterfowl, gallinaceous birds, and raptors), suggesting either that larger birds were more likely to be found or that scavengers removed smaller birds from the project area more quickly.

Two of the incidental avian carcasses (both western grebes) were found in July 2006 prior to initiation of the monitoring study (Appendix B, Table B.1). One additional carcass (an American coot) was found outside the monitoring period in early November 2006. Eight of the 11 incidental bird carcasses (73%) were found in the fall, and the three remaining bird carcasses found incidentally were found in May 2006 (Appendix B, Table B.1). An average of 1.6 birds per month was found incidentally during the summer/fall migration period compared to an average of 0.75 birds per month found incidentally during the winter/spring migration period.

When combining the 11 incidental avian finds with the 15 bird carcasses found during carcass searches, more eared grebes (five birds, 19% of the total number found) were found than any

Table 3.3 Number and Species of Carcasses Found Incidentally near Turbines and at Other Locations at the Judith Gap Wind Energy Project, July 2006 to May 2007.

	Turbine Numbers and Other Locations									
Common Name	13	18	22	32	42	75	89	Access Road near Turbine 99	O&M Building[1]	Total Number of Carcasses
Birds										
Eared grebe	2	0	0	0	0	0	1	0	0	3
Western grebe	0	2	0	0	0	0	0	0	0	2
Mallard	0	0	0	1	0	0	0	0	0	1
Merlin	0	0	0	0	0	0	0	0	1	1
Sharp-tailed grouse	0	0	0	0	0	1	0	0	0	1
American coot	0	0	1	0	0	0	0	2	0	3
Subtotal Birds	2	2	1	1	0	1	1	2	1	11
Bats										
Unidentified bat	0	0	0	0	1	0	0	0	0	1
Subtotal Bats	0	0	0	0	1	0	0	0	0	1
Total Carcasses	2	2	1	1	1	1	1	2	1	12

[1] Carcass was found behind the Judith Gap Wind Energy facility Operations and Management (O&M) building.

other species, followed by American coots (4, 15%) and horned larks (4, 15%). More avian carcasses (nine carcasses) were found in September than in any other month (Figure 3.3).

3.2.2 Incidental Bat Finds

The single bat carcass found incidentally during the course of the monitoring study was found in October 2006 (see Table 3.3; Appendix B, Table B.2). The remaining 35 (97%) bat carcasses found during the study were found during carcass searches.

3.3 SEARCHER EFFICIENCY BIAS

Sixty bird carcasses (30 large birds and 30 small birds) were used for searcher efficiency trials during the study period. The interval between trial carcass placement and search dates averaged 8.3 days for small bird carcasses and 7.2 days for large bird carcasses. Searcher efficiency was

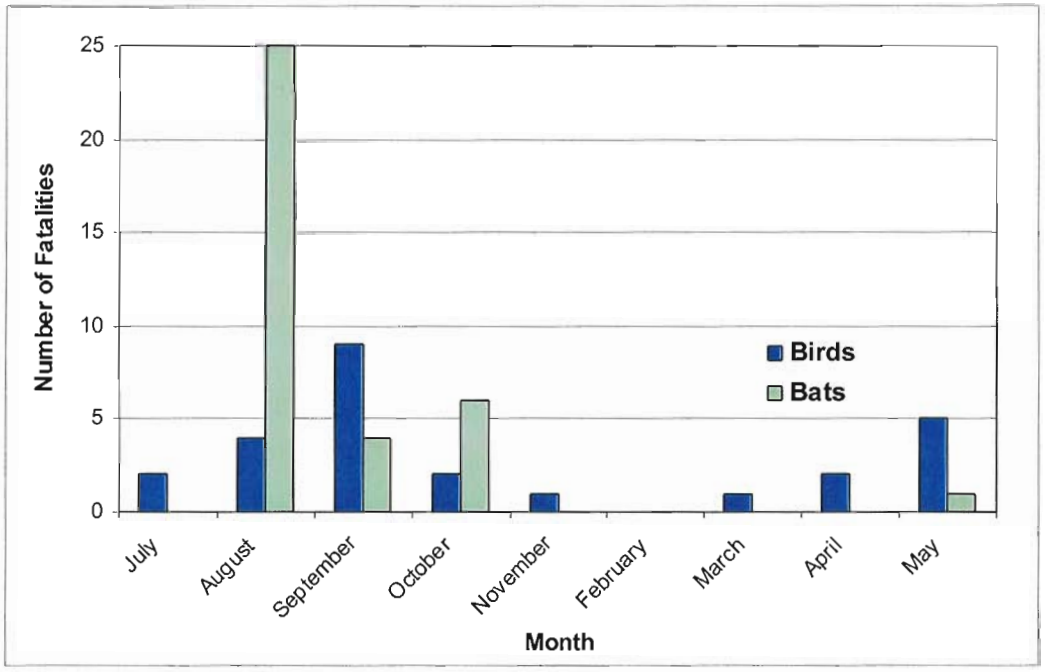

Figure 3.3 Number of Bird and Bat Carcasses Found by Month During Carcass Searches and Incidentally, August 2006-October 2006 and February 2007-May 2007.

77% for large bird carcasses and 17% for the small bird carcasses (Table 3.4). Results were similar across seasons except that large bird carcasses had a lower searcher efficiency during spring (67%) compared to summer/fall (87%). Large bird carcass searcher efficiency was similar in CRP (77%) and grassland (75%), but efficiency was higher for small bird carcasses in grassland (27%) compared to CRP (11%) (Table 3.5).

3.4 CARCASS REMOVAL BIAS

Sixty bird carcasses (30 large birds and 30 small birds) were used for scavenger removal trials during the study period (Tables 3.6 and 3.7). The average length of time carcasses remained was 12 days (15.4 days for large bird carcasses and 9.1 days for small bird carcasses). Seventeen percent of trial carcasses remained on the 20th day (23% of large bird carcasses and 10% of small bird carcasses). Mean carcass residency was shorter during the winter/spring period for both large bird (14.7 days) and small bird (5.3 days) carcasses when compared to summer/fall (16.3 days for large bird carcasses and 13.2 days for small bird carcasses) (see Table 3.6).

Table 3.4 Seasonal Searcher Efficiency Rates at Judith Gap Wind Energy Center.

Searcher Efficiency Trial Date	Habitat[1]	Number of Large Birds Placed	Number of Large Birds Found	Large Bird Searcher Efficiency	Number of Small Birds Placed	Number of Small Birds Found	Small Bird Searcher Efficiency	Total Birds Placed	Total Found	Total Searcher Efficiency
August	Grassland	1	1	100%	2	2	100%	3	3	100%
August	CRP	4	3	75%	3	0	0%	7	3	43%
Total		5	4	80%	5	2	40%	10	6	60%
September	Grassland	2	2	100%	1	0	0%	3	2	67%
September	CRP	3	2	67%	4	0	0%	7	2	29%
Total		5	4	80%	5	0	0%	10	4	40%
October	Grassland	1	1	100%	2	0	0%	3	1	33%
October	CRP	4	4	100%	3	1	33%	7	5	71%
Total		5	5	100%	5	1	20%	10	6	60%
Subtotal Summer/Fall		15	13	87%	15	3	20%	30	16	53%
March	Grassland	1	1	100%	2	0	0%	3	1	33%
March	CRP	4	4	100%	3	0	0%	7	4	57%
Total		5	5	100%	5	0	0%	10	5	50%
April	Grassland	1	0	0%	2	0	0%	3	0	0%
April	CRP	4	1	25%	3	0	0%	7	1	14%
Total		5	1	20%	5	0	0%	10	1	10%
May	Grassland	2	1	50%	2	1	50%	4	2	50%
May	CRP	3	3	100%	3	1	33%	6	4	67%
Total		5	4	80%	5	2	40%	10	6	60%
Subtotal Spring		15	10	67%	15	2	13%	30	12	40%
Total		30	23	77%	30	5	17%	60	28	47%

[1] CRP = Conservation Reserve Program land.

Table 3.5 Searcher Efficiency Rates in Different Habitats at Judith Gap Wind Energy Center.

Habitat	Searcher Efficiency Trial Date	Number of Large Birds Placed	Number of Large Birds Found	Large Bird Searcher Efficiency	Number of Small Birds Placed	Number of Small Birds Found	Small Bird Searcher Efficiency	Total Birds Placed	Total Found	Total Searcher Efficiency
CRP[1]										
	August	4	3	75%	3	0	0%	7	3	43%
	September	3	2	67%	4	0	0%	7	2	29%
	October	4	4	100%	3	1	33%	7	5	71%
Subtotal Summer/Fall		11	9	82%	10	1	10%	21	10	48%
	March	4	4	100%	3	0	0%	7	4	57%
	April	4	1	25%	3	0	0%	7	1	14%
	May	3	3	100%	3	1	33%	6	4	67%
Subtotal Spring		11	8	73%	9	1	11%	20	9	45%
Total CRP		22	17	77%	19	2	11%	41	19	46%
Grassland										
	August	1	1	100%	2	2	100%	3	3	100%
	September	2	2	100%	1	0	0%	3	2	67%
	October	1	1	100%	2	0	0%	3	1	33%
Subtotal Summer/Fall		4	4	100%	5	2	40%	9	6	67%
	March	1	1	100%	2	0	0%	3	1	33%
	April	1	0	0%	2	0	0%	3	0	0%
	May	2	1	50%	2	1	50%	4	2	50%
Subtotal Spring		4	2	50%	6	1	17%	10	3	30%
Total Grassland		8	6	75%	11	3	27%	19	9	47%
Both Habitats Combined		30	23	77%	30	5	17%	60	28	47%

[1] CRP = Conservation Reserve Program land.

Table 3.6 Seasonal Scavenger Removal Rates at Judith Gap Wind Energy Project.

Scavenger Efficiency Trial Date	Habitat[1]	Percent of Carcasses Remaining After 20 Days	Mean Number of Days Carcasses Remained[2, 3]	Percent of Large Carcasses Remaining After 20 Days	Mean Number of Days Large Carcasses Remained[2, 3]	Percent of Small Carcasses Remaining After 20 Days	Mean Number of Days Small Carcasses Remained[2, 3]
August	Grassland	33	21.0	0[4]	7.0[4]	50	35.0
August	CRP	43	28.0	50	34.5	33	21.5
Both Habitats		40	25.7	40	25.3	40	26.0
September	Grassland	0	2.3	0	3.0	0[4]	1.0[4]
September	CRP	14	13.6	33	17.0	0	12.0
Both Habitats		10	9.9	20	10.0	0	9.8
October	Grassland	33	21.0	50	35.0	0[4]	7.0[4]
October	CRP	0	9.3	0	9.3	0	9.3
Both Habitats		10	11.9	20	15.6	0	8.8
Both Habitats Summer/Fall		20	14.6	27	16.3	13	13.2
February	Grassland	33	19.0	50	35.0	0[4]	3.0[4]
February	CRP	0	6.6	0	9.3	0	4.5
Both Habitats		10	9.3	20	15.6	0	4.2
March	Grassland	33	14.5	50	28.0	0[4]	1.0[4]
March	CRP	14	10.3	33	22.5	0	4.3
Both Habitats		20	11.4	40	24.3	0	3.6
May	Grassland	25	14.3	0	10.5	50	22.0
May	CRP	0	5.3	0	6.3	0	4.3
Both Habitats		10	8.3	0	8.0	20	8.8
Both Habitats Winter/Spring		13	9.62	20	14.7	7	5.29
Overall Scavenger Removal Means and Rates		17	12.0	23	15.4	10	9.1

1 CRP = Conservation Reserve Program land.

2 Five ring-necked pheasants (representing large birds) and five coturnix quail (representing small birds and bats) were included in each scavenger removal trial.

3 To calculate means, carcasses still present at the end of the 20-day carcass removal trial period were considered to have remained for 21 days.

4 Sample size = one.

Table 3.7 Scavenger Removal Rates in Grassland Habitat and Conservation Reserve Program Land at Judith Gap Wind Energy Project.

Habitat	Searcher Efficiency Trial Date	Percent of Carcasses Remaining After 20 Days	Mean Number of Days Carcasses Remained[2, 3]	Percent of Large Carcasses Remaining After 20 Days	Mean Number of Days Large Carcasses Remained[2, 3]	Percent of Small Carcasses Remaining After 20 Days	Mean Number of Days Small Carcasses Remained[2, 3]
CRP[1]							
	August	43	28.0	50	34.5	33	21.5
	September	14	13.6	33	17.0	0	12.0
	October	0	9.3	0	9.3	0	9.3
Subtotal Summer/Fall		19	15.2	30	18.7	9	12.8
	February	0	6.6	0	9.3	0	4.5
	March	14	10.3	33	22.5	0	4.3
	May	0	5.3	0	6.3	0	4.3
Subtotal Winter/Spring		5	7.4	11	11.5	0	4.4
Total CRP		12	11.1	21	14.9	5	8.4
Grassland							
	August	33	21.0	0.00[4]	7.0[4]	50	35.0
	September	0	2.3	0.00	3.0	0[4]	1.0[4]
	October	33	21.0	50.00	35.0	0[4]	7.0[4]
	Subtotal Summer/Fall	22	13.0	20.00	12.0	25	14.3
	February	33	19.0	50.00	35.0	0[4]	3.0[4]
	March	33	14.5	50.00	28.0	0[4]	1.0[4]
	May	25	14.3	0.00	10.5	50	22.0
Subtotal Winter/Spring		30	15.7	33.33	21.0	250	8.7
Total Grassland		26	14.4	27.27	16.5	25	11.5
Both Habitats Combined		17	12.0	23.33	15.4	10	9.1

1 CRP = Conservation Reserve Program land.
2 Five ring-necked pheasants (representing large birds) and five coturnix quail (representing small birds and bats) were included in each scavenger removal trial.
3 To calculate means, carcasses still present at the end of the 20-day carcass removal trial period were considered to have remained for 21 days.
4 Sample size = one.

Average carcass residency was shorter in CRP (14.9 days for large bird carcasses and 8.4 days for small bird carcasses) than in grassland (16.5 days for large bird carcasses and 11.5 days for small bird carcasses) (see Table 3.7).

3.5 TOTAL ESTIMATED FATALITIES FOR THE STUDY PERIOD

An average of 2.5 carcasses (15 birds and 35 bats) per turbine was found during carcass surveys at the 20 searched turbines during the study period. Searcher efficiency and scavenger removal rates were incorporated into estimates of bird and bat mortality. Because the low searcher efficiency for small birds (17%) was due at least in part to searcher efficiency trial carcasses being placed an average of 8.3 days before plot searches, and because small bird carcasses were estimated to remain on plots for an average of 9.1 days, an adjustment was made to the small bird searcher efficiency rate using the formula $e^{PI/\bar{t}}$, where PI = the mean interval between carcass placement and search date, and $\bar{t}$ = mean carcass residency. This calculation accounted for the delay between carcass placement and search dates. Using the average small bird carcass residency (9.1 days) and adjusted searcher efficiency (42%) estimates for small birds, bat fatalities were estimated to be 13.4 bats/turbine (90% confidence interval = 8.04-24.72 bats/turbine) during the study period, or approximately 1,206 (90% confidence interval = 724-2,225) turbine-related bat fatalities during the study period at the 90 turbines (Table 3.8).

An average of 0.5 small birds (passerines) per turbine was found during searches. Using the 42% adjusted searcher efficiency rate and 9.1 mean carcass residency for small birds, small bird fatality rates were estimated to be 3.83 birds/turbine (90% confidence interval = 1.78-7.61), or a total of 344 small birds (90% confidence interval = 160-685) at the 90 turbines during the study period (see Table 3.8).

An average of 0.25 large birds (waterfowl and raptors) per turbine was found during carcass searches. Because the mean interval between searcher efficiency trial carcass placement and search dates was 7.2 days for large birds, and large bird carcasses remained an average of

Table 3.8 Estimated Avian and Bat Fatality Rates for JGWEP.[1]

Category	Number of Carcasses Found	Estimated Total Mortality (90% Confidence Interval)	Standard Error	Carcasses/Turbine Estimate (90% Confidence Interval)	Standard Error
Small birds	10	344 (160-685)	175	3.83 (1.78-7.61)	1.94
Large birds[2]	5	62 (21-123)	32	0.69 (0.23-1.37)	0.36
Raptors	1	12 (0-38)	13	0.14 (0-0.42)	0.14
All Birds	15	406 (28-593)	178	4.52 (0.31-6.59)	1.98
Bats	35	1,206 (724-2,225)	491	13.40 (8.04-24.72)	5.46

[1] Project-wide estimates are rounded off to the nearest whole number.
[2] Includes one raptor.

15.43 days, it was assumed that the 77% searcher efficiency estimate for large birds was not inordinately impacted by the carcass placement-search date interval, and the large bird searcher efficiency rate was not adjusted. Using the carcass residency (15.43 days) and searcher efficiency (77%) for large birds, large bird fatalities were estimated at 0.69 large birds/turbine (90% confidence interval = 0.23-1.37), or a total of 62 large birds (90% confidence interval = 21-123) during the study period at the 90 turbines (see Table 3.8).

One raptor fatality was recorded during the study period, and using the large bird mean carcass residency (15.43 days) and searcher efficiency (77%) for large birds produces an estimate of 0.14 raptor fatalities/turbine (90% confidence interval = 0-0.42), or 14 raptors (90% confidence interval = 0-38) at the 90 turbines during the study period (see Table 3.8).

Estimated fatalities for small and large birds combined is 4.52 birds/turbine (90% confidence interval = 0.31-6.59), or 406 birds (90% confidence interval = 28-593) at the 90 turbines during the study period (see Table 3.8).

4.0 DISCUSSION

Potential sources of bias are inevitably introduced into fatality studies. The species involved in turbine-related fatalities may not actually be scavenged at the same rate as the carcasses of species placed for scavenger removal trials. For example, the quail used during carcass trials may experience a higher or lower scavenging rate than carcasses normally occurring in the project area. Some studies found similar scavenger removal rates for bats and small birds (Young et al. 2003; Erickson et al. 2004; Fiedler 2004), but Johnson et al. (2003) found that bat carcasses remained an average of 10.36 days compared to 4.69 days for small bird carcasses. It is not known whether the small bird scavenger rates used to estimate carcass removal rates for bats accurately reflects the actual average carcass residency for bats at JGWEP. The inclusion in carcass totals of all carcasses found, including feather spots, may overestimate turbine-related mortality since some remains found may be due to natural predation; however, this may be offset to some extent by some turbine-related carcasses whose final location was outside the search area, either because they landed farther from the turbine, were moved by a scavenger, or the animal moved outside of search plots after being fatally injured. It seems likely that some turbine-related fatalities fell outside the search area because although searchers at JGWEP were 312 to 440 ft (95 to 134 m) from the tower when walking the search area boundaries, and 78% of the carcasses found were ≤223 ft (68 m) from the turbine, 16% were found ≥318 ft (97 m) from the search tower, with a range of 318 to 489 ft (97 to 149 m). It was also assumed that the 20 towers chosen for searching were representative of the project as a whole and do not collectively experience a fatality rate that leads to substantially inaccurate high or low fatality estimates for the entire turbine complex.

The mortality rates estimated for JGWEP are similar to those at other windfarms (Table 4.1), although the bat fatality rate was high compared to studies in the western U.S. Two windfarm studies from the eastern U.S. have reported higher bat fatality rates, but these wind farms were located on mountain ridgetops where migrating bats presumably were concentrated. Bat carcasses were found closer to turbines (average distance of 131 ft [40 m]) than bird carcasses (average distance of 210 ft [64 m]). This pattern has been noted in other studies (Erickson et al. 2000; Erickson et al. 2003; Erickson et al. 2004; Jain et al. 2007).

Table 4.1 Estimated Fatality Rates for Birds and Bats at Other U.S. Wind Farms and JGWEP.[1]

Location	Bird Fatalities/ Turbine/Year	Bat Fatalities/ Turbine/Year	Searcher Efficiency Birds (%) (Large, Medium, Small)	Carcass Residency (Days) (Large, Medium, Small)
Vansycle, OR[2]	0.63	0.74	88 L, 50 S	25
Nine Canyon, WA[3]	3.59	3.21	78 L, 44 S	33 L, 11 S
Klondike, OR[4]	1.42	1.16	92 L, 75 S	19.9 L, 14.2 S
Buffalo Ridge, MN[5]	0.98-4.45	n/a	49 L, 40 M, 29 S	8.5 L, 8 M, 4.7 S
Mountaineer, WV[6]	4.04	47.53	28 (Combined)	6.7 (Combined)
Stateline, OR[7]	1.93	1.12	78 L, 42 S	35.7 L/M, 16.7 S
Foot Creek Rim, WY[8]	1.5	1.34	92L, 87 M, 59 S	29.5 L, 37.3 M, 13.4 S
Buffalo Mountain, TN[9]	1.8	63.9	Variable	Variable
Judith Gap, MT[10]	4.52	13.4	77 L, 17 S	15.4 L, 9.1 S

1 All fatality rates have incorporated searcher efficiency and scavenger removal data. Studies of <1 year duration are indicated.
2 Erickson et al. (2000).
3 Erickson et al. (2003).
4 Johnson et al. (2003).
5 Johnson et al. (2000).
6 Kerns and Kerlinger (2004); 7-month study.
7 Erickson et al. (2004).
8 Young et al. (2003).
9 Fiedler et al. (2007); 9-month study.
10 This study; 7-month study.

Ninety-seven percent of all bat carcasses were found during fall migration. Johnson (2004) noted that wind farms pose the greatest risk to bats during fall migration, and the timing of bat mortality events at JGWEP, as well as species composition (highly migratory, tree-roosting species) (Cryan and Brown 2007), is similar to that in other studies (Erickson et al. 2000; Erickson et al. 2003; Erickson et al. 2004; Fiedler et al. 2007; Kerns and Kerlinger 2004; Jain et al. 2007).

Because of the dates on which they were found, waterfowl fatalities likely represented migrating birds. Although several small reservoirs and small waterways associated with Roberts Creek and its tributaries occur within 0.6 mi (1.0 km) of the project area, these are used only by mallards and other dabbling ducks and by occasional migrating shorebirds (personal communication,

August 13, 2007, with Ralph Rogers, Centmont Bioconsultants). Waterfowl (including American coots) made up 50% of the total bird fatalities recorded during the study (see Table 3.1), but waterfowl are considerably larger than passerines and their carcasses are more likely to be discovered incidentally. By contrast, horned larks (39%) and McCown's longspurs (41%) together comprised 80% of the birds detected during grassland bird surveys in 2003 and 2007 (Appendix A, Table A.3) but only 27% (all horned larks) of the carcasses found during turbine plot searches (see Table 3.2).

The results of this study suggest that avian fatality rates at JGWEP are similar to fatality rates at other wind plants around the U.S. (see Table 4.1--note that some studies were conducted for <1 year), whereas estimated fatality rates for bats are somewhat higher when compared to other studies in the western U.S.

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APPENDIX A:

GRASSLAND BIRD DISPLACEMENT STUDY

1.0 INTRODUCTION

Wind energy plants constructed in grassland habitats have the potential to displace grassland breeding birds in the vicinity of the turbines (Leddy et al. 1999; Johnson et al. 2000; Erickson et al. 2004). To examine the impact of the Judith Gap Wind Energy Project (JGWEP) on breeding grassland birds, point count surveys that were conducted in 2003 prior to construction activities (Flath 2003) were repeated in 2007 after the wind farm was completed and became operational. Comparisons were made between numbers of birds recorded during the pre- and post-construction bird surveys to determine if the construction of the wind plant had any detectable impact on locally breeding grassland birds.

2.0 METHODS

Flath (2003) established 13 point count transects in each of the habitat types found on the wind project: natural grasslands, wheat stubble, and Conservation Reserve Program (CRP) (Figure A.1). Eight of the 13 transects were within the future footprint of the windfarm area, and five control transects were established outside the proposed windfarm in habitat types similar to those found within the windfarm. The number of transects in each habitat type approximated the relative percentage of the various habitat types in the study area. Each 0.78-mi (1.25-km) transect consisted of six point count locations separated by 820 ft (250 m). Flath (2003) counted each bird seen or heard within a 328-ft (100-m) radius circle from each point during a 10-minute period. Counts were conducted between 6:45 a.m. (after the dawn chorus ended) and 10:00 a.m. Counts on all transects were conducted during the breeding season in the last two weeks of April, May, and June. A "survey" was defined as the completion of one round of point counts at all six points on each of the 13 transects.

Flath's (2003) study was repeated, using the same transects and methodology, during the spring of 2007 after all wind turbines in the project area were fully operational. The beginning and end points of each transect were recorded using a global positioning system (GPS) unit, and distances between survey points were traversed on an all-terrain vehicle. In 2007, transects 1-8 (the experimental transects) were immediately adjacent to recently constructed wind towers, and transects 9-13 (the control transects) were outside the wind plant (≥1.0 mi [1.6 km] from the nearest turbine) in habitats unchanged since the 2003 surveys.

Only grassland birds with ≥5 total detections during the six surveys (long-billed curlew; mountain plover; horned lark; Sprague's pipit; grasshopper, savannah, and vesper sparrows; McCown's longspur; western meadowlark) were used for analysis. Potential differences in bird numbers between the 2003 and 2007 experimental and control plots were examined using two-sample t-tests. Differences in birds/transect between years were calculated for each species for both experimental and control transects by subtracting 2003 numbers from 2007 numbers for each transect, after which two-sample t-tests were performed on the differences to detect any significant changes in numbers between years ($\alpha = 0.05$).

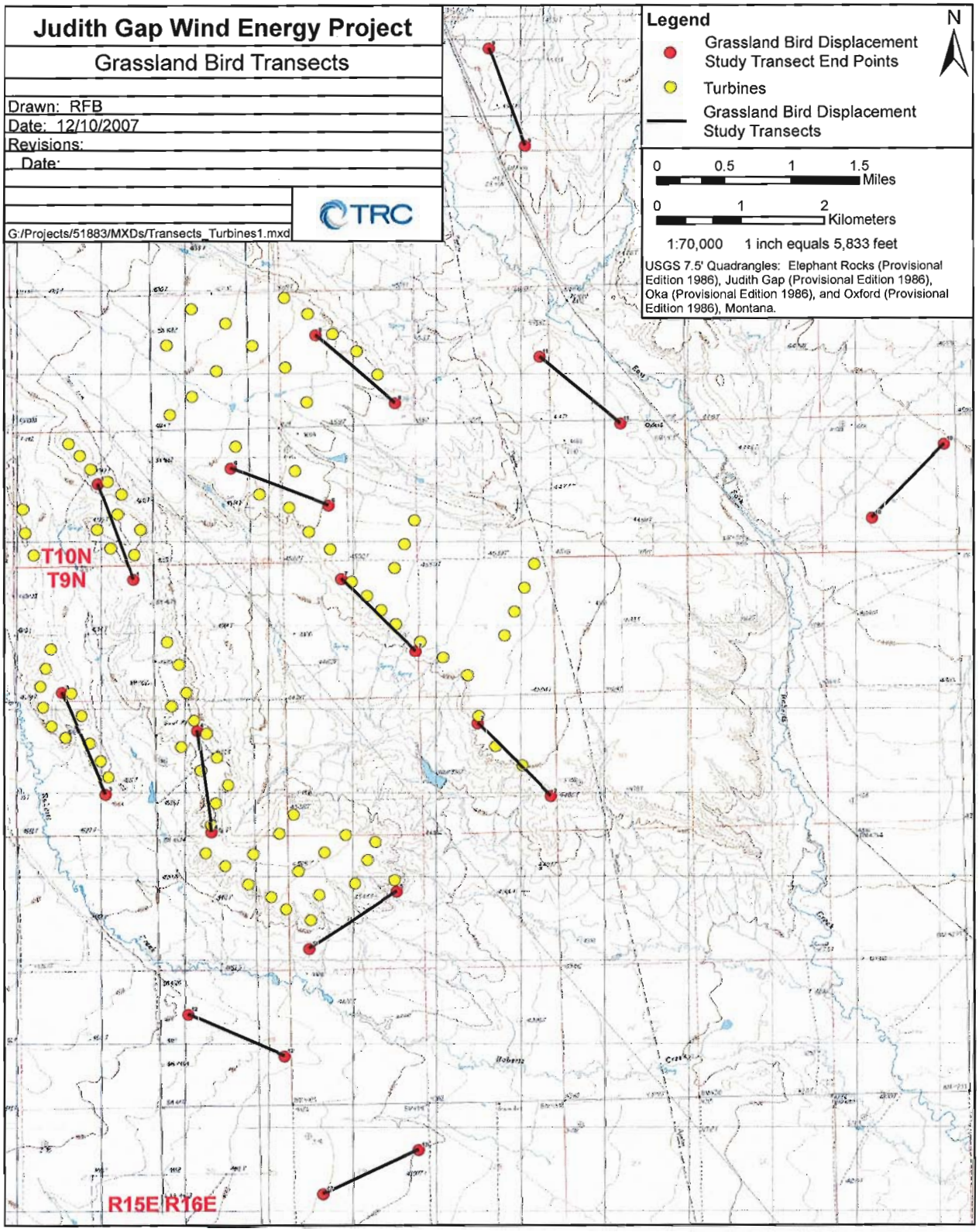

Figure A.1 Wind Turbine Arrays and Grassland Bird Displacement Study Transects.

3.0 RESULTS

Bird numbers recorded during point count surveys increased between 2003 and 2007 in both the experimental and control areas for six of the nine grassland bird species analyzed (Table A.1). Overall totals for grassland birds were 54% higher on the experimental transects and 20% higher on the control transects in 2007 compared to 2003. The results of the t-tests indicated significant increases for two species (western meadowlark, $p = 0.048$; vesper sparrow, $p = 0.044$), but a comparison of overall bird numbers indicated no significant change ($p = 0.072$). Table A.2 presents the combined counts for both years for all birds, and Table A.3 presents the results of each of the six surveys.

Table A.1 Results of Monthly (April, May, and June) Point Counts for Grassland Birds on Experimental and Control Transects at Judith Gap Wind Energy Project.

Species	2003	2007	Difference (% Change)
Experimental Transects (n = 8/survey)			
Mountain plover	2	18	16 (900)
Long-billed curlew	0	2	2 (n/a)
Horned lark	393	502	109 (28)
Sprague's pipit	29	21	-8 (-28)
Grasshopper sparrow	5	0	-5 (n/a)
Vesper sparrow	13	85	72 (554)[1]
Savannah sparrow	75	77	2 (3)
McCown's longspur	330	562	232 (70)
Western meadowlark	37	93	56 (151)[1]
Totals	884	1,360	476 (54)
Control Transects (n = 5/survey)			
Mountain plover	0	0	0 (0)
Long-billed curlew	13	17	4 (31)
Horned lark	264	258	-6 (-2)
Sprague's pipit	2	20	18 (900)
Grasshopper sparrow	0	0	0 (0)
Vesper sparrow	2	5	3 (150)
Savannah sparrow	43	48	5 (12)
McCown's longspur	257	344	87 (34)
Western meadowlark	10	17	7 (70)
Totals	591	709	118 (20)

[1] Significant at $\alpha = 0.05$ level.

Table A.2 Total Numbers of Various Species Detected During Point Counts Conducted at JGWEP in 2003 and 2007.

Species	2003	2007	Total	% of Total
McCown's longspur	587	906	1,493	41
Horned lark	657	760	1,417	39
Savannah sparrow	118	125	243	7
Western meadowlark	47	110	157	4
Vesper sparrow	15	90	105	3
Sprague's pipit	31	41	72	2
Long-billed curlew	13	19	32	1
Mountain plover	2	18	20	1
Gadwall	0	13	13	0
Northern pintail	2	8	10	0
Mallard	0	8	8	0
Northern harrier	3	5	8	0
Grasshopper sparrow	5	0	5	0
Red-winged blackbird	0	5	5	0
Gray partridge	3	2	5	0
Sandhill crane	0	5	5	0
Ferruginous hawk	0	4	4	0
Killdeer	0	4	4	0
Brown-headed cowbird	0	3	3	0
Barn swallow	0	2	2	0
Chipping sparrow	2	0	2	0
Lark bunting	2	0	2	0
American kestrel	1	0	1	0
Northern flicker	0	1	1	0
American robin	0	1	1	0
Ring-billed gull	0	1	1	0
Clay-colored sparrow	0	1	1	0
Canada goose	0	1	1	0
American coot	0	1	1	0
Total	1,488	2,134	3,622	98[1]

[1] Total does not equal 100 due to rounding errors.

Table A.3 Results of Point Counts Conducted at JGWEC in 2003 and 2007.[1]

Species	T1	T2	T3	T4	T5	T6	T7	T8	Experimental	T9	T10	T11	T12	T13	Control	Total
April 2003																
Horned lark	12	24	20	35	28	7	8	4	138	6	25	1	21	24	77	215
McCown's longspur	48	9	25	0	41	0	1	5	129	43	38	0	2	20	103	232
Western meadowlark	0	0	0	0	0	9	8	2	19	0	0	5	0	0	5	24
Vesper sparrow	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1
Savannah sparrow	0	0	0	0	0	2	0	0	2	0	0	2	0	0	2	4
Brown-headed cowbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mountain plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sprague's pipit	0	0	0	0	0	1	3	4	8	0	0	0	0	0	0	8
Northern harrier	0	0	0	0	0	1	0	0	1	1	0	0	0	0	1	2
Long-billed curlew	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	2
Killdeer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ferruginous hawk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-winged blackbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern flicker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sandhill crane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray partridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mallard	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ring-billed gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clay-colored sparrow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern pintail	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	2
Gadwall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canada goose	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A.3 (Continued)

Species	T1	T2	T3	T4	T5	T6	T7	T8	Experimental	T9	T10	T11	T12	T13	Control	Total
American kestrel	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1
Grasshopper sparrow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lark bunting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Barn swallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American coot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals									301						190	491
May 2003																
Horned lark	22	16	21	21	17	7	10	0	114	7	13	0	32	24	76	190
McCown's longspur	31	9	31	4	21	1	0	0	97	23	39	0	6	11	79	176
Western meadowlark	0	1	1	0	0	3	4	2	11	1	0	0	0	1	2	13
Vesper sparrow	0	0	0	0	0	2	3	5	10	0	0	0	0	0	0	10
Savannah sparrow	0	0	0	2	0	15	3	17	37	0	1	17	0	1	19	56
Brown-headed cowbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mountain plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sprague's pipit	0	0	0	0	0	1	4	6	11	0	2	0	0	0	2	13
Northern harrier	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long-billed curlew	0	0	0	0	0	0	0	0	0	1	2	0	0	0	3	3
Killdeer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ferruginous hawk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-winged blackbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern flicker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sandhill crane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray partridge	0	0	0	0	0	1	0	0	1	0	0	2	0	0	2	3
Mallard	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A.3 (Continued)

Species	T1	T2	T3	T4	T5	T6	T7	T8	Experimental	T9	T10	T11	T12	T13	Control	Total
American robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ring-billed gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clay-colored sparrow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern pintail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gadwall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canada goose	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American kestrel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chipping sparrow	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	2
Grasshopper sparrow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lark bunting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Barn swallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American coot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals									283						183	466
June 2003																
Horned lark	20	17	18	30	29	5	22	0	141	11	36	0	36	28	111	252
McCown's longspur	34	11	42	1	16	0	0	0	104	36	21	0	13	5	75	179
Western meadowlark	0	0	0	0	0	2	1	4	7	0	0	1	1	1	3	10
Vesper sparrow	0	0	1	0	0	0	1	0	2	0	0	0	0	2	2	4
Savannah sparrow	0	1	0	0	0	20	8	7	36	1	1	17	0	3	22	58
Brown-headed cowbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mountain plover	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	2
Sprague's pipit	0	0	0	0	0	1	4	5	10	0	0	0	0	0	0	10
Northern harrier	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1
Long-billed curlew	0	0	0	0	0	0	0	0	0	0	8	0	0	0	8	8

Table A.3 (Continued)

Species	T1	T2	T3	T4	T5	T6	T7	T8	Experimental	T9	T10	T11	T12	T13	Control	Total
Killdeer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ferruginous hawk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-winged blackbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern flicker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sandhill crane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray partridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mallard	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ring-billed gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clay-colored sparrow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern pintail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gadwall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canada goose	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American kestrel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chipping sparrow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grasshopper sparrow	0	0	0	0	0	4	1	0	5	0	0	0	0	0	0	5
Lark bunting	0	0	1	0	0	0	0	0	1	0	0	1	0	0	1	2
Barn swallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American coot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals									309						222	531
April 2007																
Horned lark	12	39	10	58	26	13	20	9	187	19	22	13	22	22	98	285
McCown's longspur	42	4	25	2	40	0	0	9	122	49	51	0	5	20	125	247
Western meadowlark	0	2	4	2	2	6	7	5	28	0	1	5	0	0	6	34
Vesper sparrow	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	2

Table A.3 (Continued)

Species	T1	T2	T3	T4	T5	T6	T7	T8	Experimental	T9	T10	T11	T12	T13	Control	Total
Savannah sparrow	0	0	0	0	0	1	1	0	2	0	0	4	0	0	4	6
Mountain plover	2	0	0	0	4	0	0	0	6	0	0	0	0	0	0	6
Sprague's pipit	0	0	0	0	0	4	3	0	7	0	3	0	0	0	3	10
Northern harrier	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	2
Long-billed curlew	0	0	0	0	0	0	0	0	0	4	2	0	0	0	6	6
Ferruginous hawk	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
Red-winged blackbird	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	2
Northern flicker	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1
Sandhill crane	0	0	5	0	0	0	0	0	5	0	0	0	0	0	0	5
Gray partridge	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	2
Mallard	0	0	0	2	0	0	0	0	2	6	0	0	0	0	6	8
American robin	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1
Ring-billed gull	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1
Clay-colored sparrow	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1
Northern pintail	0	0	0	0	0	0	0	0	0	8	0	0	0	0	8	8
Gadwall	0	0	0	0	0	0	0	0	0	10	0	0	0	0	10	10
Canada goose	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
Totals	56	45	45	66	74	24	33	25	368	97	80	25	27	42	271	639
May 2007																
Horned lark	18	26	23	31	24	12	28	0	162	7	20	0	28	24	79	241
McCown's longspur	67	16	60	27	23	0	0	15	208	21	33	0	2	22	78	286
Western meadowlark	2	0	5	2	4	3	5	13	34	1	3	0	0	1	5	39
Vesper sparrow	0	0	16	0	2	10	11	5	44	0	0	0	0	2	2	46

Table A.3 (Continued)

Species	T1	T2	T3	T4	T5	T6	T7	T8	Experimental	T9	T10	T11	T12	T13	Control	Total
Savannah sparrow	0	0	1	0	0	11	2	17	31	0	0	21	0	1	22	53
Brown-headed cowbird	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	3
Mountain plover	0	0	0	2	4	2	0	0	8	0	0	0	0	0	0	8
Sprague's pipit	0	0	0	0	0	0	0	8	8	0	8	0	0	0	8	16
Northern harrier	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1
Long-billed curlew	0	0	0	0	0	0	0	0	0	3	1	0	0	0	4	4
Killdeer	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2
Ferruginous hawk	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
Red-winged blackbird	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	2
Totals	87	42	108	62	57	38	47	58	499	34	66	23	30	50	203	702
June 2007																
Horned lark	25	33	21	14	20	10	20	10	153	2	17	0	38	24	81	234
McCown's longspur	48	12	58	40	72	0	0	2	232	66	58	0	10	7	141	373
Western meadowlark	2	0	1	0	6	7	5	10	31	3	0	2	0	1	6	37
Vesper sparrow	0	0	6	0	0	11	3	19	39	0	0	0	0	3	3	42
Savannah sparrow	0	0	0	0	0	13	5	26	44	4	0	15	0	3	22	66
Mountain plover	0	0	0	1	3	0	0	0	4	0	0	0	0	0	0	4
Sprague's pipit	0	0	0	0	0	4	0	2	6	2	7	0	0	0	9	15
Northern harrier	0	0	0	0	0	0	1	0	1	0	1	0	0	0	1	2
Long-billed curlew	0	0	0	0	0	0	0	2	2	5	2	0	0	0	7	9
Killdeer	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2
Ferruginous hawk	0	0	0	1	0	0	0	0	1	0	1	0	0	0	1	2

Table A.3 (Continued)

Species	T1	T2	T3	T4	T5	T6	T7	T8	Experimental	T9	T10	T11	T12	T13	Control	Total
Red-winged blackbird	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
Gadwall	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3	3
Barn swallow	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2
American coot	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
Totals	75	45	86	56	101	45	34	71	513	91	86	17	48	38	280	793

[1] "T" refers to Transect number, "Experimental" indicates transects (1-8) in areas where turbines were built between 2003 and 2007, and "Control" indicates transects (9-13) in areas with no turbines in either year.

4.0 DISCUSSION

The results of the grassland bird surveys conducted before and after construction of the windfarm suggest that construction of the facility did not negatively impact numbers of breeding grassland birds. In fact, there was actually an increase in the numbers recorded on the experimental transects (i.e., near the turbines) for six of the nine species analyzed, and overall count totals on the experimental transects were 54% higher after construction (compared to 20% higher on the control transects). O'Connell and Piorkowski (2006) found that of 23 species analyzed at an Oklahoma windfarm, only western meadowlarks were present at lower densities <656 ft (200 m) from turbines than in control areas 0.62 to 6.2 mi (1.0 to 10.0 km) from turbines. The results of other studies (Leddy et al. 1999; Johnson et al. 2000; Erickson et al. 2004) indicated small-scale (≤164-262 ft [50-80 m] from the turbines) decreases in grassland breeding birds. The study design used at JGWEP did not allow for detection of changes at a fine spatial scale, but experimental transects were placed in close proximity to turbines (see Figure 2.3) and numbers of birds detected during surveys increased along those transects after construction.

The 2003 and 2007 surveys were conducted by different personnel, and the increase in birds recorded in 2007 could be attributed to differences in surveyors' abilities to detect birds. However, bird counts on the experimental transects were 54% higher in 2007, and only 20% higher on the 2007 control transects; this suggests an increase in bird numbers on the transects closest to the turbines. The two-sample t-test for total bird numbers did not indicate a significant change, but this is likely due to the high variance between transects in number of birds detected. Multi-year studies, as opposed to the single years pre- and post-construction study conducted at JGWEP, would produce a more robust data set for analysis, and would reduce the probability of a single year potentially having unusually high or low grassland bird numbers (Erickson et al. 2004).

5.0 LITERATURE CITED

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APPENDIX B:

BIRD AND BAT FATALITY TABLES

Table B.1 Bird Fatalities at the Judith Gap Wind Energy Site During the Migration Period (August-October 2006 and February-May 2007).

Sequential Number	Date	Species	Type of Find[1]	Location/Tower (T) Number	Distance from Tower (m)	Comments
1	07/05/06[2]	Western grebe	IF	T18	35[3]	Dismembered (head severed; otherwise intact); could be a Clark's grebe, but Western grebe more likely
2	07/05/06[2]	Western grebe	IF	T18	35[3]	Dismembered (head severed; gash in ventral side); could be Clark's grebe, but Western grebe more likely
3	08/18/06	Short-eared owl	CS	T2	97	Intact carcass
4	08/21/06	Unidentified passerine	CS	T50	26	Intact but old; sparrow or longspur
5	08/25/06	Unidentified passerine	CS	T32	31	Feather spot; 3-4 flight feathers only; possible blackbird
6	08/29/06	Horned lark	CS	T34	47	Carcass desiccated and scavenged
7	09/07/06	Sharp-tailed grouse	IF	T75	7	Intact carcass
8	09/19/06	American coot	IF	Access road southeast of T99	137[3]	Intact carcass; trauma to bill and head
9	09/19/06	Eared grebe	CS	T32	82	Intact carcass; identification tentative; could be a horned grebe
10	09/21/06	Eared grebe	IF	T89	20	Intact carcass, but ventral area split open
11	09/21/06	American coot	IF	Access road near T99	n/a	Intact carcass; trauma to bill and head
12	09/22/06	Merlin	IF	By O&M building	n/a	Intact carcass
13	09/23/06	White-crowned sparrow	CS	T1	113	Dismembered (decapitated) and scavenged
14	09/23/06	Wilson's warbler	CS	T73	86	Intact carcass
15	09/23/06	Wilson's warbler	CS	T73	99	Intact carcass
16	10/07/06	Western meadowlark	CS	T76	17	Scavenged carcass
17	10/15/06	American coot	CS	T99	149	Feather spot; identification tentative
18	11/02/06	American coot	IF	T22	55[3]	Intact carcass
19	03/11/06	Unidentified waterfowl	CS	T64	36	Feather spot; tegmen visible on flight feather

Table B.1 (Continued)

Sequential Number	Date	Species	Type of Find[1]	Location/Tower (T) Number	Distance from Tower (m)	Comments
20	04/17/07	Horned lark	CS	T83	108	Feather spot
21	04/17/07	Horned lark	CS	T83	18	Intact carcass
22	05/06/07	Mallard	IF	T32	11	Dismembered (decapitated) and scavenged
23	05/16/07	Eared grebe	IF	T13	60	Intact carcass
24	05/16/07	Eared grebe	IF	T13	55	Intact carcass
25	05/26/07	Eared grebe	CS	T31	26	Scavenged, but otherwise intact carcass
26	05/27/07	Horned lark	CS	T2	23	Dismembered and heavily scavenged; identification tentative

1 Type of find = Carcass was either found during Carcass Search (CS) or was an Incidental Find (IF).
2 Incidental find prior to initiation of migration study.
3 Indicates visually estimated distance.

Table B.2 Bat Fatalities at the Judith Gap Wind Energy Site During the Migration Period (August-October 2006 and February-May 2007).

Sequential Number	Date	Species	Type of Find[1]	Location/Tower (T) Number	Distance from Tower (m)	Comments
1	08/14/06	Unidentified bat	CS	T6	40	Intact carcass
2	08/14/06	Hoary bat	CS	T6	11	Intact carcass
3	08/14/06	Hoary bat	CS	T6	53	Intact carcass
4	08/16/06	Hoary bat	CS	T1	68	Intact carcass
5	08/16/06	Hoary bat	CS	T1	62	Intact carcass
6	08/16/06	Hoary bat	CS	T1	108	Intact carcass
7	08/18/06	Hoary bat	CS	T2	43	Intact carcass
8	08/18/06	Hoary bat	CS	T2	13	Intact carcass
9	08/19/06	Unidentified bat	CS	T99	26	Intact carcass
10	08/21/06	Hoary bat	CS	T50	8	Intact carcass
11	08/24/06	Unidentified bat	CS	T31	36	Scavenged carcass; only wings remained
12	08/25/06	Hoary bat	CS	T32	51	Intact carcass
13	08/25/06	Unidentified bat	CS	T87	68	Scavenged carcass; only wings remained
14	08/27/06	Unidentified bat	CS	T63	35	Intact carcass
15	08/28/06	Hoary bat	CS	T73	33	Intact carcass but wing scavenged
16	08/28/06	Unidentified bat	CS	T73	47	Intact carcass but some scavenging or decomposition evident
17	08/28/06	Hoary bat	CS	T84	31	Intact carcass with some scavenging by insects
18	08/28/06	Hoary bat	CS	T84	14	Intact carcass with some decomposition
19	08/28/06	Hoary bat	CS	T83	4	Intact carcass with some scavenging by insects
20	08/29/06	Unidentified bat	CS	T40	26	Wings only with attached pelage
21	08/29/06	Hoary bat	CS	T40	42	Wing only with attached pelage
22	08/29/06	Silver-haired (?) bat	CS	T66	57	Intact carcass; tentative identification based on photograph

Table B.2 (Continued)

Sequential Number	Date	Species	Type of Find[1]	Location/Tower (T) Number	Distance from Tower (m)	Comments
23	08/29/06	Unidentified bat	CS	T64	23	Decomposed carcass
24	08/29/06	Hoary bat	CS	T64	17	Decomposed carcass
25	08/29/06	Hoary bat	CS	T64	9	Carcass intact but decomposed or insect-scavenged
26	09/09/06	Silver-haired (?) bat	CS	T76	72	Intact carcass; tentative identification based on photograph
27	09/17/06	Unidentified bat	CS	T40	6	Dismembered, scavenged carcass; only wings remained
28	09/23/06	Unidentified bat	CS	T6	48	Scavenged carcass
29	09/23/06	Unidentified bat	CS	T73	54	Scavenged carcass; only parts of wings remained
30	10/07/06	Unidentified bat	IF	T42	33	Only scavenged wing remained
31	10/09/06	Unidentified bat	CS	T66	16	Dismembered, insect scavenged carcass
32	10/09/06	Unidentified bat	CS	T66	17	Only scavenged wings remained
33	10/13/06	Silver-haired (?) bat	CS	T34	10	Intact carcass; tentative identification based on photograph
34	10/14/06	Unidentified bat	CS	T83	108	Intact but decomposed carcass
35	10/15/06	Hoary bat	CS	T73	100	Scavenged, decomposed carcass
36	05/19/07	Silver-haired bat	CS	T63	50	Intact carcass

[1] Type of find = Carcass Search (CS) or Incidental Find (IF).

APPENDIX C:

FORMS

JUDITH GAP WIND ENERGY PROJECT
FATALITY/INJURED WILDLIFE DATA FORM

DATE: _____ TIME: _____ OBSERVER: _____

FOUND DURING *(check one)*: SCHEDULED CARCASS SEARCH _____ INCIDENTAL FIND _____

COLLECTED? yes no ID[1]: _____ PHOTO NOS: _____

WHEN TAKING THE PHOTOGRAPHS, INCLUDE AN OBJECT FOR SCALE, PHOTOGRAPH THE BACK AND THE UNDERSIDE, AND INCLUDE CLOSE-UPS OF HEAD, FEET, AND PLUMAGE.

PLOT NO.: _____

LOCATION, IF NOT ON PLOT: _____

HABITAT: _____

SPECIES: _____ SEX *(circle)*: M F U AGE *(circle)*: A J U

CONDITION *(circle one)*: intact scavenged dismembered feather spot injured

DISTANCE & BEARING FROM THE NEAREST TOWER/POLE:

DESCRIPTION	DISTANCE (ft)	BEARING (degrees)
Part 1		
Part 2		
Part 3		
Other		

COMMENTS:

ESTIMATED TIME SINCE DEATH/INJURY: _____

WEATHER:

HISTORY: *(if carcass is estimated to be less than one week old, circle any of the following weather conditions that occurred at or before the estimated time of death/incident)*

clear calm fog cloudy rain snow storm gusty wind violent storm blizzard

NOTES:

GENERAL COMMENTS: *(e.g., behavior observed if bird is injured; details of carcass – body parts missing, injuries, number of feathers in feather spot; indications of cause of death, field marks for identification, USFWS band no., etc.)*

USFWS CONTACT:

DATE: _____ TIME: _____ RECOVERY APPROVAL: yes no

CONTACT PERSON(s):

COMMENTS:

DISPOSITION OF FIND: _____

TRANSPORTED TO FREEZER: _____ DATE: _____ TIME: _____

RELEASE TO USFWS - PERSON: _____ DATE: _____ TIME: _____

COMMENTS:

[1] ID = mm-dd-yy-hrmin (e.g., 08-24-06-1307).

JUDITH GAP WIND ENERGY PROJECT
GRASSLAND BIRD POINT COUNT DATA SHEET

DATE _____ TRANSECT NO. _____ PAGE ____ OF ____

OBSERVER _____ PRECIP _____ CLOUD COVER _____ TEMP _____

WIND DIRECTION/SPEED _____ NOTES _____

Plot No.	Start Time	Stop Time	Species Observed	Age/sex	Activity	Incidental observations (outside of plot)	Comments

Grassland bird.doc

RAPTOR NESTING RECORD

Nest Number_____ Location_____ UTM_____

Map Location

See Raptor Nest Map

Date first observed_____

Initial observer_____

Habitat Type_____

Nest type_____

Nest material_____

Substrate_____

Rim/tree height (ft)_____

Nest height above ground level (ft)_____

Elevation (ft)_____

Nest exposure_____

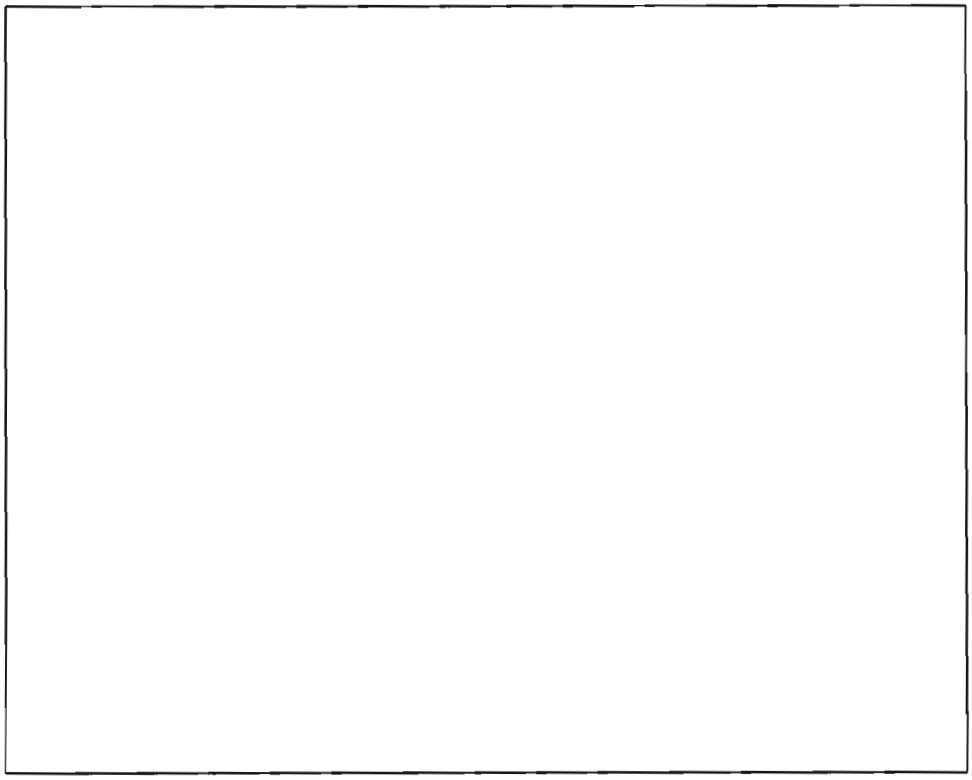
Comments_____

USGS Quad_____

Date/ Time	Status	Species	# adults	# eggs	# young	Observer	Comments (condition, activity of individuals, etc.)

Photo of the nest location is provided.

{***Nest Number}*** Photo Page



Photograph 1 *{Nest Number}*, Looking _____.

JUDITH GAP WIND ENERGY PROJECT
SCAVENGER REMOVAL TRIAL DATA FORM

DATE PLACED:_____

Carcass ID	Species/Age	Placed By	Time	Plot No.	Days After Placement – Presence (P)/Absence (A)							
					1	2	3	4	7	10	14	20

WEATHER (DAY CARCASSES ARE PLACED):

Time _____ Temp _____ Wind Dir _____ Wind Speed _____ Precip _____

Time _____ Temp _____ Wind Dir _____ Wind Speed _____ Precip _____

Time _____ Temp _____ Wind Dir _____ Wind Speed _____ Precip _____

Time _____ Temp _____ Wind Dir _____ Wind Speed _____ Precip _____

COMMENTS:

[1] Carcass ID No. = SR-mm-dd-yy-# (e.g., SR-08-24-06-1)

JUDITH GAP WIND ENERGY PROJECT
SEARCHER EFFICIENCY TRIAL DATA FORM

DATE PLACED:_____

Carcass ID[1]	Species/Age	Placed By	Time	Plot No.	Date Found	Date Retrieved	Notes

WEATHER (DAY CARCASSESS ARE PLACED):

Time _____ Temp _____ Wind Dir _____ Wind Speed _____ Precip _____

Time _____ Temp _____ Wind Dir _____ Wind Speed _____ Precip _____

Time _____ Temp _____ Wind Dir _____ Wind Speed _____ Precip _____

Time _____ Temp _____ Wind Dir _____ Wind Speed _____ Precip _____

COMMENTS:

[1] Carcass ID No. = SE-mm-dd-yy-# (e.g., SE-09-16-06-2).


TRC