Post-Construction Studies for the Spion Kop Wind Farm Project in Judith Basin County, Montana

Final Post-Construction Monitoring Report
May 2015 – October 2017

Prepared for:

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11 E. Park Street
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Agreement Number: CLM0003575 SOS13

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September 19, 2019

MONTANA FISH, WILDLIFE & PARKS

EXECUTIVE SUMMARY

NorthWestern Energy owns the Spion Kop Wind Farm Project, a 25-turbine facility with a total capacity of 40 MW, located in Judith Basin County, Montana. NorthWestern Energy contracted Montana Fish, Wildlife and Parks (MFWP) to develop and implement a post-construction monitoring study in accordance with the Tier 4a and 4b US Fish and Wildlife Service Land-Based Wind Energy Guidelines. By contracting with MFWP NorthWestern Energy ensured that all data and reports would be in the public domain. MFWP saw an opportunity to gain on the ground experience monitoring impacts to wildlife, expertise that will allow agency biologists to be more effective in consultations with wind developers. In 2015 we conducted pilot field studies and assembled the Project's Technical Advisory Committee (TAC). The Post-Construction Monitoring Plan was written, and approved by the TAC, in the winter of 2016. This report presents the post-construction monitoring methods and results from studies conducted May 2016 through October 2017, including a summary of bat acoustic monitoring conducted by the Montana Natural Heritage Program.

Post-construction monitoring consists of tier 4a studies of direct impacts (fatality studies) and tier 4b studies of indirect impacts. The primary objectives of the tier 4a studies were to estimate the number of bird and bat fatalities attributable to collisions with operating wind turbines during months with high bird and bat activity (May through October). Tier 4a studies have four components: (1) standardized carcass searches around selected turbines, (2) searcher efficiency trials to estimate number of carcasses found by searchers, (3) carcass persistence trials to estimate the percentage of carcasses available for searchers to detect in each search interval and (4) fatality estimates for birds and bats calculated by adjusting total carcasses found for searcher efficiency and carcass persistence bias. The primary objectives of the tier 4b studies were to monitor use of the project area by species of special interest (i.e. raptors, grouse and bats). These studies included (1) eagle point-counts, (2) raptor nest monitoring, (3) Sharp-tailed Grouse lek monitoring and (4) bat acoustic monitoring.

We found four bird and 28 bat fatalities in 2016 and 14 bird and 33 bat fatalities in 2017, including those found incidentally. Hoary bat (*Lasiurus cinereus*) was the most common fatality (n = 44) and is also a Species of Concern in Montana. No raptor fatalities were found. No federal threatened or endangered species were found. Searcher efficiency trials were conducted to estimate the proportion of fatalities found by searchers. In 2016, searcher efficiency (SE) rates were 98% for large birds, 94% for medium birds 67% for small birds and 34% for bats. In 2017, searcher efficiencies were lower for medium (61%) and small birds (53%) but higher for bats (55%) and large birds (100%). Carcass persistence trials were conducted to estimate the percentage of carcasses remaining into the next search interval (7 days). In 2016, approximately 80% of large bird, 84% of medium bird, 79% of small bird and 71% of bat, carcasses persisted into the next search interval. In 2017, carcass persistence (CP) rates were similar to 2016 rates for medium (85%) and small birds (78%) but higher for bats (94%) and large birds (98%).

Fatality estimates were calculated by adjusting the number of carcasses found during formal searches for observer detection bias and carcass persistence rates. The 2-year mean bird fatality estimate was 0.97 birds/MW/study period (1.5 birds/turbine) and a site total of 39 birds/study period. The 2-year

mean bat fatality estimate was 4.1 bats/MW /study period (6.5 bats/turbine) and an estimated site total of 163 bats/study period. The bat fatality estimate was higher in 2016 (5.5 bats/MW/study period) than in 2017 (2.6 bats/MW/study period), due primarily to higher SE rates in 2017.

Eagle point counts were conducted May 2015 through December 2016 as a continuation of pre-construction efforts to understand eagle use of the project area. In 2016, just 3 eagle use minutes were recorded out of 66 observation hours. While eagle use appears lower in 2016, direct comparison is complicated because both the number of observation hours and survey overlap were reduced in 2016. We monitored raptor nests in the project area for three breeding seasons, March 2015 through July 2017. In 2015, a new Golden Eagle (*Aquila chrysaetos*) nest was discovered less than one mile from turbine 25. Seven raptor nests were active and successfully fledged in 2015; in 2016, three raptor nests fledged young, and in 2017 only two nests fledged. The Golden Eagle nest near turbine 25 was not active in 2016 or 2017 and the Golden Eagle nest near William's Creek Road was inactive in 2017.

Sharp-tailed Grouse are sensitive to anthropogenic disturbances; surveys were conducted to locate leks within the project area and monitor activity. In 2016, two new Sharp-tailed Grouse leks were discovered; each had 15 to 22 males displaying. In 2017, both leks were active and a third lek was located with 11 displaying males. Sharp-tailed Grouse are observed regularly at the wind farm; no fatalities were found during formal searches.

Acoustic bat detectors were deployed at two locations, a reservoir just east of the Project Footprint and below the nearest turbine to examine year-round activity patterns. Nine bat species were confirmed at the site, several species were confirmed for the first time in the vicinity of the Little Belts – Highwood Mountains and others were confirmed present in additional months across the year. At both detectors, bats were more active at low wind speeds (2 – 4 m/s) than would be expected if bats were not selecting for wind speed; 95% of all bat activity occurred at wind speeds at or below 6 m/s.

Fatality monitoring data at Spion Kop indicate that bird mortality due to turbine collisions is low in comparison to other wind farms in the region. We conclude that the low impact to birds predicted in the Bird and Bat Conservation Strategy (BBCS) is accurate. The BBCS assessed risk to bats as low but post-construction monitoring data reveal this assessment to be inaccurate. The BBCS set a fatality threshold at 6 bats/MW/year and while the observed average fatality estimate (4.1 bats/MW) is below this metric, caution is warranted because fatality estimates varied between years and the 95% CI in 2016 was 3.3 – 9.9 bats/MW. In addition, the bat fatality estimate is substantially higher than the median estimate of 2.3 bats/MW derived from 27 wind farms in the Mountain Prairie region. For these reasons, we assess the impact to bats using the Project area as higher than predicted in the BBCS; strategies to reduce the number of bat fatalities should be discussed with the TAC. There is widespread acknowledgement and concern over the potential impact of wind energy facilities on bat populations, and a need to implement measures to reduce bat fatalities. Curtailment is a post-construction mitigation measure that has been proven to reduce bat fatality at wind farms; small increases in cut-in speeds can substantially lower bat fatality (Arnett et al. 2011; Baerwald et al. 2009).

RECOMMENDED CITATION

Montana Fish, Wildlife and Parks. 2019. Post-Construction Studies for the Spion Kop Wind Farm Project in Judith Gap County, Montana. Prepared for NorthWestern Energy, Butte, Montana. Prepared by Kim Linnell and Kristina Smucker, Montana Fish, Wildlife and Parks, 4600 Giant Springs Rd, Great Falls, Montana. 57 pp. + appendices.

STUDY PARTICIPANTS

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Mark Melton	Volunteer Field Technician

SPION KOP WIND FARM TECHNICAL ADVISORY COMMITTEE

A Technical Advisory Committee (TAC) was formed in the fall of 2015 to make recommendations for developing and implementing effective measures to monitor, avoid and minimize impacts to wildlife and their habitats during operations at Spion Kop Wind Farm, owned by NorthWestern Energy. The TAC reviewed the post-construction monitoring plan (PCM) and has evaluated reports to help ensure that negative impacts to avian and bat species do not reach levels that are significant as a result of routine operation. The TAC consists of volunteer representatives, whose names are listed below, from USFWS, FWP, Montana State University, Montana Audubon and Tetra Tech. Each member provides different expertise in the conservation of wildlife and habitats, specifically with respect to birds and bats.

The TAC met at least once annually to review the results from the field studies and determine if any fatality thresholds had been met. Responsibilities of the TAC included but were not restricted to:

- Attend and participate in TAC meetings, as well as, be available for advice and assistance.
- Review the PCM plan and updated Bird and Bat Conservation Strategy (BBCS); provide recommendations.
- Provide sufficient flexibility to adapt as more was learned about project impacts and current mitigation strategies.
- Provide recommendations to NorthWestern Energy regarding threshold adjustments, if needed.
- Develop and recommend additional mitigation measures or research if significant fatalities occur.

TAC MEMBERSHIP

Allison Begley	Montana Fish, Wildlife and Parks
Jeff Berglund	US Fish and Wildlife Service
Jim Burruss	Burns & McDonnell
Janet Ellis	Montana Audubon (retired)
Brent Esmoil	US Fish and Wildlife Service (retired)
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Sam Milodragovich	Northwestern Energy – ex officio member

ACKNOWLEDGEMENTS

We thank the dedicated field technicians who conducted field surveys. Pete Feigley and Manuela Huso offered valuable advice in formatting data for analysis and interpreting statistical results. We thank the members of the TAC for taking the time to attend meetings and provide guidance throughout the study. And we thank NorthWestern Energy for recognizing the importance of monitoring the impacts of operational wind farms on wildlife and funding this research with full support. We extend a special thanks to NWE's Senior Biologist, Sam Milodragovich, for facilitating and championing this work from beginning to end. Montana Fish, Wildlife and Parks has gained invaluable experience through this project; FWP biologists are better equipped to make recommendations on how to monitor, minimize and mitigate impacts to birds and bats, which makes us more effective in consultations with wind developers.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

NorthWestern Energy owns the Spion Kop Wind Farm Project, operated by General Electric, in Judith Basin County, Montana. NorthWestern Energy (NWE) contracted Montana Fish, Wildlife and Parks (MFWP) to develop and implement a post-construction monitoring study to estimate both direct and indirect impacts of the Project to birds and bats. The protocols for this study are similar to other post-construction monitoring protocols used around the nation and follow guidance described in the US Fish and Wildlife Service (USFWS) Land-Based Wind Energy Guidelines (WEG, USFWS 2012). NWE also contracted Montana Natural Heritage Program (MNHP) in 2015 to deploy two acoustic bat detectors to monitor bat species present and activity levels within the Project area as part of their statewide white-nose syndrome surveillance effort.

The post-construction monitoring study consists of two parts as per WEG (USFWS 2012): tier 4a studies of direct impact (fatality studies) and tier 4b studies of indirect impact (e.g. displacement or nest studies). The primary objectives of the tier 4a studies were to estimate the number of bird and bat fatalities attributable to the operation of wind turbines during months of high activity (spring through fall). Tier 4a studies consisted of four components: (1) standardized carcass searches around selected turbines, (2) searcher efficiency trials to estimate number of carcasses found by searchers, (3) carcass persistence trials to estimate percentage of carcasses available for searchers to detect in each search interval and (4) fatality estimates for birds and bats calculated by adjusting total carcasses found for searcher efficiency and carcass persistence bias. The primary objectives of the tier 4b studies were to monitor the use by species of special interest (i.e., raptors, grouse and bats) within the Project area. These studies included (1) eagle point-counts, (2) raptor nest monitoring, (3) Sharp-tailed Grouse lek monitoring and (4) bat acoustic monitoring.

Raptor nest monitoring, eagle point counts and bat acoustic monitoring began in the summer of 2015. Sharp-tailed Grouse surveys began in April 2016 and fatality monitoring began in May 2016. Fatality monitoring was conducted from May – September 2016 and May – October 2017. In addition to providing results, this report compares findings to existing information, describes decision points and lessons learned and provides a summary for the TAC to provide recommendations.

STUDY AREA

Spion Kop Wind Farm is located 6.5 miles northeast of Raynesford, Judith Basin County, Montana on the southern flank of South Peak in the Highwood Mountains (Fig. 1). The Project Footprint encompasses an approximately 3,000-acre agricultural area of private land and contains 25 General Electric 1.6 MW wind turbine generators with a total capacity of 40 MW. The Project area is characterized by rolling eroded foothills and benches with coulees and rock outcroppings that are bisected by numerous perennial and intermittent streams. The landscape is a mosaic of native lower montane grasslands and non-native agricultural grasslands; the Project area is dominated by non-native grasslands used primarily for pasture, hay and small grain production. The elevation ranges from 4,740 feet above mean sea level (ASL) at the far southern turbine to 5,200 feet ASL at the far northern turbine.

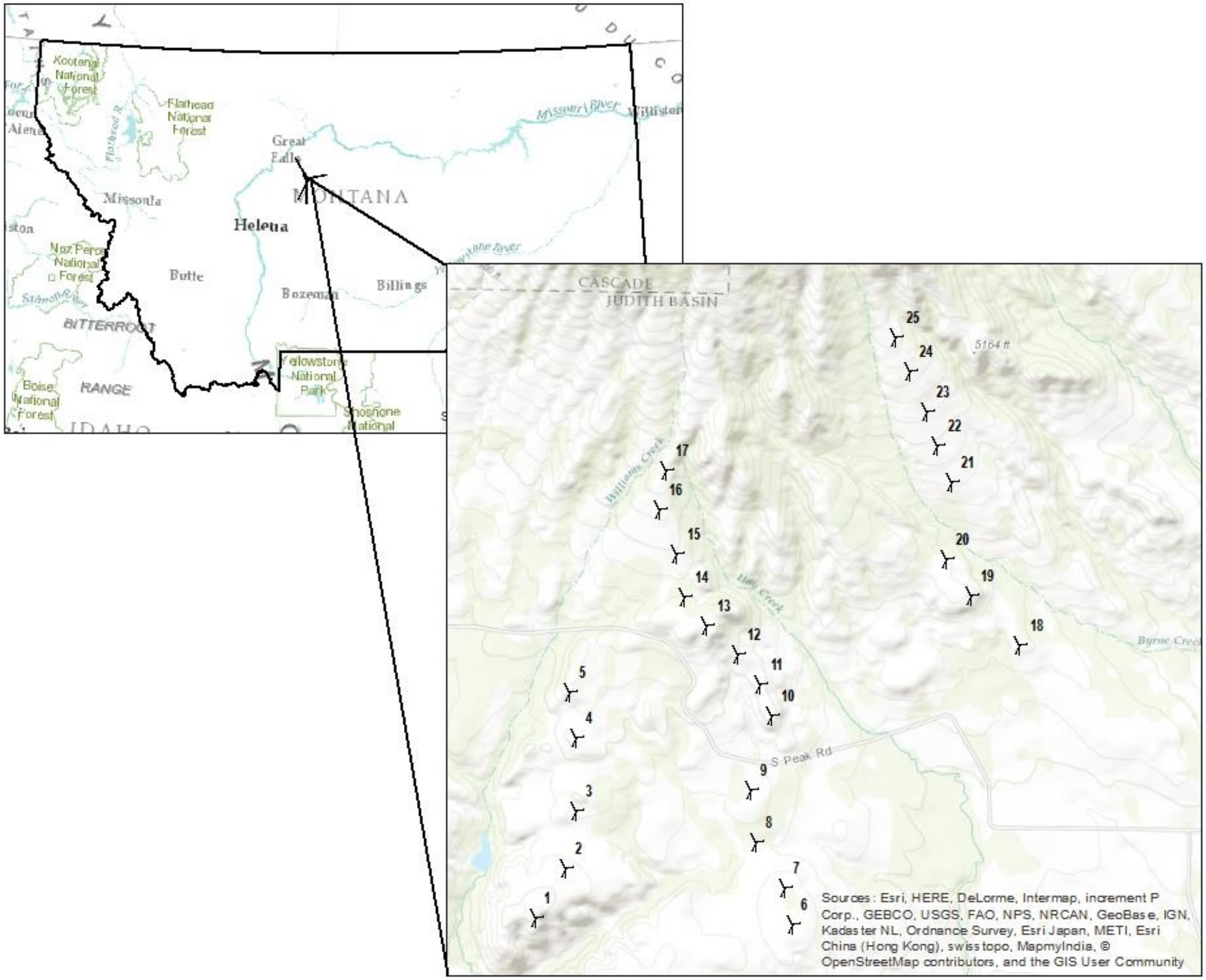


Figure 1. Location of the Spion Kop Wind Farm Project in Judith Basin County, Montana.

TIER 4a FATALITY STUDIES

METHODS

Standardized Carcass Searches

While the USFWS WEG gives suggestions on the percentage of turbines to be searched and plot size for different objectives, there are several methods for searching a turbine plot in a standardized manner. Challenges we faced in planning were a small field crew, terrain, ground visibility and the presence of cattle. We used the summer of 2015 to test different search methods, search intervals and methods for processing carcasses; this information was used in drafting a post-construction monitoring plan (MFWP 2016).

Formal fatality searches were conducted May 16th – September 29th, 2016 (terminated early due to heavy snowstorms) and May 15th – October 18th, 2017. Searches were not conducted in winter due to snow cover and lack of visibility. Across two years of fatality monitoring we conducted 44 search intervals, resulting in a total of 448 turbine searches.

Ten turbines (40% of site) were randomly selected to be searched every seven days beginning May 16th, 2016 (Fig. 2); in early June 2016, turbine 23 was replaced by turbine 6 due to a broken blade. In 2017, searching turbine 23 resumed due to better ground visibility than turbine 6.

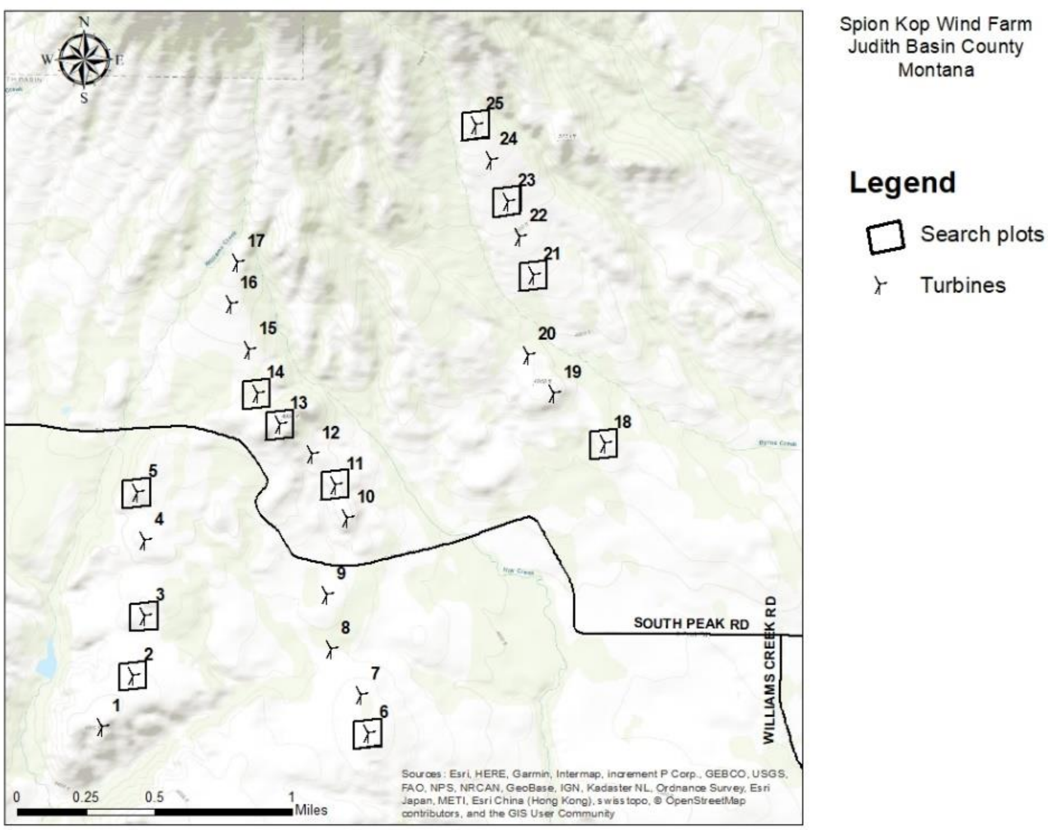


Figure 2. Turbine locations at Spion Kop Wind Farm. Search turbines identified by search plot squares.

Plots (160m x 160m) centered at the turbine's base were searched completely by walking transects (n = 27) spaced 6m apart. Two searchers walked transects side-by-side with the guidance of a GPS unit and a compass, searching out to 3m on either side (Fig. 3). Technicians selected a new corner of the plot to begin searches each week to provide a different perspective each interval. In 2016, any area classified as "Very Difficult Visibility" (i.e., no bare ground and >30 cm vegetation height) was mapped and not searched; in 2017, ground visibility was not categorized, and the entire plot was searched. When a carcass was found we marked it with pink tape and a GPS coordinate; after the search was completed, we returned to the carcass and recorded species, time found, distance and bearing from turbine, age and sex if identifiable and estimated time of death (sample datasheet in Appendix A). In 2016 bird fatalities were left in place and checked for carcass persistence. NorthWestern Energy applied for a Special Purpose Utility Permit from the USFWS Migratory Bird Office; this allows permit holders to remove native bird fatalities and place them in different locations for trials. USFWS issued a permit in September 2016 (SPUT permit #MB74992B-0, Appendix B), so in 2017 all fresh bird carcasses encountered were collected and used in searcher efficiency and carcass persistence trials. In both years, all bat fatalities were collected to be used in bias trials.

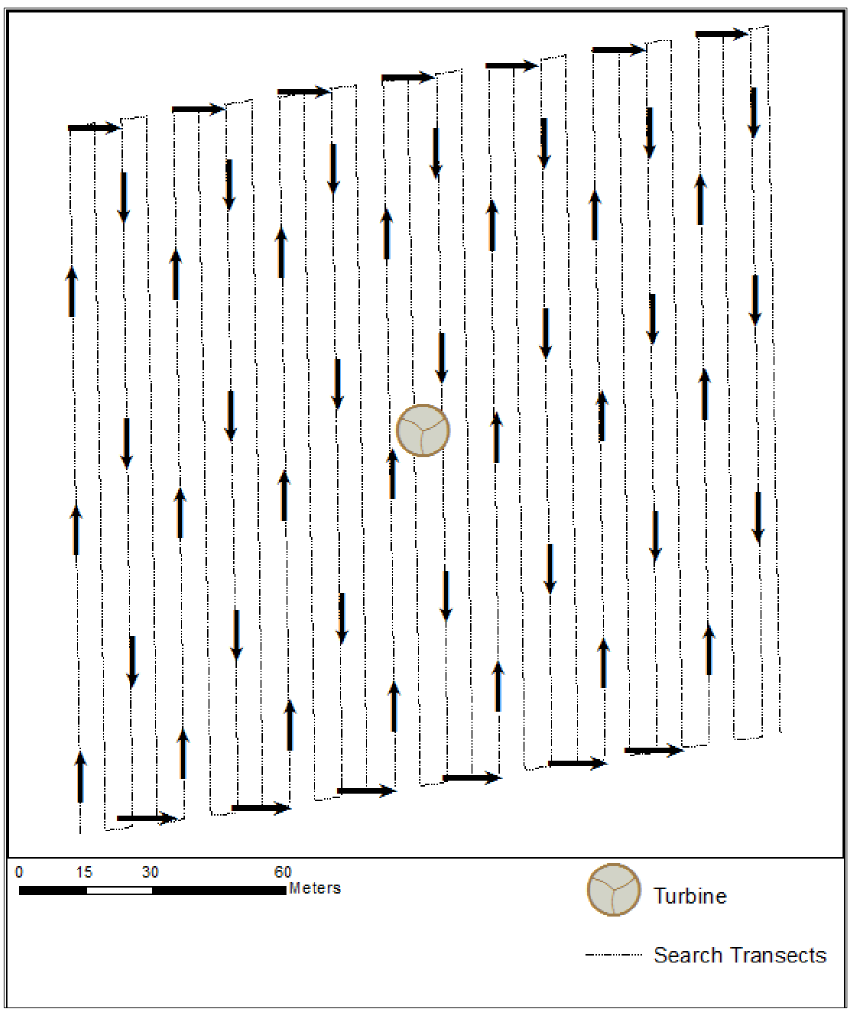


Figure 3. Diagram of the search path grid technicians walked beneath search turbines at Spion Kop Wind Farm.

Searcher Efficiency Trials

The objective of the searcher efficiency (SE) trials was to estimate the percentage of fatalities found by searchers. Because some carcasses are bound to be missed by searchers, SE rates are used to adjust fatality estimates. Trials began with the start of carcass searches and were conducted at least once each search interval; trial carcasses were placed by personnel not conducting the searches. Searchers did not know when the trials were being conducted, which turbines were selected nor the locations of trial carcasses on the search plot. Carcasses were dropped from waist height and allowed to land in random posture; each carcass was discreetly marked with black electrical tape around the left leg so that it could be identified as a trial carcass. Plant markers were placed beneath each carcass to help determine if it had been removed by a scavenger. Searcher efficiency was estimated for each carcass type (bird or bat) and size of bird carcass (small, medium and large). These SE estimates were then used to adjust the total number of carcasses found for those missed by searchers, therefore correcting detection bias.

In 2016, four replicates of each carcass type (bat, small bird, medium bird and large bird) were randomly placed at locations generated in ArcGIS in each of three visibility classes (easy, moderate or difficult). Carcasses were put out no more than 24 hours in advance of a search and no more than four carcasses were placed per turbine. We primarily used surrogates in bias trials for birds; small birds were represented by House Sparrows (*Passer domesticus*), 2-week old Northern Bobwhite Quail (*Colinus virgianus)* and European Starlings (*Sturnus vulgaris*); medium birds were represented by Rock Pigeons (*Columbia livia*) and young chickens (*Gallus gallus*); large birds (i.e. raptors) were represented by large, adult chickens. Any bat fatality encountered was collected to be used in an SE trial and we supplemented with rabies-negative carcasses (primarily *Myotis* spp.) from the Veterinary Diagnostics Laboratory in Bozeman, MT; mice (*Mus musculus*) were used to fill in when fresh bats were not available. The number of carcasses found was recorded and the number of carcasses available for detection during each trial was determined by the searchers, who were given the carcass locations at the end of each trial day. Thus, searchers had just one opportunity to find an SE trial carcass.

In 2017, there were three important changes in the methods for SE trials. (1) Fewer carcasses were placed because we did not include visibility class as a variable. Classifying visibility was difficult because vegetation height changed throughout the season and more importantly the 2016 analysis revealed that visibility did not explain variation in carcasses detected. (2) Acquiring a SPUT permit allowed us to use native birds acquired through Montana Fish, Wildlife and Parks' salvage permit or donated by USDA APHIS Wildlife Services. Bird fatalities encountered at the wind farm could also be moved and used in SE trials. In 2017, 75% of all SE trial carcasses were native species and included all large birds (i.e. raptors) which were represented primarily by Turkey Vultures (*Cathartes aura*) and Red-tailed Hawks (*Buteo jamaicensis)*. All bats used were either hoary (*Lasiurus cinereus*) or silver-haired bats (*Lasionycteris noctivagans*) found at the wind farm. (3) Carcasses were placed randomly at any time of the week and were not collected until found by searchers. Carcasses not found by searchers on the first day were checked for persistence until found by searchers or removed by a scavenger. By this more "realistic" method, no more than two carcasses were placed at any given turbine and searchers had multiple chances to find them. We recorded the number of carcasses found and the number of carcasses that were not available for searchers to find.

Carcass Persistence Trials

Another potential bias in fatality monitoring is the removal of carcasses by scavengers, making carcass observations incomplete. The average time a carcass persists in the search area needs to be included in the fatality estimates to adjust for this factor. Estimates of carcass removal were used to adjust fatality estimates for removal bias.

Once SE trial carcasses were located, only fresh carcasses were moved to turbines not being searched for fatalities. Locations were randomly selected, though we opted for the same vegetation cover as the SE location. Carcass persistence trials were concurrent with fatality searches throughout the monitoring period, early summer through fall. Carcass species composition was similar to that used for SE trials; surrogates were primarily used in the year 2016 and mostly native birds and tree roosting bats were used in 2017. Carcasses were dropped at waist height, identifiable by black electrical tape around the left leg and their locations marked with both a GPS coordinate and a plant marker (Fig. 4).

Figure 4. Swainson's Hawk used in SE and CP trials. Birds were marked with black electrical tape on the left leg and raptors were photographed to document decomposition.

Carcasses were checked by field personnel every day for the first four days, then on day 7, 10, 14 and 30 or until removed. This schedule varied somewhat depending on weather and other field survey work. Any remains left on day 30 were disposed of.

Extended Raptor Carcass Persistence Trial

Raptor carcasses are known to persist in the environment much longer than 30 days. In 2017, a subset of 26 raptor carcasses placed for carcass persistence trials were left in place beyond the 30-day trial period. Extended trials ran from June – December 2017 and carcasses were checked every 30 days up to 180 days. On each visit, we documented carcass condition and took photographs. We were unable to check carcasses on most dates in October and November due to heavy snow. Winter conditions prevented carcass removal in December and carcasses remained in the field until removal in October 2018; carcasses were not visited or photographed during this time.

Fatality Estimates

Bird and bat mortality was estimated using Fatality Estimator software (Huso et al. 2015). The computer program uses data from bias to estimate Searcher Efficiency (SE) and Carcass Persistence (CP). These parameters are then used to adjust for bias in the calculated fatalities per turbine and provide fatality estimates for the entire site, based on carcasses found during scheduled searches beneath selected turbines. Additional data input into the estimator include the number of turbines searched for carcasses, the total number of turbines at the site and the proportion of the carcass density estimated to be within searchable areas beneath each turbine (density-weighted proportion - DWP). DWP is incorporated into the fatality model to expand estimates to the entire search area beneath individual turbines.

Bias Trial Estimates

Visibility Class (easy, moderate and difficult) was considered a covariate for SE and CP for birds and bats in 2016, and Size Class (small, medium, and large) was a second covariate considered for birds in both 2016 and 2017. For SE estimates, planted carcasses that were scavenged before searches were initiated were excluded from the analysis. Inclusion of Visibility Class and Size Class (for birds only) in the SE model was determined by conducting trial runs and evaluating Akaike's Information Criterion (AICc) as an indicator of the relative quality of the model relative to other models considered (i.e., lowest AICc with ΔAICc >10 units compared to modeling without an explanatory variable, Huso et al. 2015). Similarly, CP was modeled with and without Visibility Class and assuming a Weibull failure time distribution. The process was repeated for exponential, loglogistic and lognormal failure time distributions and the resultant AICc values compared. The program was run separately for estimating fatalities of birds and bats. Ninety-five percent confidence intervals (alpha 0.05) with 5,000 bootstrap resamples were used for final fatality estimates.

Density-weighted Proportion (DWP)

In 2016, to estimate the fraction of fatalities that fell in the sampled areas (excluding very difficult), we assumed the overall distribution of carcasses found during searches were representative of all turbines. We then calculated the total searchable area within 5m bands from the base of each search turbine as well as the proportion of bat and bird carcasses that were found within each 5m band (Fig. 5). For each sampled turbine, we multiplied the proportion of bat and bird carcasses by the proportion of searchable area in each band (Huso & Dalthorp 2014). The sum of these products for each turbine was used as DWP. Because visibility class was not considered in 2017, DWP was assumed to be 100% in the analysis.

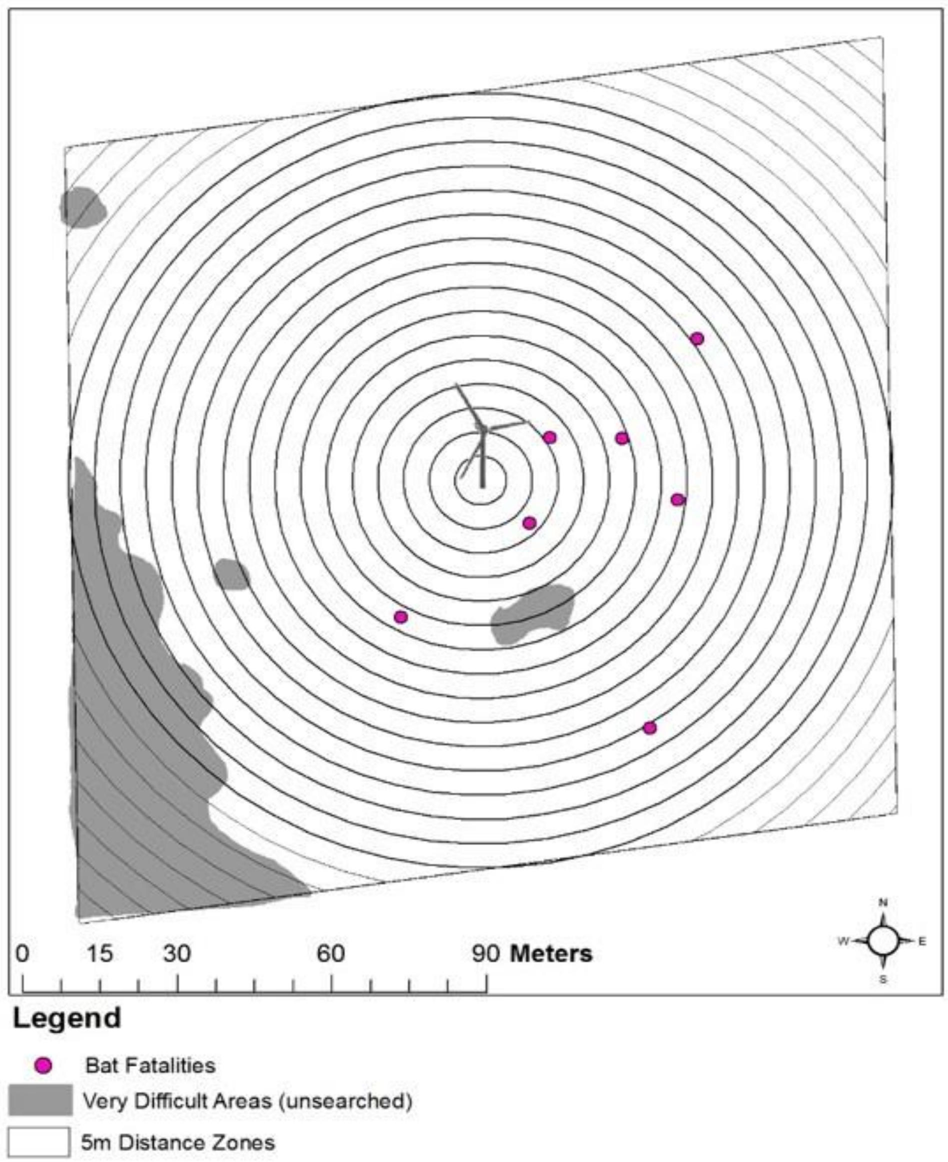


Figure 5. Diagram of how searchable area was mapped and used to calculate DWP at Spion Kop Wind Farm

Evidence of Absence

We used Evidence of Absence software (Dalthorp et al. 2014) as an additional analysis because no raptor fatalities were found in either 2016 or 2017. This program uses SE and CP estimates of interest (i.e. eagles, raptors or large birds in general) from the Fatality Estimator as well as parameters of the search protocol (turbines searched, sampling dates, sampling coverage) to estimate the number of possible fatalities of a specific group, even though zero carcasses in that group were encountered. We ran the model using two numbers for sampling coverage, which is analogous to DWP in the Fatality Estimator, however EOA has one value for sampling coverage whereas the Fatality Estimator has a value per search turbine. As such, we chose to run the model twice, once with the smallest search turbine

DWP (.75) and another time using an even smaller number (.70), to account for the possibility of large birds falling outside of our search plots. We used the SE data of raptors with 95% confidence intervals, sampling dates of 21 search events in 2016 and 23 search events in 2017 with a 7-day search interval, and CP data of raptors with 95% confidence using Lognormal (2016) and Weibull (2017) distributions because they had the lowest AICc value, indicating best fit.

RESULTS

Technicians searched 160m x 160m square plots at 10 wind turbines (40% of turbines) from May 15th – September 29th, 2016 and May 16th – October 18th, 2017. In total, 448 turbine searches were conducted over the course of the study. Across the two seasons, searchers encountered 18 bird and 61 bat fatalities during standardized carcass searches or incidentally (i.e. outside the standardized search period or at a non-search turbine). See Appendix A for a complete list of carcasses.

Bird Fatalities

During the 2015 pilot study, four birds were found: Green-winged Teal (*Anas crecca*), Hungarian Partridge (*Perdix perdix*) and two Sharp-tailed Grouse (*Tympanuchus phasianellus*). Data were collected for these fatalities, but they were not used in estimates.

During the search season May 15th – September 29th, 2016 four bird fatalities were found (2 Western Meadowlark (*Sturnella neglecta*), 1 Hungarian Partridge (found incidentally) and 1 unknown feather spot (Table 1). In the search season May 16th – October 18th, 2017 we found 14 bird fatalities, including 5 Western Meadowlark, 1 Eurasian Collared-Dove (*Streptopelia decaocto*), an unknown thrush species (*Catharus spp*.), 1 White-throated Swift (*Aeronautes saxatalis*) and feather spots of 5 Hungarian Partridge. Two of these were found incidentally.

Table 1. Bird fatalities encountered at Spion Kop during 2016 and 2017 formal searches or incidentally. Only carcasses encountered during formal searches were used in the fatality estimator, reported here as (#).

Species	Size class	2016	2017	Total
Hungarian Partridge	Medium	1	5	6
Eurasian Collared-Dove			1	1
White-throated Swift	Small		1	1
Western Meadowlark		2	5	7
Unknown thrush			1	1
Unknown feather spot		1	1	2
Total (# for estimator)		4 (2)	14 (12)	18

Bird fatalities were found throughout the monitoring season and there does not appear to be a temporal pattern for fatalities. However, 14 of 18 birds were found on the far west string of turbines, Turbines 1 through 17. The highest number of bird fatalities were found at Turbine 14 (n = 4) and Turbine 13 (n = 3) (Fig. 6); two birds found at Turbines 3, 5, and 21, and one bird found at Turbines 1, 2, 18, and 6. We did not find raptor fatalities in either monitoring year and no avian Species of Concern were found (MNHP & MFWP 2018)

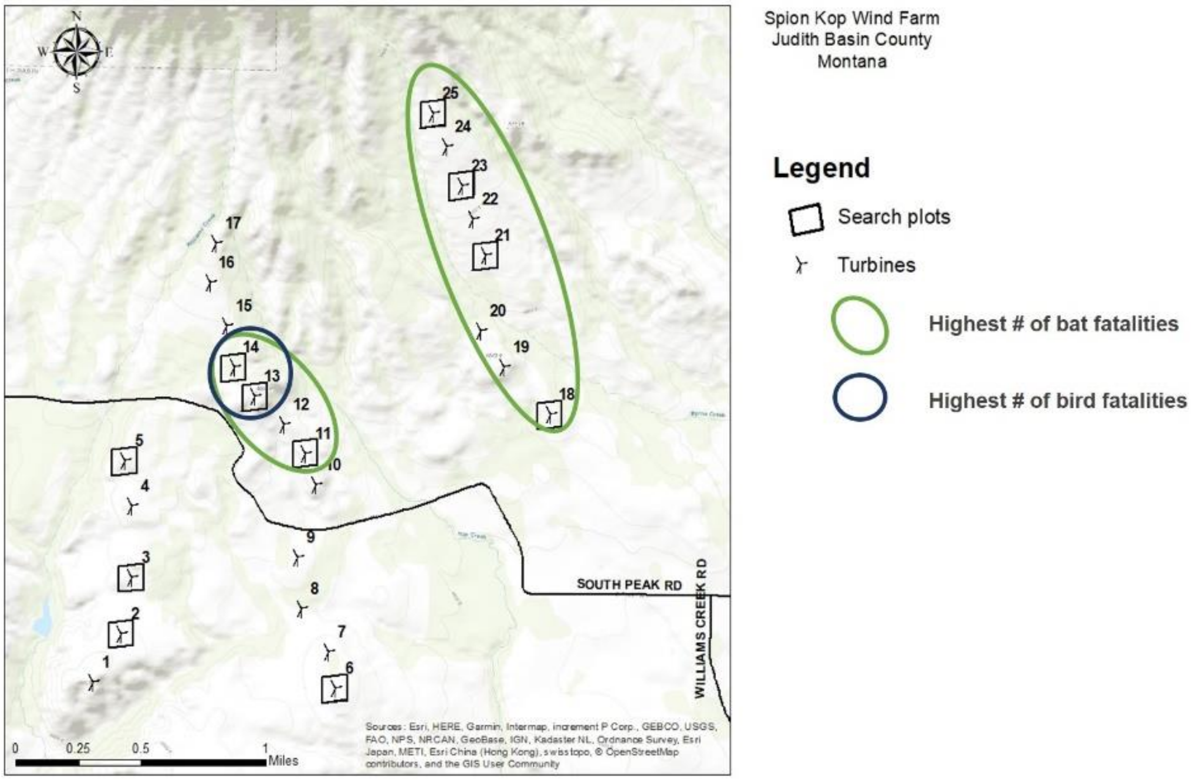


Figure 6. Turbines with the highest observed bird and bat fatalities at Spion Kop Wind Farm. 44% of bird fatalities (8 of 18) were found at the two turbines within the blue circle. 70% of bat fatalities (43 of 61) were found at the 12 turbines within the green circles.

Bat Fatalities

Four bats were found during the 2015 pilot carcass searches, one silver-haired bat and three hoary bats. Data were collected on these carcasses, but none were used in estimates.

In the 2016 monitoring season, 19 hoary bats and 9 silver-haired bats were found for a total of 28 bats; 7 were found incidentally. In the 2017 search season, 25 hoary bats and 8 silver-haired bats were found for a total of 33 bats; 11 were found incidentally. Some incidental carcasses were discovered at non-search turbines where carcass persistence trials took place. No other bat species were encountered. Hoary bats were the most common fatality (n=44).

Table 2. Bat fatalities encountered at Spion Kop Wind Farm during 2016 & 2017 formal searches or incidentally. Only carcasses encountered on search plots were used in the fatality estimator, reported here as (#).

Species	2016	2017	Total
Hoary bat	19	25	44
Silver-haired bat	9	8	17
Total	28 (21)	33 (22)	61 (43)

Bats were found at all search turbines. The search plots with the highest number of bat fatalities were Turbine 25 (n=8) and Turbine 18 (n=7); both turbines are located on the easternmost string (Fig. 6), which is also the string closest to forest. Fatalities were found during the known bat migration season (July – October). In both years, the first bat fatality was not found until late June/early July. Fatalities peaked in August and by October had dwindled to only two bat fatalities (Fig. 7).

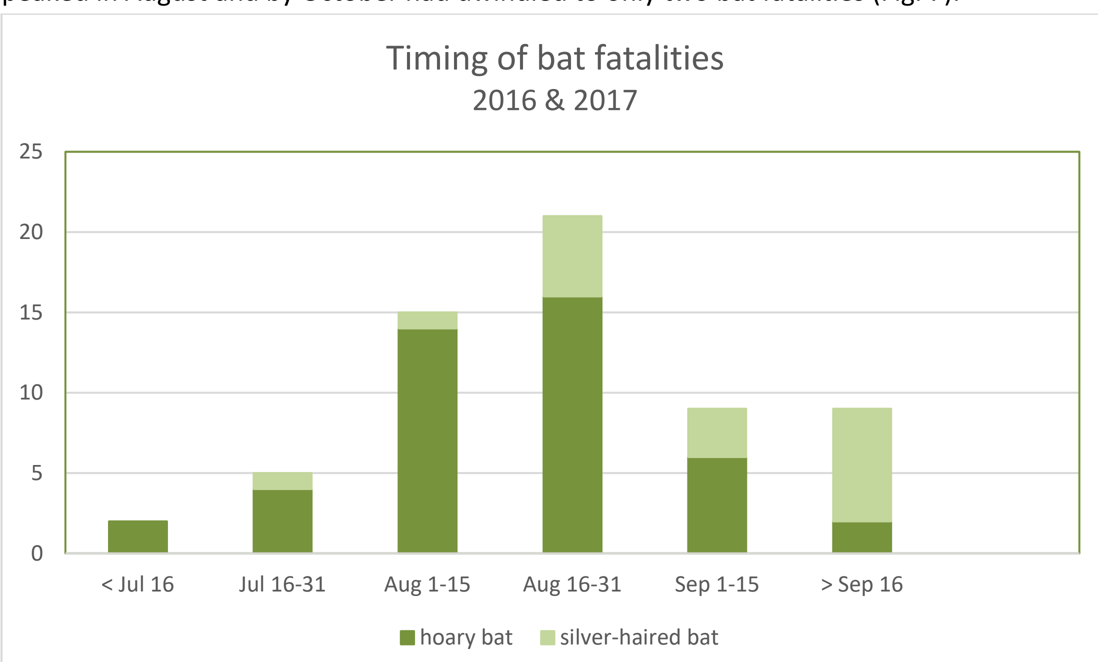


Figure 7. Timing of bat fatalities encountered at Spion Kop Wind Farm. Fatalities tracked the migration period with a peak in August. Note that silver-haired bat fatalities were encountered later in the migration season.

Searcher Efficiency Estimates

For searcher efficiency trials during the 2016 study period, we used 63 small bird, 64 medium bird, 61 large bird and 58 bat/mice carcasses for a total of 246 trial carcasses. Estimated efficiency rates were 67% for small birds, 94% for medium birds,98% for large birds and 34% for bats (Table 3). Using AICc, we determined that visibility did not explain substantial variation in finding bird or bat carcasses; however, size was an important explanatory variable for finding birds and was included in the model.

Table 3. Searcher efficiency trials at Spion Kop Wind Farm in the 2016 and 2017 search seasons. Number of trial carcasses placed, found and searcher efficiency (SE) estimates (with a 95% confidence interval) for bats and birds by size class.

	2016			2017		
Carcass type	**# trial carcasses**	**# found**	**SE (95% CI)**	**# trial carcasses**	**# found**	**SE (95% CI)**
Small bird	63	42	**67%** (56 – 78%)	19	10	**53%** (26 – 68%)
Medium bird	64	60	**94%** (87 – 98%)	18	11	**61%** (17 – 61%)
Large bird	61	60	**98%** (95 – 100%)	17	17	**100%**
Bat	58	20	**34%** (22 – 47%)	20	11	**55%** (35 – 75%)
Total	**246**			**74**		

During the 2017 monitoring season a total of 19 small bird, 18 medium bird, 17 large bird and 20 bat trial carcasses were placed for searcher efficiency trials for a total of 74 trial carcasses. Fewer trial carcasses were placed in 2017 because we did not place carcasses in different visibility classes. Efficiency rates were 53% for small birds, 61% for medium birds, 100% for large birds and 55% for bats. Based on model selection, size was again important for explaining whether we found birds during the 2017 monitoring season.

Carcass Persistence Estimates

In 2016, we used 71 small bird, 66 medium bird,66 large bird and 57 trial carcasses for bats (17 mice, 40 bats), for a total of 260 trial carcasses (Table 4). Carcass persistence is the percentage of carcasses that persist until the next search interval; estimated persistence rates were 79% of small bird, 84% of medium bird, 80% of large bird and 71% of bat carcasses. The best model for both bird and bat carcasses was the lognormal distribution without the use of visibility or size class (birds) as covariates. However, size class was used in bird estimates to be able to use the data in an EOA analysis.

Table 4. Carcass persistence trials at Spion Kop Wind Farm in the 2016 and 2017 search seasons. Number of trial carcasses placed for carcass persistence estimates (with a 95% confidence interval) for bats and birds by size class. Carcass persistence is the percentage of carcasses that persist until the next search interval.

	2016		2017	
Carcass type	**# trial carcasses**	**CP (95% CI)**	**# trial carcasses**	**CP (95% CI)**
Small bird	71	**79%** (72 – 85%)	20	**78%** (66 – 90%)
Medium bird	66	**84%** (78 – 90%)	17	**85%** (73 – 94%)
Large bird	66	**80%** (74 – 87%)	20	**98%** (92 – 100%)
Bats/mice	57	**71%** (62 – 79%)	15	**94%** (88 – 98%)
Total	**260**		**71**	

During the 2017 monitoring season, a total of 20 small bird, 17 medium bird, 20 large bird and 15 bat carcasses, for a total of 71 trial carcasses, were placed for persistence trials (Table 4). Again, fewer trial carcasses were placed in 2017 because we did not place carcasses in different visibility classes of vegetation in the plots. Seventy-eight percent of small birds, 85% of medium birds, 98% of large birds and 71% of bats persisted into the next search interval. The best model fit for bat carcass persistence was exponential, whereas Weibull with size was the best model fit for birds. As with searcher efficiency estimates in 2017, visibility was not tested as a possible explanatory variable in the persistence of trial carcasses.

Extended Raptor Carcass Persistence Trial

In 2017, we placed 27 raptor carcasses for persistence trials between June 5 and October 11. On day 60, 93% of carcasses can be documented as present. Carcass condition varied but most were intact with little change to body position, i.e. wing and tail feathers, but if the carcass fell “face up”, the exposed breast showed significant decomposition. Only three carcasses were documented as scavenged by day 120: a Swainson’s Hawk (Day 8), a Sharp-shinned Hawk (Day 90), a Cooper’s Hawk (Day 120).

Regular checks concluded in December 2017, but carcasses were not retrieved until fall/winter of 2018/2019. We recovered remains for 63% of the carcasses placed for this study (17 of the 27) more than one year after they were placed. Of the carcasses recovered, persistence times ranged from 383 days (Turkey Vulture) to 527 days (Red-tailed Hawk). Condition of the final remains recovered varied, but in most cases only the largest bones (e.g. keeled sternum, long bones) and/or flight feathers or feather shafts persisted. Visibility of remains also varied – in some cases bones or feathers could be seen from five meters away, making it plausible the remains could have been detected in a formal search. In other cases, we navigated to the coordinates and scoured the area to find the carcass, either because little remained or because only a few bones or feathers were visible. All bone and feather remains were removed from the site on October 23 2018, January 9 or January 15 2019. Detailed results are presented in a separate report (Photo record of raptor CP trials at Spion Kop Wind Farm) and an accompanying photo guide is available. See Appendix.

Adjusted Fatality Estimates

Fatality estimates and 95% confidence intervals were calculated for birds and bats. The fatality estimates were adjusted based on the estimates of searcher detection bias, carcass removal and density-weighted proportion. Fatality rates were calculated per turbine and translated into per MW to allow comparisons with results from other wind farms.

Small Birds

We found two small birds during 2016 searches, both of which were Western Meadowlark (Table 6). We also found a feather spot during formal searches that could not be identified to species, but we omitted this bird from the analysis since size class could not be determined. The total number of small bird fatalities estimated for the site was 13 (95% CI 10 – 16) and the per turbine estimate was 0.5, which is 0.35/MW/study period.

Seven small birds were found during 2017 searches: five Western Meadowlark, one White-throated Swift, and one thrush spp. In 2017, the total number of small bird fatalities estimated for the site was 45 (95% CI 18 – 110) and the per turbine estimate was 1.76. This translates to 1.1 small birds/MW/study period.

Table 5. Bird fatality estimates at Spion Kop Wind Farm in the 2016 and 2017 search seasons by size category per turbine, per megawatt and site totals. 95% confidence intervals are shown in parentheses.

	Size Group	Birds per turbine	Birds per MW	Site total
2016	**TOTAL BIRDS**	**0.5 (0.4 – 0.6)**	**0.31 (0.3 – 0.4)**	**13 (10-16)**
	Small birds	*0.5 (0.4 – 0.6)*	*0.31 (0.3 – 0.4)*	*13 (10-16)*
2017	**TOTAL BIRDS**	**2.6 (1.5 – 6.9)**	**1.6 (1.0 – 4.3)**	**64 (29-173)**
	Small birds	*1.8 (0.7 – 4.38)*	*1.1 (0.4 – 2.7)*	*45 (18 – 110)*
	Medium birds	*0.8 (0.3 – 3.5)*	*0.5 (0.2 – 2.2)*	*20 (8 – 88)*
AVERAGE	**TOTAL BIRDS**	**1.5**	**0.97**	**39**

Medium Birds

Only one medium bird was found in 2016, a Hungarian Partridge, and it was found incidentally in April before formal searches began. It was therefore not used in the analysis and thus there are no medium bird estimates for 2016.

Four medium birds were found during 2017 searches (three Hungarian Partridges and one Eurasian Collared Dove). The site total estimate for medium birds in 2017 was 20 and the per turbine estimate was 0.8, which is 0.5 medium birds/MW/study period.

Large Birds

No large birds were found in either 2016 or 2017 and thus there are no large bird fatality estimates.

Evidence of Absence

No raptor fatalities were found, therefore, we used Evidence of Absence software (the Dalthorp et al. 2014) to assess the chances of a raptor fatality that we may have missed. According to our analysis, we can assert with 95% credibility that no more than three large birds were killed (Fig. 8) during the monitoring period in 2016.

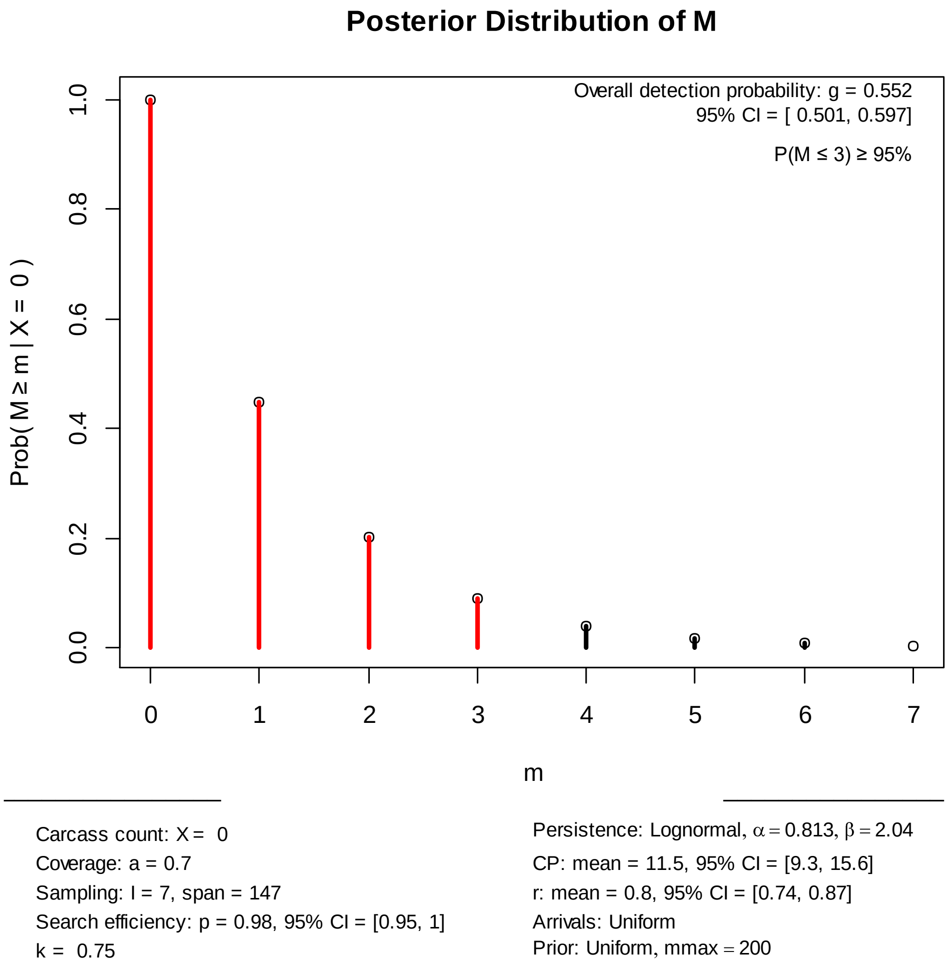


Figure 8. Output from Evidence of Absence software showing the probability of missing large birds at Spion Kop Wind Farm, 2016. Red bars represent the probability that the number of fatalities exceeded the given values of M on the x axis; the range of m values with red bars are within 95% CI, which in this analysis represents a credibility interval.

Using an updated version of the software (Dalthorp et al. 2017) for the Evidence of Absence analysis in 2017, we found that there was a 90% credibility that the true number of raptor fatalities that occurred during the monitoring period was less than or equal to three. The updated version of the EOA software can also project a fatality probability for the entire year rather than just the months in which turbines were searched. We can assert with 90% credibility that the true number of large bird fatalities (raptors specifically in 2017) in a full year was less than or equal to 10.

Bats

In 2016, bat fatalities were found between late July and early October; no bats were found during May and June searches. The estimated fatality for the Project was 221 bats with a 95% CI of 120 – 397 bats (Table 5). The total per turbine rate was 8.83 bats, which translates to 5.5 bats/MW/study period.

In 2017, the first bat fatality was found in June and bats were found regularly until the end of September. The total number of bat fatalities estimated for the site was 104 (95% CI 60 – 197). The per turbine rate was 4.12, which is 2.6 bats/MW/study period.

Table 6. Bat fatality estimates at Spion Kop Wind Farm by species per turbine, per megawatt and estimated site totals in 2016 and 2017. 95% confidence intervals are shown in parentheses.

	Species	Bats per turbine	Bats per MW	Site total
2016	**TOTAL BATS**	**8.8 (4.8 – 15.9)**	**5.5 (3.0 – 9.9)**	**221 (120-397)**
	Hoary bat	*6.7 (3.7 – 11.8)*	*4.2 (2.3 – 7.4)*	*167 (93 – 294)*
	Silver-haired bat	*2.2 (0.6 – 4.6)*	*1.4 (0.4 – 2.9)*	*55 (160 – 116)*
2017	**TOTAL BATS**	**4.1 (2.4 – 7.9)**	**2.6 (1.5 – 4.9)**	**104 (60 – 197)**
	Hoary bat	*3.0 (1.8 – 5.3)*	*1.9 (1.1 – 3.3)*	*74 (44 – 134)*
	Silver-haired bat	*1.1 (0.3 – 3.0)*	*0.7 (0.3 – 3.0)*	*30 (6 – 73)*
2-YEAR AVERAGE	**TOTAL BATS**	**6.5**	**4.1**	**163**

TIER 4b STUDIES OF INDIRECT IMPACTS

METHODS

Tier 4b studies of indirect impacts included (1) eagle point-counts; (2) raptor nest monitoring; (3) Sharp-tailed Grouse lek monitoring and (4) bat acoustic monitoring.

Eagle Point Counts

Pre-construction studies predicted moderate risk for raptors based on the presence of Bald (*Haliaeetus leucocephalus*) and Golden (*Aquila chrysaetos*) Eagles, and seven other raptor species including nesting Ferruginous (*Buteo regalis*), Swainson's (*Buteo swainsoni*) and Red-tailed (*Buteo jamaicensis*) Hawks (Madden & Harmata 2013, pg. 16). The closest active Golden Eagle nest was 4.4 miles from the project area. In a pre-construction study, one breeding adult from this nest was outfitted with a telemetry device; the eagle was not observed using the project area. Pre-construction raptor use was low: during 204 hours of formal counts one Golden Eagle was detected within an 800m survey plot.

Post-construction eagle point counts began in spring of 2014, prior to FWP involvement. A consultant established 12 eagle point counts following the draft Eagle Conservation Plan Guidance (ECPG) (USFWS 2013) and conducted monthly counts from spring 2014 – spring 2015 (Fig. 9). MFWP involvement began in May 2015 and we continued eagle point counts at the 12 established locations using the same methods. In April 2016, we reduced the number of point-count locations, following a consultation with the TAC and Kevin Kritz (USFWS Region 6 Eagle Specialist, pers. comm.), to minimize overlap. The ECPG recommends non-overlapping point-count locations and at least 30% coverage of the Project Area. However, the 12 established point counts overlapped significantly and covered 83% of the Project Area (Fig. 9). We retained the 6 point-count locations with the highest visibility and least overlap, covering 65% of the Project Area (Fig. 10). These points had also produced a majority of the eagle observations in the 2015 field season. We conducted counts from April 2016 through December 2017.
Eagle point counts were conducted once monthly, and count duration was one hour. Data were recorded on an aerial photo of the 800m radius point count and included date, observer, start time, wind direction, wind speed, cloud cover and temperature. When an eagle (or other raptor) entered the point count plot (within 800m laterally and 200m vertically), its location was plotted on the aerial photo along with species, age, time, behavior and whether it was observed above the rotor swept zone, within it or below it. In the ECPG, an "eagle minute" is any amount of time an eagle spends within the plot rounded up to the nearest minute, for example an eagle that spends 20 seconds quickly passing through is rounded up 1 eagle minute. Risk time is the calculated total number of eagle minutes that were spent flying (not perching) in a survey plot.

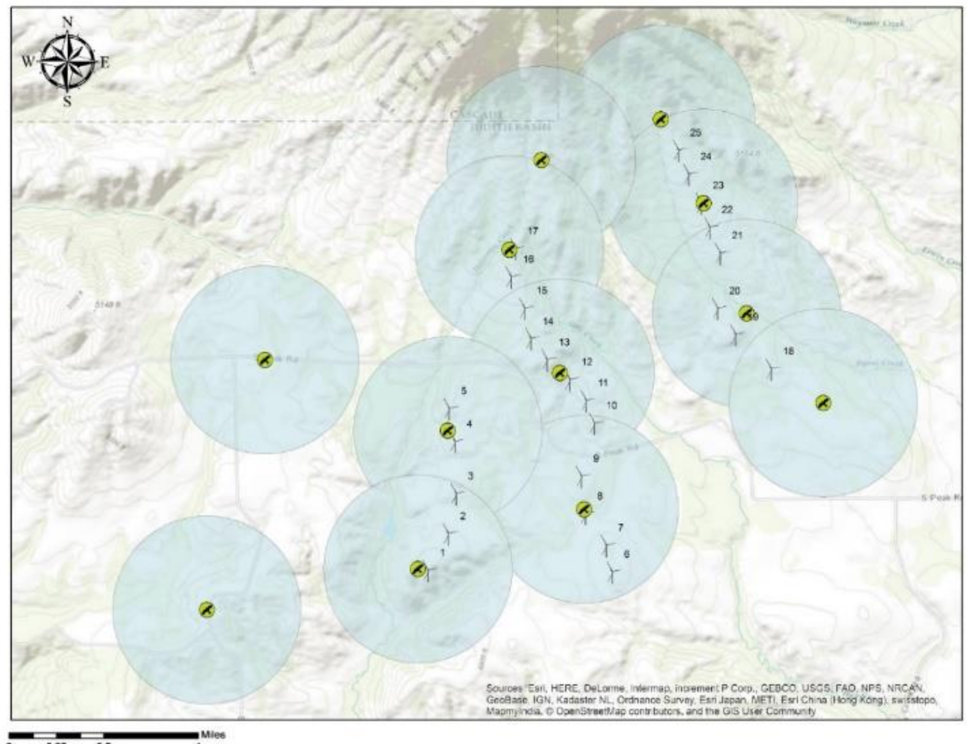


Figure 9. Locations of 12 eagle point counts at Spion Kop Wind Farm, surveyed May 2015 – April 2016.

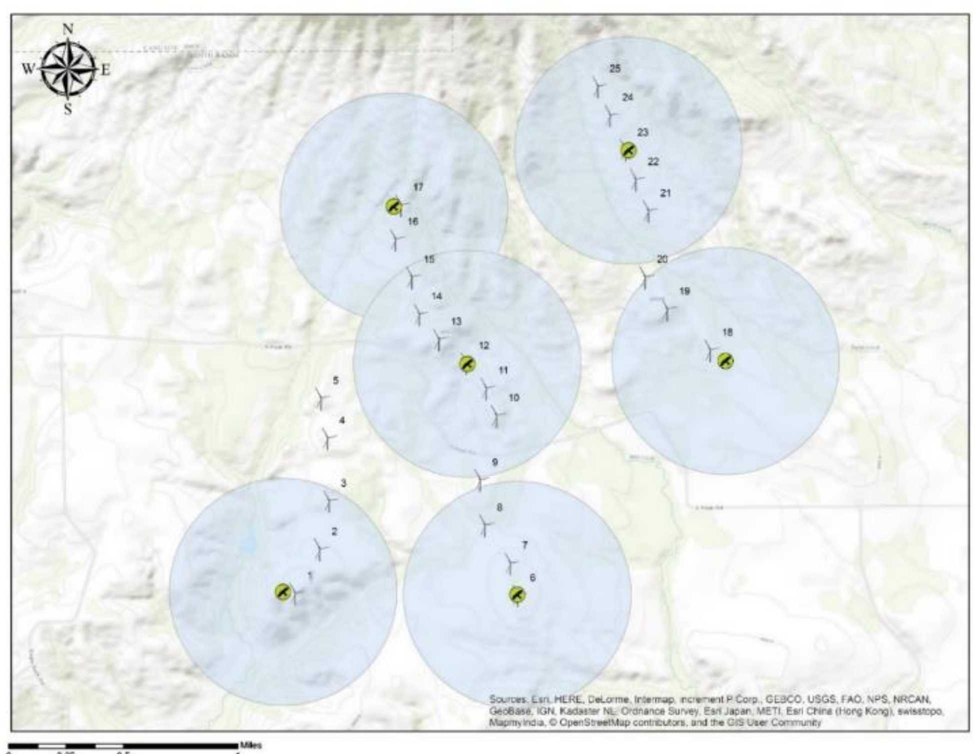


Figure 10. Locations of six eagle point count stations at Spion Kop Wind Farm surveyed April 2016 – December 2017. There is slight overlap between the turbine 17 and turbine 12 counts, but because of a ridge the area of overlap is not viewable from turbine 12.

Raptor Nest Monitoring

In 2015, we attempted to locate nests described in pre-construction studies and each year (2015 – 2017) we searched for new nests within the Project Area and monitored all nests. All raptor nests received ground surveys in March to determine whether they were active; active nests were checked once a month throughout the breeding season (April – July) or until fledging to determine nest success. When a nest was visited, we recorded visit number, date, nest status and condition, species and activity. Any new nests found were assigned coordinates and described.

We also conducted one 10-mile radius eagle flight in June 2015 to search for 10 eagle nests documented in pre-construction flights. Two flights were conducted in 2016, an initial flight in early spring to locate eagle nests and a second flight in early summer to determine productivity. The April 2016 search flight began at 7:00 am and ended at 2:00 pm; searching was done by flying over nesting habitat (e.g. coulees, cliffs, lone trees and forest edges) and all previously known nests were checked for activity. All nests determined active during the April flight were revisited for productivity in mid-June. No flights were conducted in 2017.

Sharp-Tailed Grouse Lek Monitoring

Pre-construction studies predicted low to moderate risk for Sharp-tailed Grouse (Madden & Harmata 2013, pg. 16). Montana Fish, Wildlife and Parks noted a historical Sharp-tailed Grouse lek 0.85 miles southeast of the Project Area, but it was not confirmed active during pre-construction surveys. In April 2016, we conducted ground surveys according to the methods proposed in the BBCS and incorporated guidance from MFWP area biologists to locate this lek and others in the area.

Three ground surveys to detect Sharp-tailed Grouse leks were conducted seven days apart in April 2016 by driving the wind farm roads and stopping every 800m to listen for lekking activity (Fig. 11). Surveys were conducted before sunrise when wind was light. New leks were to be assigned coordinates and monitored three times in May, seven days apart, before sunrise when winds were low. However, due to a large snowstorm in May 2016 leks were only counted once before birds were no longer active. During these lek counts we counted the total number of grouse present and the number of displaying males. Leks discovered in 2016 were again monitored April – May 2017, with assistance from MFWP biologists. Data were entered into MFWP’s Wildlife Information System database.

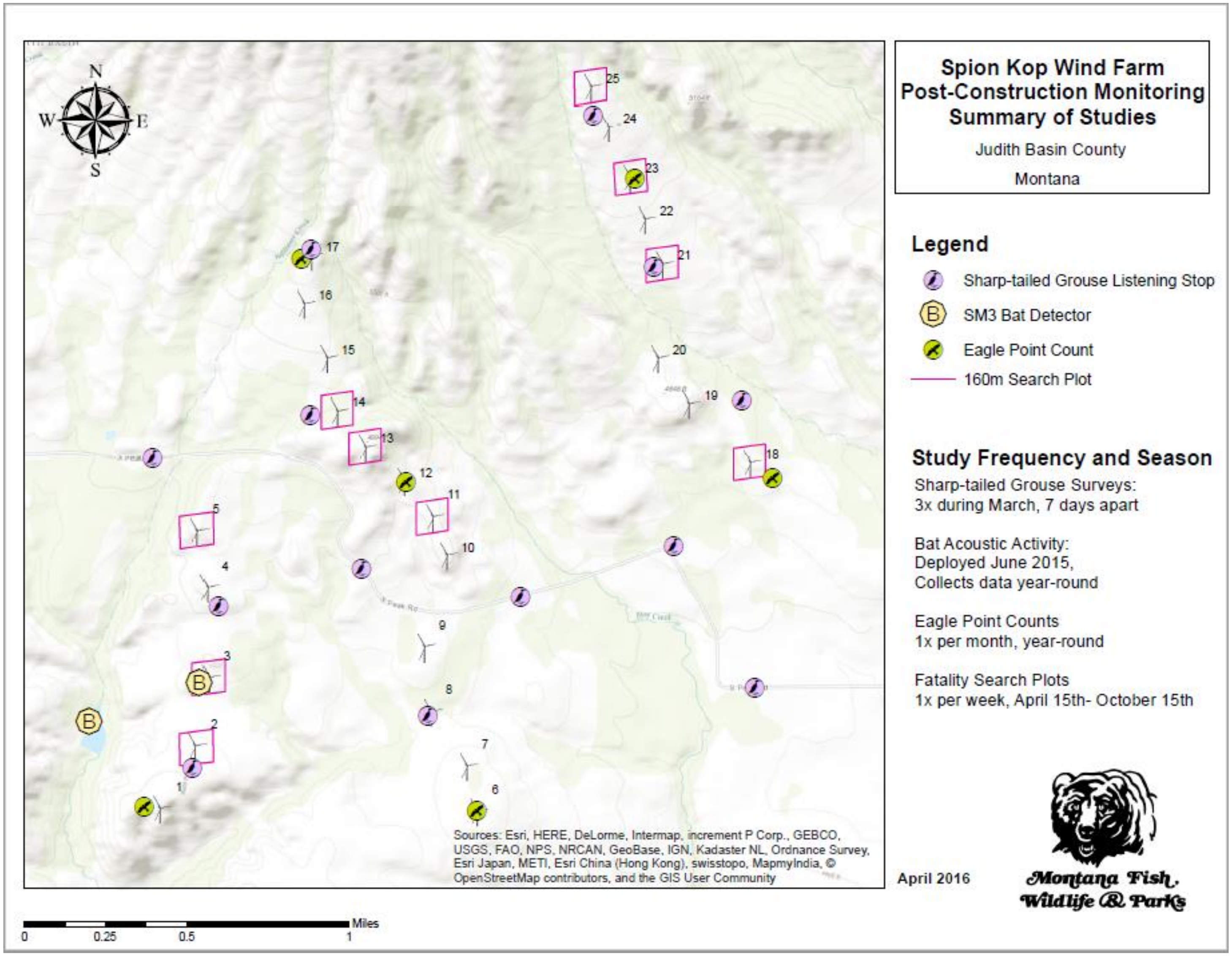


Figure 11. Locations of post-construction monitoring studies at Spion Kop Wind Farm, including the SM3 acoustic bat detectors, Sharp-tailed Grouse listening stops, eagle point count plot centers and turbine search plots.

Acoustic Bat Monitoring

In 2012, Montana partnered with other agencies to develop a statewide network of detectors to establish baseline information on bat populations, and detectors placed at Spion Kop contributed data to this network. Tree roosting bats, such as the hoary bat and silver-haired bat, have been shown to have high mortality at wind farms and are on Montana's Species of Concern list (MNHP & MFWP 2018). In June 2015, two SM3 Wildlife Acoustics bat detectors were deployed to examine year-round activity patterns. One detector was placed near a reservoir on the western edge of the wind farm and the second was placed up a draw from the reservoir at the base of turbine 3 (Fig. 11). Bats often use bodies of water for drinking and foraging, thus the detector was strategically placed to sample species present within the Project Area. The detector at the base of turbine 3 was placed to capture species active within the wind farm. SD cards were collected once a month and sent to MNHP for processing. Sequences were analyzed to determine species presence by month following call attributes established for Montana species by MNHP (Bachen et al. 2018).

RESULTS

Eagle Point Counts

In 2015, we had 14 Golden Eagle observations during formal counts at 12 overlapping locations for an estimated total of 47 eagle use minutes during 285 survey hours (Table 7).

Table 7. Summary of Golden Eagles observations during monthly surveys at Spion Kop Wind Farm from May – December 2015. The time eagles perched is not included in risk time.

Month	Location(s)	Age(s)[1]	Behavior	Risk Time (min)
May	turbines 20, 23	AD	hunting below & within the rotor swept zone	0:11
August	turbines 8, 17, SE of T18	JUV & SUB	soaring & stooping above; flap-gliding below the rotor swept zone	0:04
October	turbines 23, 8, 12	AD	soaring and perched below and within the rotor swept zone	0:03
November	W of T1 on Eagle Rock Rd, W of T5 on South Peak Rd, upslope of T17	AD & JUV	soaring, flap-gliding & perched below & above the rotor swept zone	0:07
December	turbines 1, 8, W of T1 on Eagle Rock Rd, W of T5 on South Peak Rd, upslope of T17	AD, SUB & JUV	soaring, flap-gliding & perched above and below the rotor swept zone	0:22
Total Observations		14	**Total Risk Time:**	**0:47**

Age[1]: AD – adult, SUB – sub-adult, JUV – juvenile

In 2016, three Golden Eagles were observed during formal surveys, two in December and one in May (Table 8). Two eagles quickly passed through survey points; the eagle observed near turbine 1 in December flew to a fence post and then remained perched for the duration of the survey. One incidental Golden Eagle (not observed during surveys) was seen perched on a power pole off Spion Kop Road in early November 2016. The total risk time for eagles observed in 2016 was 3 minutes during 66 survey hours. No eagle point counts were conducted in 2017.

Table 8. Golden Eagle observations at Spion Kop Wind Farm during 2016 surveys.

Date	Turbine	Age[1]	Time In	Behavior	Rotor Zone	Time Out	Risk Time (min)
5/23/2016	1	SUB	12:44	soaring	Above	12:45	00:01
12/10/2016	12	JUV	12:01	flap-gliding	Above	12:02	00:01
12/8/2016	1	AD	13:01	multiple	Below	13:30	00:01
Total Observations		**3**				**Total Risk Time**	**00:03**

Age[1]: AD – adult, SUB – sub-adult, JUV – juvenile

While conducting eagle point counts, we recorded the same data on non-eagle raptors within the 800m radius. In 2015, non-eagle raptors were observed 27 times: 3 Ferruginous Hawk, 2 Northern Harrier (*Circus cyaneus*), 4 Rough-legged Hawk (*Buteo lagopus)*, 6 Red-tailed Hawk, 1 Sharp-shinned Hawk and 11 Swainson's Hawk for a total risk time of 2.5 hours (150 minutes) out of 285 survey hours. During 2016 surveys, non-eagle raptors were observed 10 times: 2 Rough-legged Hawk, 2 Swainson's Hawk, 1 Northern Harrier, 3 Red-tailed Hawk and 2 Ferruginous Hawk. Non-eagle raptors were observed throughout the year, but most frequently in the summer months and most commonly at turbines 1 and 6. They used the survey plots for longer durations than eagles, resulting in a total of 3 hours (180 minutes) of risk time out of 66 survey hours.

Raptor Nest Monitoring

Pre-construction studies reported eight raptor nests within the Project Footprint; in the summer of 2015, we located seven of the eight nests and found an additional five not previously described, including one Swainson's Hawk and four Red-tailed Hawk nests (Fig. 12.). During a helicopter survey we also discovered a new Golden Eagle nest located < 1 km north of turbine 25. We monitored this new nest (GE_2), and known nest (GE_1) located 4.4 mi from the Project (Fig. 13).

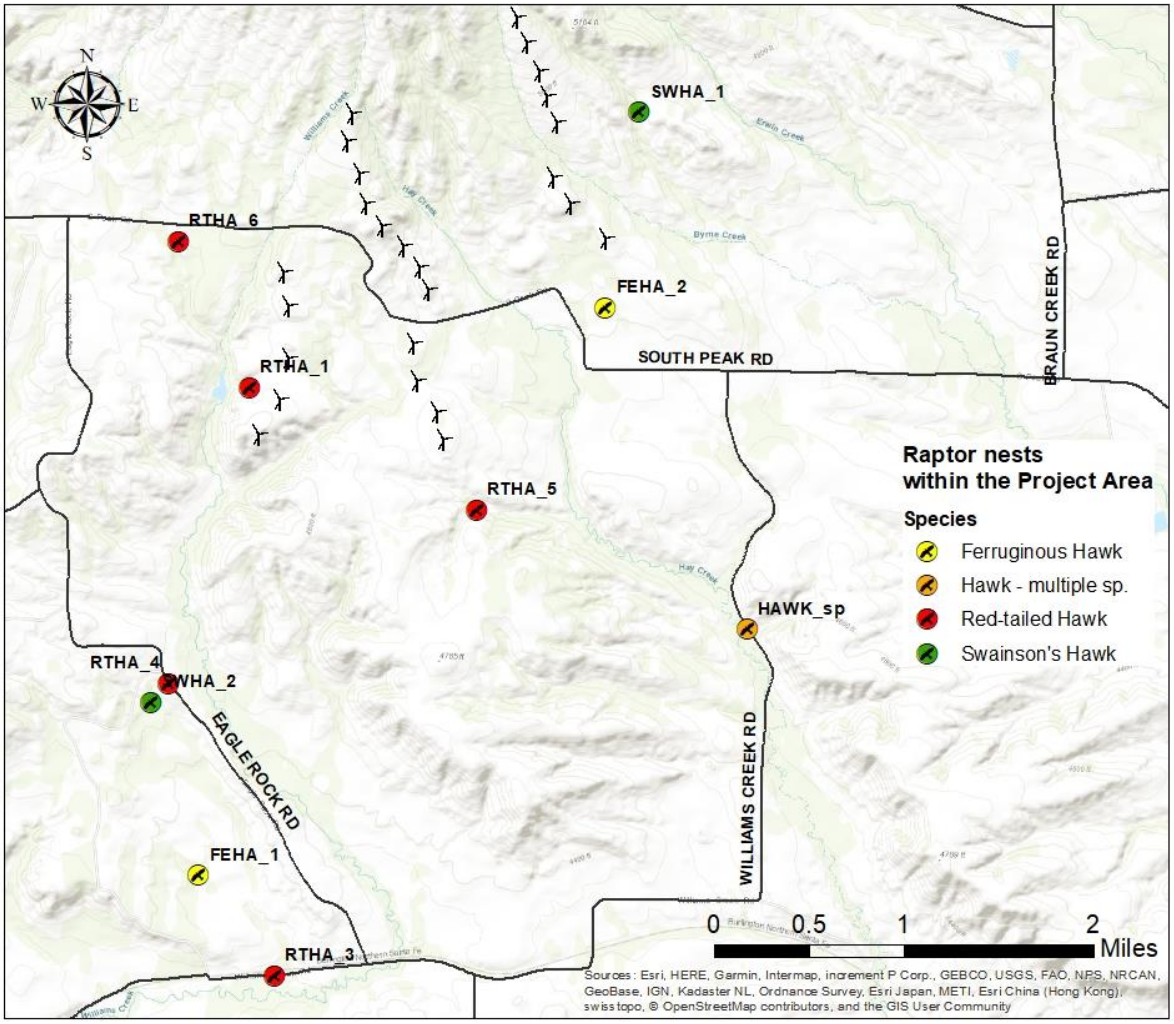


Figure 12. Locations of non-eagle raptor nests monitored in the Spion Kop Wind Farm Project Area, 2015 - 2017.

In 2015, of the 13 documented nests, seven successfully fledged young, including both eagles, one Swainson's Hawk and four Red-tailed Hawks (Table 9). In 2016, 8 of the 13 nests described within the Project area were active during the initial check (breeding pair present, nest building, adult on eggs, etc.) including 1 Golden Eagle nest, 2 Ferruginous Hawk nests, 3 Red-tailed Hawk nests and 2 Swainson's Hawk nests. Three of the 8 active nests were successful (observed fledglings on nest edge or in tree, next check empty nest), including the Golden Eagle, 1 Ferruginous Hawk and 1 Red-tailed Hawk. Nest success was unknown for 2 nests due to viewing difficulty and/or access. Three nests were unsuccessful (had activity in beginning of season but no fledglings ever observed) including a Red-tailed Hawk, a Ferruginous Hawk and a Swainson's nest. Three nests were blown out/never relocated and 2 nests remained empty throughout the breeding season, including the Golden Eagle nest (GE_2) near turbine 25. In the 2016 helicopter flight we searched the surrounding area intensively but were unable to locate an alternate Golden Eagle nest.

In the 2017 breeding season, only three of the 13 nests were active in the spring: two Red-tailed Hawk nests and one Ferruginous Hawk nest; two successfully fledged: one Red-tailed Hawk and one Ferruginous Hawk nest. Neither Golden Eagle nest was active in 2017, and no alternate nests were located. See Appendix D for non-eagle nest coordinates and Appendix E for eagle nest coordinates.

Table 9. Summary of 13 known raptor nests within the Spion Kop Project Area and their activity during the 2015 - 2017 breeding seasons. Only three nests were active in 2017 (shaded dark green). Species code corresponds to the locations in Figure 12 & 13.

Species code[1] _Nest ID	1st year monitored	2015 fate	2016 fate	2017 fate	2016 & 2017 notes on nest activity
***GE_1**	PRE-CON	FLEDGE	FLEDGE	INACTIVE	One fledgling, last seen in June in 2016. Pair did not nest in 2017.
GE_2	2015	FLEDGE	INACTIVE	INACTIVE	Checked monthly until June, no alternate nest found. Did not return in 2016 or 2017.
FEHA_1	PRE-CON	UNK	FLEDGE	**FLEDGE**	Three fledglings, last seen in June of both 2016 and 2017.
FEHA_2	PRE-CON	UNK	FAIL	NO NEST	Adult on eggs in March 2016; no adult in April, dead nestlings in nest – appears depredated. Nest was blown out in 2017.
RTHA_1	PRE-CON	UNK	NO NEST	-	Nest blown out in 2016
RTHA_2	PRE-CON	NO NEST	NO NEST	-	Documented in pre-construction surveys; nest was never located post-construction.
RTHA_3	2015	UNK	INACTIVE	NO NEST	Nest found in Fall 2015 but not active during the breeding season in 2016. Nest blown out in 2017.
RTHA_4	2015	FLEDGE	FATE UNK	INACTIVE	Could not monitor nest after May 2016 as foliage was too dense for observation. Inactive in 2017.
RTHA_5	2015	FLEDGE	BUILDING ONLY	INACTIVE	RTHA pair building nest in spring but no further activity in 2016; inactive in 2017.
RTHA_6	2015	FLEDGE	FLEDGE	**FLEDGE**	Three fledglings, last seen in July, in both 2016 and 2017.
SWHA_1	PRE-CON	INACTIVE	NOT MONITORED		On eggs in June 2016 but not able to check nest again. Did not have access to nest in 2017.
SWHA_2	PRE-CON	FLEDGE	NO NEST	-	Nest gone in both 2016 and 2017.
HAWK_sp[2] (multiple)	PRE-CON (FEHA)	FLEDGE (RTHA)	INCUBATE FAIL (SWHA)	**INCUBATE FAIL (RTHA)**	In pre-con reports described as FEHA nest; occupied by RTHA in 2015 & 2017; 2016 occupied by SWHA. In both 2016 and 2017 observed incubating in early spring but abandoned before fledge date.

[1] Species codes: GE – Golden Eagle; FEHA – Ferruginous Hawk; RTHA – Red-tailed Hawk; SWHA – Swainson's Hawk; [2] The species using this nest site changed annually; *GOEA_1 nest is 4.4 mi from Spion Kop and outside the Project Area.

10-Mile Radius Helicopter Flights

Ten eagle nests were described within a ten-mile radius around the Project before construction and an additional five nests were found on flights post-construction, three in 2015 and two in 2016 (Fig. 13). No flights were conducted in 2017. Of the 15 nests, nine were active in one or both years. In 2015, one flight was conducted in early June and five nests were observed with large nestlings; we assigned the fate for these nests as successful. In 2016, six nests were found active (adult present and/or eggs, etc.) in April 2016. During the June productivity flight, two of the six active eagle nests had blown out, two had fledglings present and two nests were in good condition but empty. The fate of these nests is unknown, since we cannot determine with confidence whether we missed fledging or nests were unsuccessful. A substantial effort was made to locate an alternate nest for the inactive Golden Eagle nest near turbine 25, but no nest was found. See Appendix E for eagle nest activity summary and coordinates.

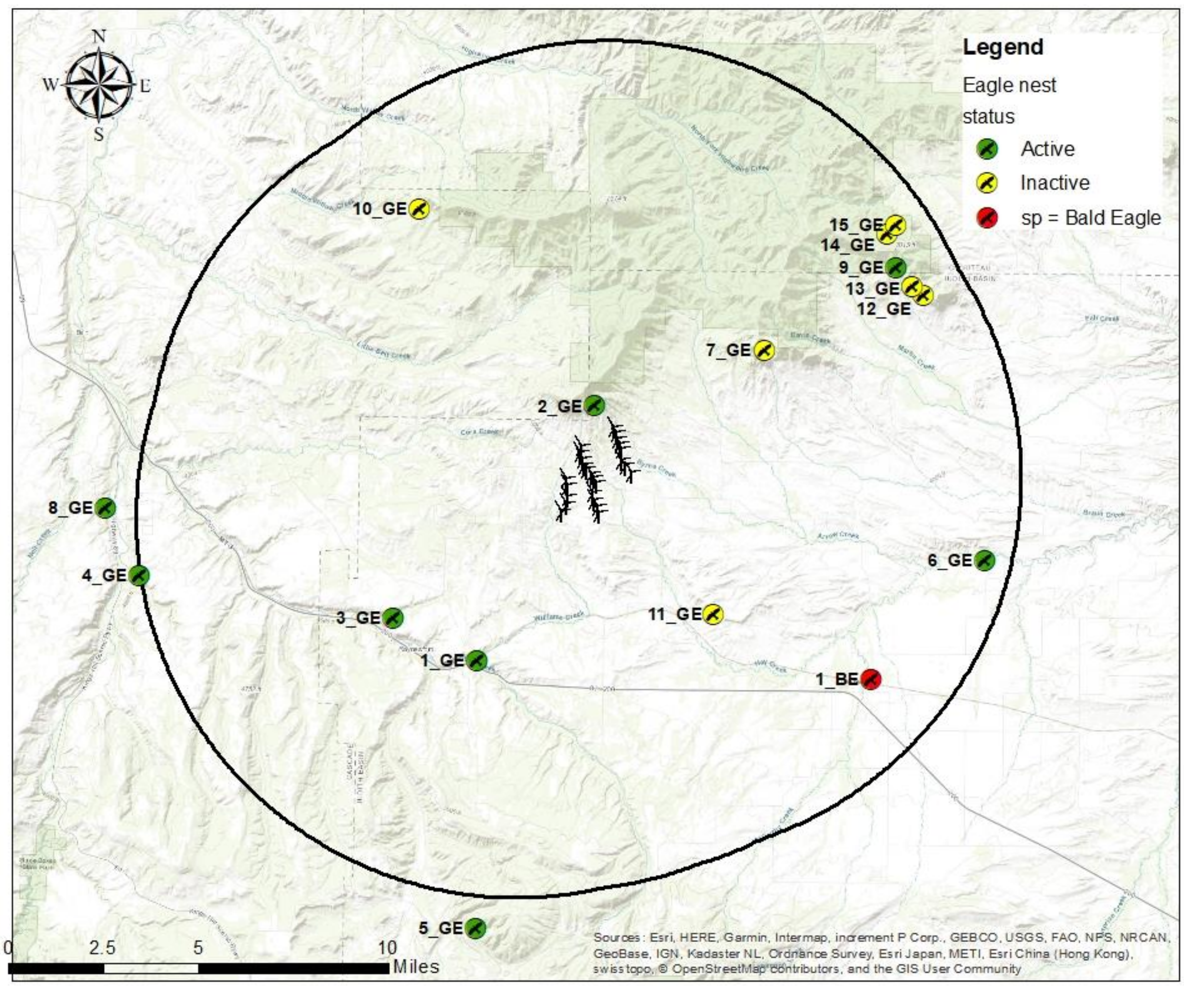


Figure 13. Bald and Golden Eagle nests located and monitored via 10-mile radius flights around Spion Kop Wind Farm in 2015 and 2016.

Sharp-tailed Grouse Lek Surveys

During the April 2016 ground surveys, lekking activity could be heard at three survey points, but only two leks were confirmed visually. Lek_1 was located a few miles west of the described location for the historical lek, north of South Peak Road, and had 15 males and 8 females using the area on May 3, 2016 (corresponding name in Fig. 14). Lek_2 was visually confirmed west of the wind farm and east of Eagle Rock Road; this was a new lek and data were added to FWP's Wildlife Information System. Lek_2 had 22 males and 11 females present on May 3, 2016 (corresponding name in Fig. 14). In 2017, a third lek was located near the area where calls were heard in 2016, southwest of the wind farm. On April 13, 2017, lek_3 had 12 displaying males and 4 females. On the same date lek_2 had 8 males and 1 female present; lek_1 had 18 males and 4 females (Corresponding name in Fig. 14).

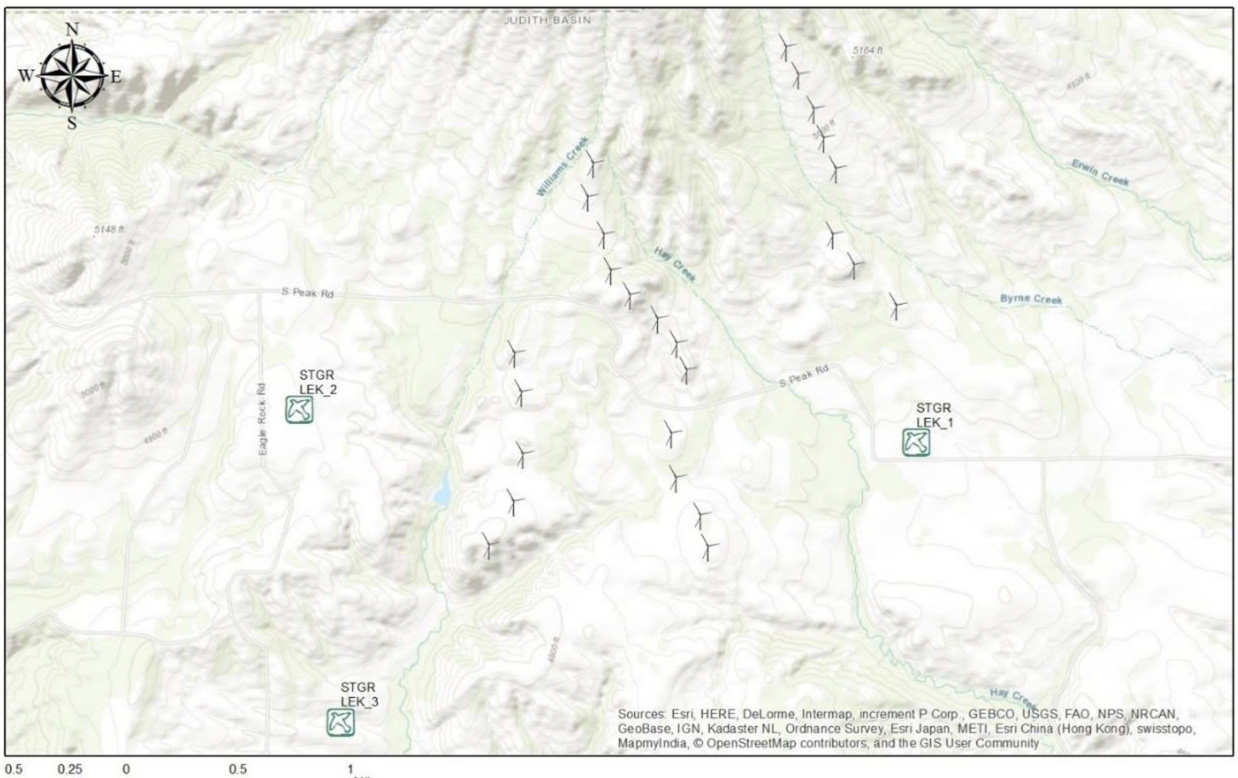


Figure 14. Locations of the three Sharp-tailed Grouse leks within the Spion Kop Wind Farm Project Area, monitored from 2015 – 2017.

Bat Acoustic Surveys

Between June 2015 and December 2017 acoustic detectors at Spion Kop recorded a total of 335,689 call sequences; 333,396 sequences at the reservoir site and just 2,282 sequences at the turbine site. It was anticipated that more calls would be recorded at the reservoir because all bats need to drink and several species forage over water. The number of calls recorded does not directly translate to abundance, a small number of bats foraging in an area throughout the night will generate a lot of calls. Rather, the number of call sequences is an index of bat activity. Placing a detector where there is high activity increases the likelihood of detecting the full community of bat species present.

Bat Species Detected

Across both detector sites, nine species of bat were documented at the site across both detectors (Table 10). At the reservoir detector we recorded: big brown bat (*Eptesicus fuscus*), Eastern red bat (*Lasiurus borealis*), hoary bat, silver-haired bat, spotted bat (*Euderma maculatum*), Western small-footed myotis (*Myotis ciliolabrum*), long-eared myotis (*M. evotis*), little brown myotis (*M. lucifugus*), and long-legged myotis (*M. volans*). At the turbine detector, we recorded seven of the nine species, excluding the spotted bat and long-legged myotis. Given the proximity of the detectors and similar species there is little evidence to warrant consideration of separate communities for each site, and the nine species are likely present across the Project area.

Deployment of long-term acoustic detectors at Spion Kop also contributed to the goals for the Statewide detector array, producing a more complete record of the bat community in the area. Several species were recorded for the first time in this geographic area: Eastern red bat and spotted bat had not been previously detected in the vicinity of the Little Belts or Highwoods. In addition, species were documented in additional months during the year. For example, silver-haired bats were previously recorded in the area only in June and August, whereas detectors at Spion Kop recorded the species present from May – September. Across all detected species we added 13 new species/months to the MNHP dataset (Table 10).

Table 10. Bat species definitively detected by month each year of the study at Spion Kop Wind Farm (2015 – 2017). Gray cells indicate the species was documented within 50 mi (80 km) of the project area during this month prior to this study; blue cells indicate new species/months that the detectors at Spion Kop documented the species as present. Borrowed from Bachen et al. 2018 (Table 6) and used here by permission.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Townsend's Big-eared Bat (*Corynorhinus townsendii*) [1]												
Big Brown Bat (*Eptesicus fuscus*)					2015 2016 2017	2015 2016 2017	2015 2016 2017	2015 2016 2017	2015 2016 2017	2015 2016 2017		
Spotted Bat (*Euderma maculatum*)								2015				
Hoary Bat (*Lasiurus cinereus*)						2015 2016 2017	2015 2016 2017	2015 2016	2015 2016 2017	2015		
Silver-haired Bat (*Lasionycterus noctivagans*)					2017	2015 2016 2017	2015 2017	2015 2016	2015 2016			
Eastern Red Bat (*Lasiurus borealis*)							2015 2016	2015 2016				
Western Small-footed Myotis (*Myotis ciliolabrum*)							2015 2017	2015				
Long-eared Myotis (*Myotis evotis*)							2016 2017	2017	2016			
Little Brown Myotis (*Myotis lucifugus*)				2016	2016 2017	2015 2016 2017	2015 2016 2017	2015 2016 2017	2015 2016 2017	2015		
Fringed Myotis (*Myotis thysanodes*)												
Long-legged Myotis (*Myotis volans*) [2]					2016	2015 2017	2017	2015	2015 2016			

[1] Species is relatively quiet and often does not create fully definitive echolocation call recordings on bat detectors.

[2] Characteristics of most call sequences produced by Long-legged Myotis have a high degree of overlap with those produced by Western Small-footed Myotis, Long-eared Myotis, Little Brown Myotis, and Fringed Myotis, and sequences with definitive characteristics are rarely recorded. Given the paucity of call sequences that can be confidently attributed to this species, it is likely more common than acoustic data suggest (Maxell 2015).

Timing of Bat Activity

All species recorded at each detector were detected during the active season (May - September). As with other detectors across the network, average nightly passes began to increase in mid to late April, with peaks in late May through early June (MNHP 2012). At Spion Kop, bat fatalities were observed only during the second half of the active season (all species), coinciding with the timing of migratory tree roosting bats, which were the only species documented as fatalities (Fig. 15). After the summer, activity began to decline in September, reaching typical winter levels by October. Given the low bat activity levels documented October – April there is little risk to local populations during this time period.

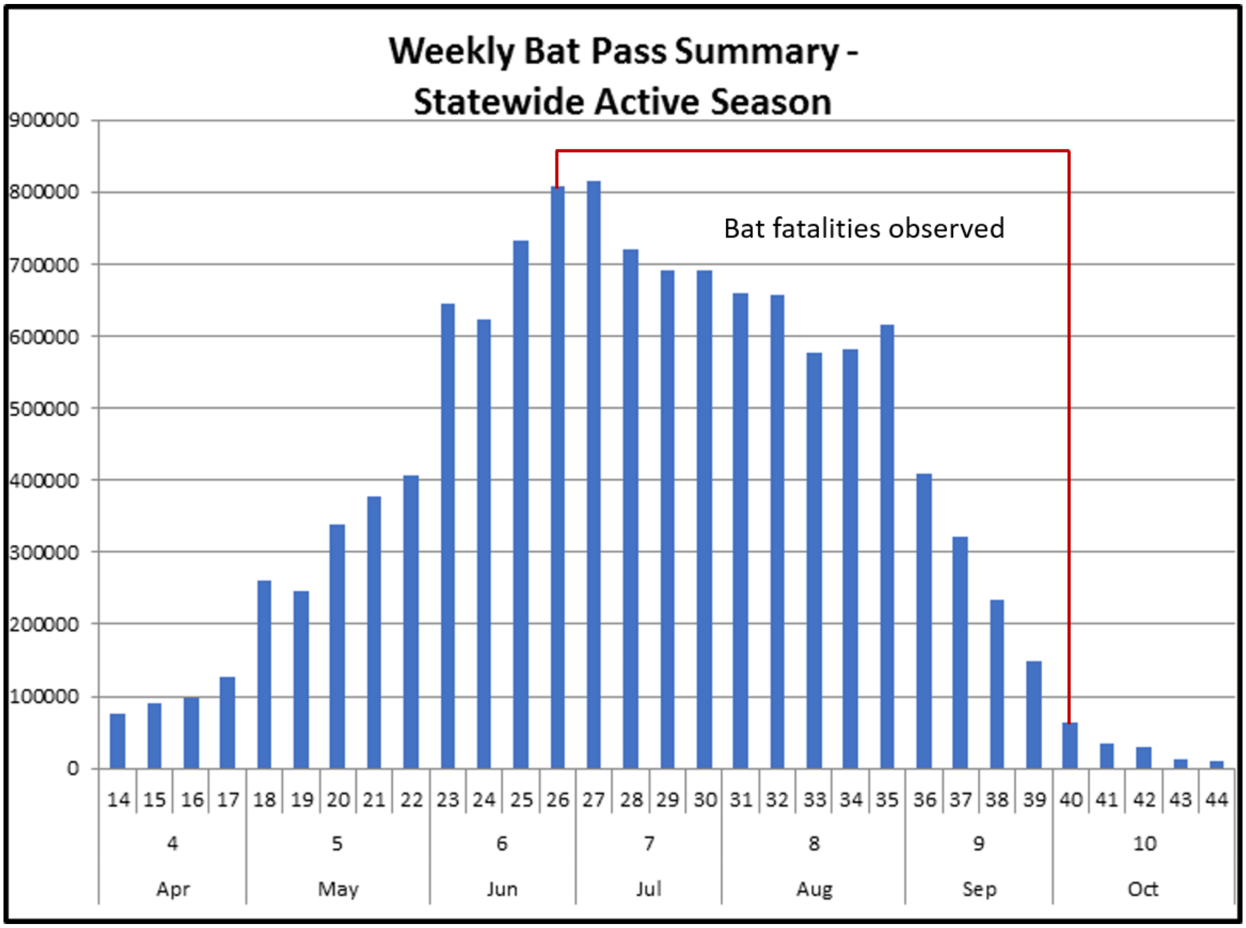
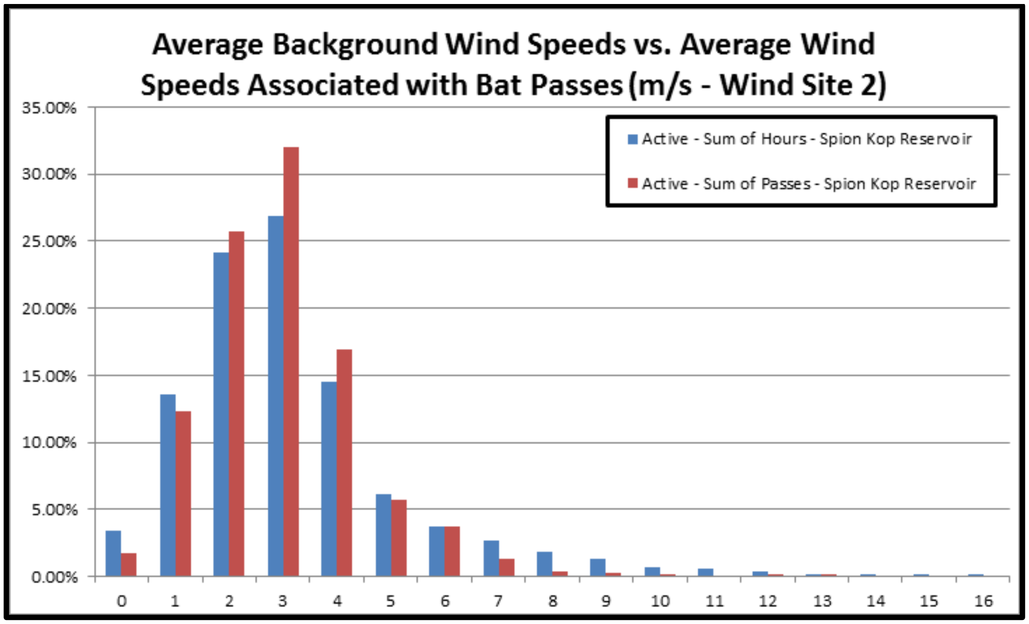


Figure 15. Comparison of bat activity patterns (all species) recorded on the Montana statewide network of bat detectors versus the data range when bat fatalities were observed at Spion Kop Wind Farm. Figure comes from Bachen et al. 2018 (Figure 9); modified and used here by permission.

Across all network detectors, including those at Spion Kop, some level of bat activity was evident throughout the night during the active season (April through October). In the spring, activity was generally highest early in the evening, then decreased through dawn. As the season progressed, activity began to peak within a few hours after sunset and again within a few hours of sunrise, which is likely the result of multiple bouts of foraging by some species. In the late summer and early fall, activity returned to the spring pattern.

Bat Activity and Wind Speed

At both the reservoir and turbine detectors, bats were more active at low wind speeds (2 – 4 m/s) than would be expected if bats were not selecting for wind speed (Fig. 16). Furthermore, 90% of all activity was recorded at wind speeds at or below 5 m/s and over 95% of activity was at or below 6 m/s (13.4 mph).



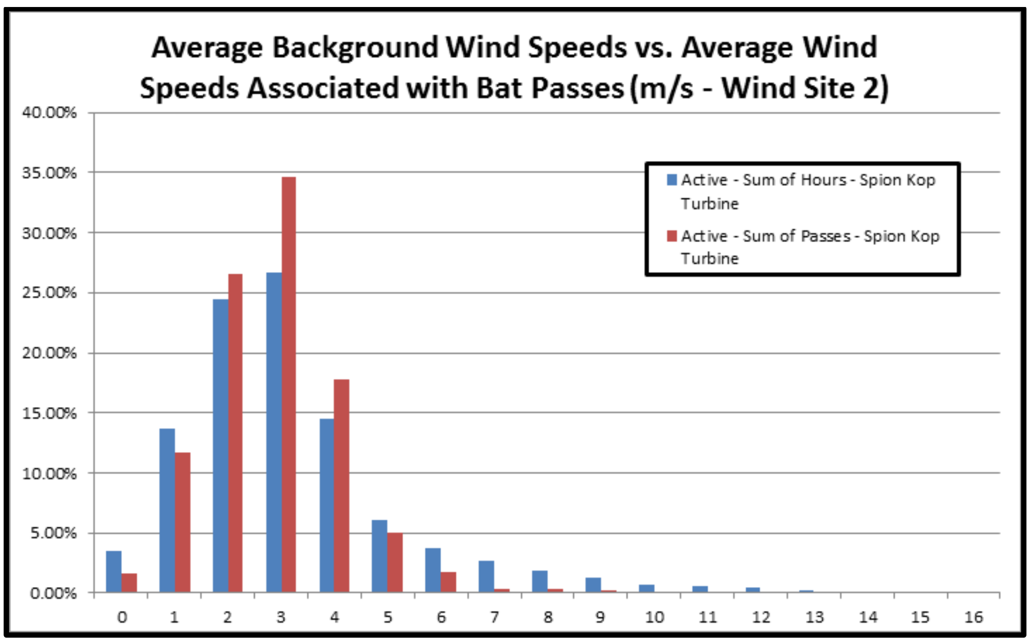


Figure 16. Average wind speed vs. sums of bat passes recorded at Spion Kop Wind Farm. Percent of hours with average background wind speeds (blue) and average wind speeds associated with bat passes (red) at the closest associated weather station at: (a) Reservoir Detector, (b) Turbine Detector for both the active and winter seasons. Numbers are lower ends of wind speed bins. Figures comes from Bachen et al. 2018 (Figure 16a & b); used here by permission.

The same bat activity patterns are evident across Montana's statewide network: activity is high during periods of calm or low wind and the number of bat passes recorded at detectors falls off steeply as wind speed increases (Fig. 17). Data averaged from recorders across the state of Montana show that 80% of all activity occurs at or below 3.8 m/s (blue line) and activity is rarely recorded at wind speeds exceeding 10 m/s. The proportion of bat activity at or below 6m/s (red line) recorded on the statewide network (94%) was virtually the same as the data collected on Spion Kop detectors (95%).

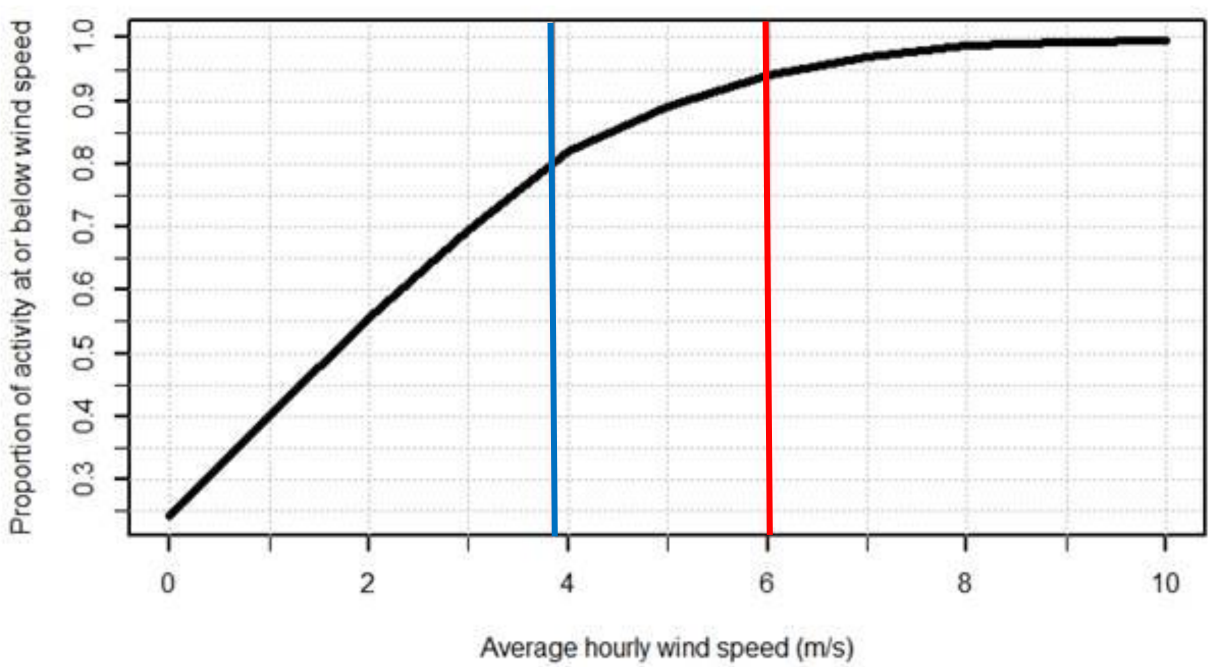


Figure 17. The relationship between activity (bat passes/ hour) and average hourly wind speed across the Montana bat acoustic detector network as shown by the proportion of activity of susceptible species occurring at or below a given wind speed.

DISCUSSION AND IMPACT ASSESSMENT

BIRD IMPACT ASSESSMENT

The estimated number of bird fatalities at Spion Kop was lower in 2016 (0.35 birds/MW) than in 2017 (1.6 birds/MW) with a two-year average of 0.97 birds/MW/study period. The two-year mean estimate for the total number of fatalities each year at Spion Kop is 39 birds. In a post-construction monitoring report for the Beethoven Wind facility in South Dakota, WEST (2016) compiled data from 39 wind facilities in the Midwest and reported fatality rates that ranged from 0.27 to 8.25 bird fatalities/MW/year; Spion Kop bird fatality estimates fall at the low end of this range (Fig. 18). Judith Gap Wind Farm, the only other wind facility in Montana to make fatality data publicly available, falls mid-range. (WEST 2010). However, the statistical analysis used to estimate fatality rates at Judith Gap pre-date the Huso estimator, so caution is warranted when making comparisons with other wind farms.

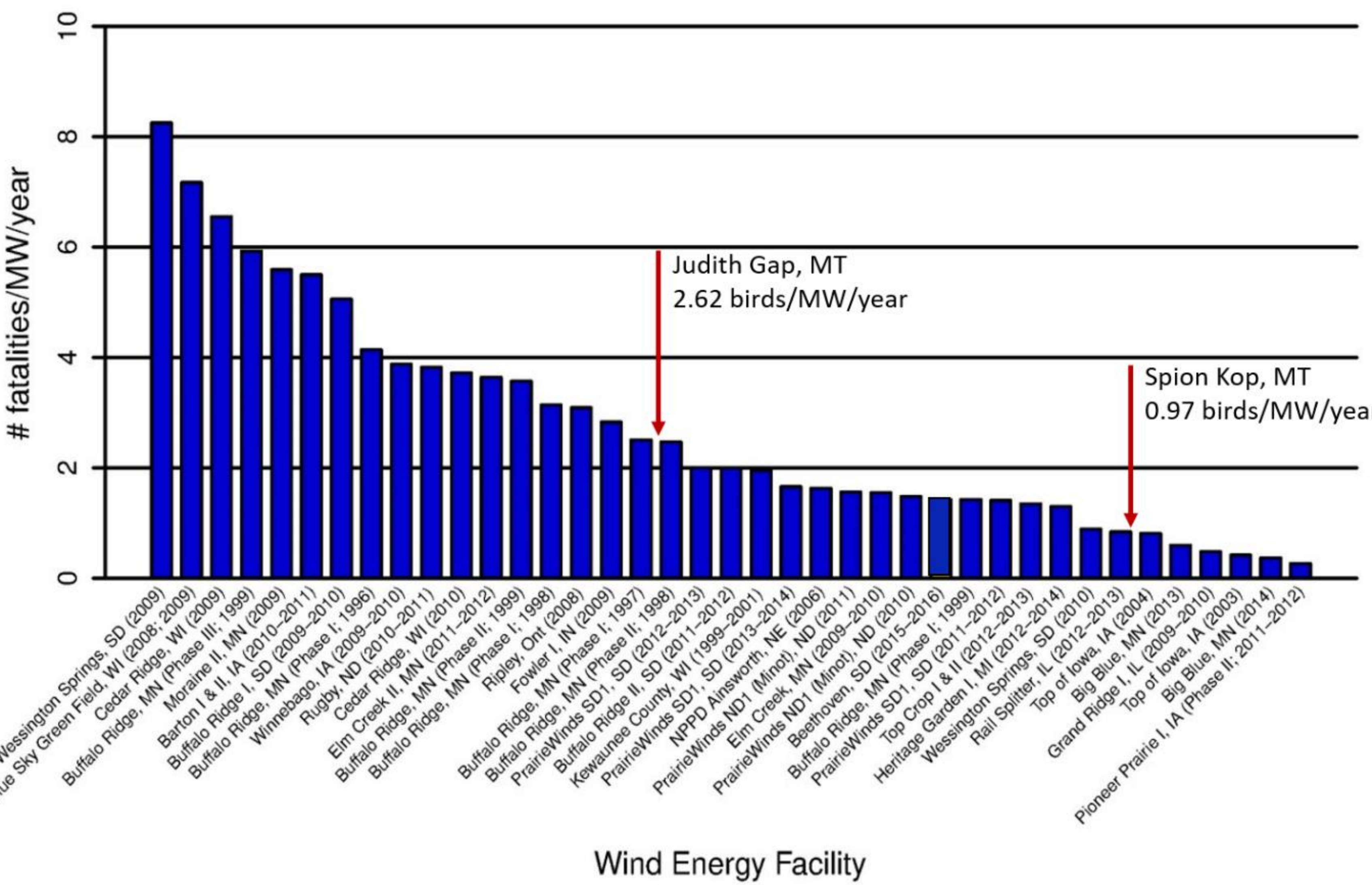
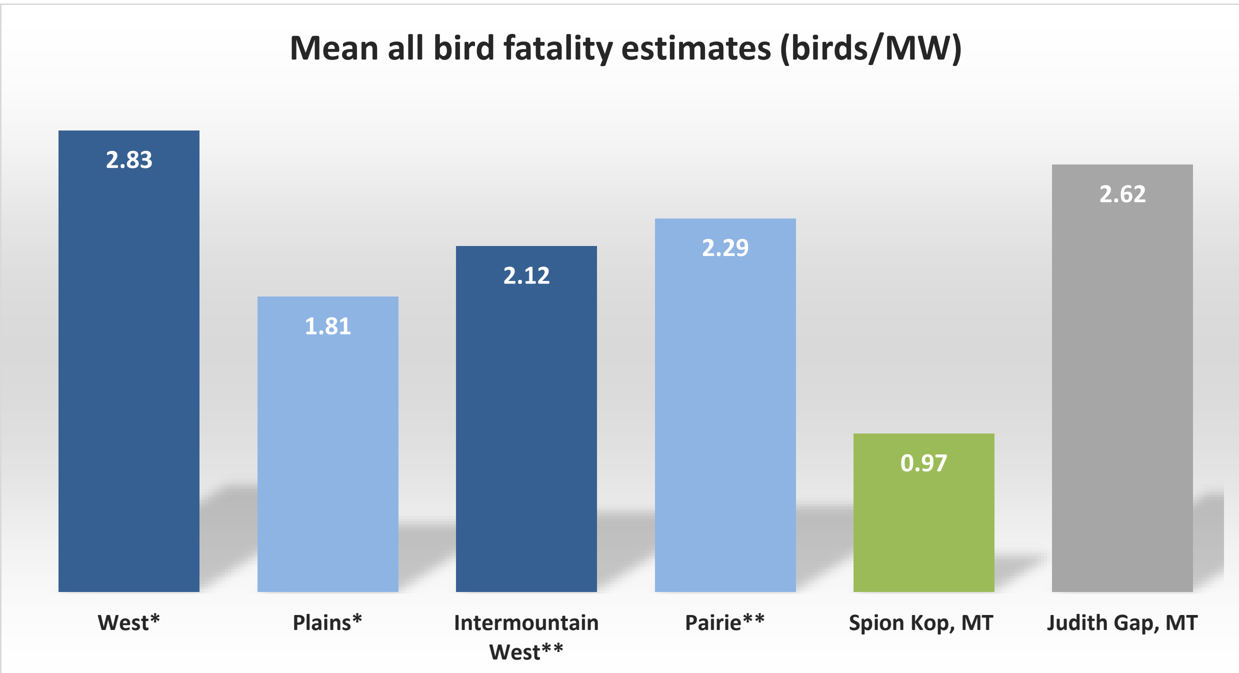


Figure 18. The estimated number of bird fatalities at Spion Kop and Judith Gap Wind Farms, compared to fatality rates at 39 wind energy facilities in the Midwest. Figure comes from a fatality report for Beethoven Wind Energy Project (WEST 2016), used here by permission.

Two recent studies analyzed data on small bird fatalities at 116 (Erickson et al. 2014) and 68 (Loss et al. 2013) wind energy facilities nationwide and regionally. Bird fatality estimates varied among geographic regions but the estimate at Spion Kop was below means reported in both Western and Midwestern regions whereas the estimate from the Judith Gap Wind Facility, also in central Montana, was at the upper end of this range (Fig. 19). Given the low estimate of all-bird fatalities relative to other wind farms in the region, we assess the impact of Spion Kop to local or migrating bird populations as low.



* Loss et al. 2013; **Erickson et al. 2014

Figure 19. Bird fatality estimates at Spion Kop and Judith Gap Wind Facilities compared to regional estimates from the literature. Montana is grouped with different states in the two studies: the Spion Kop Wind Facility falls within the region defined as "Prairie" by Erickson et al. 2014, and within the region defined as "West" by Loss et al. 2013.

Raptors

Due to (1) the presence of several raptor species, including three Species of Concern and (2) confirmed nests of three hawk species within the turbine vicinity during pre-construction surveys, raptor impact was predicted to be moderate in the BBCS (Madden & Harmata 2013, pg. 16). The closest Golden Eagle nest documented in pre-construction surveys was 4.2 miles away. We confirmed all raptor nests documented in pre-construction surveys and found six new or moved nests, including an active Golden Eagle nest less than one mile from turbine 25, which increased risk in 2015.

We noted a steep decline in nest activity over the three years of post-construction monitoring, and by 2017 only three of 13 known nests were active. Neither the Golden Eagle nest near turbine 25 nor the nest 4.2 miles away were active in 2017, though this is not necessarily concerning; eagles are known to use alternate nest sites and even forego nesting in some years. While the potential for wind farms to cause raptor nest displacement is widely recognized (Usgaard et al. 1997, Drewitt 2006) there have been few before-after studies to examine the issue and results are mixed. A recent review suggests that nest displacement likely depends on the extent of development and species-specific tolerances to disturbance (Watson et al. 2018). A long-term study of Golden Eagles nesting in the Altamont Pass Wind Resource Area found that all territories surveyed were occupied five years later, almost all were still occupied 13 years later (Hunt et al. 2016). Other studies found no evidence that distance to a wind farm affected territory occupancy, however success was lower at nests near turbines (Kolar 2013, Balotari-Chiebao et al. 2015, Kolar & Bechard 2016). In post-construction monitoring at a wind facility in Norway, the number of active White-tailed Eagles territories near turbines declined (Bevanger et al. 2010); researchers attributed this to both direct morality (i.e. collisions) and displacement due to high disturbance (confirmed in one pair with DNA-sampling). In this study, a decrease in nest occupancy within 500m to the closest turbine was compensated by an increase in nest density within a “buffer zone” of 0.5 km – 3 km, but Dahl et al. (2012) caution that nest displacement should be factored into overall estimates of nest success. Without intensive research (e.g. DNA sampling at nests), we cannot determine the cause of raptor nesting decline at Spion Kop. New decision-support tools are being developed to calculated percent displacement values for breeding waterfowl and grassland birds (Shaffer et al. 2019). If declining raptor nest activity is of concern this methodology might be adapted to quantify and compensate for a loss in raptor breeding habitat.

No raptor fatalities were found. Searcher efficiency for large birds in both years was very high, 98-100%. Furthermore, as shown by our carcass persistence studies in 2017, raptor carcasses persist in the environment for a very long time. Out of 24 raptor carcasses placed, only one was completely removed by a scavenger and most carcasses persisted for 160+ days. If a raptor was struck and landed in a search plot, it likely would have been found.

During eagle point count surveys, we observed different levels of eagle activity between 2015 and 2016. The difference could be annual variation, as most eagles in 2015 were observed during the winter months, meaning they are likely migratory birds passing through. However, it is more likely caused by reducing the original 12 point count locations to six in April 2016. The overlap amongst the 12 point count locations could have caused us to double-sample eagle use, and though reducing the number of locations minimized overlap, it also cut observation time in half, another likely factor in documenting lower eagle activity in 2016. Overall raptor use, at least during the search season, appeared to be low as indicated in the number of minutes spent in the project area. We rarely observed eagles incidentally and saw only the occasional Red-tailed hawk, Northern Harrier or Swainson’s Hawk. This is may be due to a low prey base (food sources) at the wind farm. Throughout our fieldwork, Richardson’s ground squirrels (*Urocitellus richardsonii*) were never observed. Rabbits were present, but not in high numbers.

The BBCS assessed project specific risk for non-eagle raptors as moderate. Post-construction monitoring documented a decline in the number of active raptor nests, but the monitoring program was not designed to differentiate nest displacement as a result of the wind farm from variability in raptor nest occupancy over time. Given no raptor carcasses were found, high searcher efficiency, the low all-bird fatality estimate, EOA analysis and eagle point count observations, we assess the impact on raptors to be lower than predicted.

Sharp-tailed Grouse

Sharp-tailed Grouse rely on grassland habitats, which also happen to be some of the nation's richest wind resources (USFWS 2012). They are sensitive to anthropogenic structures and have high site fidelity to their lekking grounds, making them vulnerable to projects such as wind farms. Before construction, the closest known lek to the Project area was located 0.85 miles southeast of the wind farm, so the BBCS predicted overall project impacts on Sharp-tailed Grouse to be low to moderate (Madden & Harmata 2013, p. 17).

In conversations with landowners before construction, several expressed concerns over upland bird populations, noting grouse were rarely observed (Sam Milodragovich, pers. comm.). However, Sharp-tailed Grouse were regularly observed by field technicians throughout all seasons and were frequently flushed from the grass during fatality searches, along with Hungarian Partridge. Lek_1, located southeast of the project (Fig. 14), was confirmed active in both 2016 and 2017 and two additional active leks were located near the project that had not been described before. No grouse fatalities were located during formal searches, however two were found in 2015. We did not determine cause of death for these fatalities, and it is possible that these were background mortalities (i.e. death due to something besides a turbine strike). Given regular observations in the field and activity on three leks, it seems that Sharp-tailed Grouse are doing well with the operation of the wind farm, though indirect impacts of habitat fragmentation can take many years to detect (Strickland et al. 2011). The BBCS predicted low to moderate risk to Sharp-tailed Grouse. In three years of post-construction monitoring, we assess the impact on Sharp-tailed Grouse to be low.

Other Bird Species

Fifteen bird species listed as either a USFWS Bird of Conservation Concern or a Montana Species of Concern were detected during pre-construction surveys, and of these, 12 are associated with native grasslands. Pre-construction mitigation measures included working with landowners to implement grazing systems that would improve grassland habitat and minimizing construction on native prairie to reduce bird strikes. We found seven species of birds as fatalities, none of which are Montana Species of Concern with the project area.

The BBCS predicted project specific impacts on other avian species as low to moderate and set a mortality threshold of 3.71 birds/MW to indicate the need for management or mitigation attention (Madden & Harmata 2013 p. 29). The observed bird fatality estimate was well below this threshold, with a two-year average estimate of 0.97 birds/MW/study period. This estimate is also low relative to other wind farms in the intermountain west region (2.12 – 2.83 birds/MW/study period). We can use the 95% CIs around the annual fatality estimates to account for the uncertainty around the two-year average. The 2017 estimate was higher, at 1.60 birds/MW and 95% CI of 0.3 – 3.4 birds/MW), and the upper bound is still below the threshold set in the BBCS. For these reasons, we assess the impact of Spion Kop to local or migrating bird populations as low.

BAT IMPACT ASSESSMENT

The pre-construction report notes that up to 10 of Montana's 15 bat species may use the Project Area, and pre-construction acoustic surveys conducted at the site confirmed 7 of Montana's 15 bat species were present. Silver-haired and hoary bats were recorded by acoustic detectors only in late summer. Because of this, and due to lack of evidence of roosting areas near the project, impacts to bats were predicted to be low in the BBCS (Madden & Harmata 2013, p. 17). However, silver-haired bat activity has been documented year-round in Montana, even during the winter, and hoary bats are present March-October. The roosting activity for many Montana bat species is not fully understood. It is feasible that some of the tree-roosting bats, such as silver-haired and hoary bats, use trees located less than 1 km north of the Project. In addition, the outcome of acoustic bat surveys is subject to timing of deployment and placement. Surveys done by the MNHP at Spion Kop post-construction showed very high levels of activity near the reservoir on the western border of the project, which is likely a water source and foraging area for bats. It is also difficult to know whether and how bat activity changes following construction of a wind facility. Research using thermal imagery video shows that bats are attracted to wind turbines (Horn et al. 2008, Cryan & Barclay 2009); the reason for this behavior is an area of active research and hypotheses include the inability to differentiate turbines from trees, attraction to lighting, mating behavior and increased feeding activity (Cryan 2008, Cryan et al. 2014, Reimer et al. 2018, Voigt et. al 2018).

The estimated number of bat fatalities at Spion Kop was higher in 2016 (5.5 bats/MW) than in 2017 (2.6 bats/MW) with a two-year average of 4.1 bats/MW/study period. The two-year mean estimate for the total number of fatalities each year at Spion Kop is 163 bats. A recent summary by the American Wind Wildlife Institute (AWWI) pulls data from 227 post-construction monitoring studies at 146 wind energy projects to estimate bat fatality rates nationwide and regionally (AWWI 2018). This report shows that bat fatality estimates nationwide have a skewed distribution: 75% of wind facilities report fewer than five bats/MW/year and the median fatality rate across all studies is 2.66 bats/MW/year. This pattern is also apparent in bat fatality data compiled in a report for the Beethoven Wind Facility in South Dakota with data from 49 wind facilities in the Midwest (WEST 2016). Reported fatality rates range from 0.16 to 30.61 bat fatalities/MW/year; the Spion Kop bat fatality estimate of 4.1 bats/MW falls in the middle among these studies (Fig. 21).

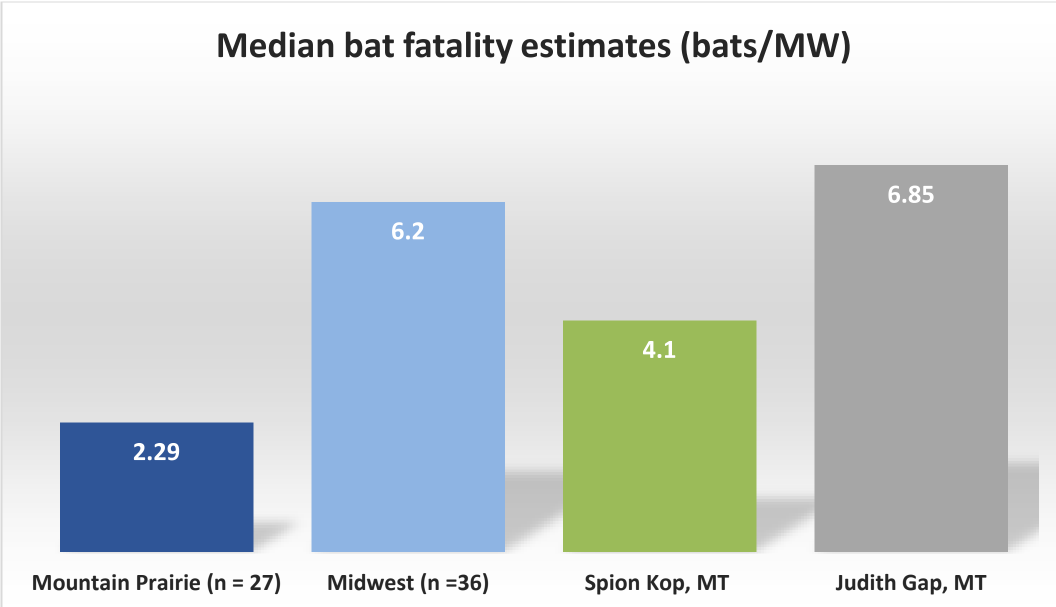


Figure 20. Mean bat fatality estimates (bats/MW) at Spion Kop and Judith Gap Wind Farms compared to regional median estimates of bat fatalities (AWWI 2018); n = the number of wind farms contributing to the estimate.

As with birds, bat fatality rates vary by region. The observed bat fatality estimates at Spion Kop (4.1 bats/MW) is greater than the median estimated fatality rate of 2.4 bats/MW/year for wind projects in Mountain Prairie region (n = 27), which includes Montana (Fig. 20). The adjacent Midwest region (n = 36) had the highest median estimate of any region at 6.2 bats/MW/year. Bat fatality estimates at Judith Gap Wind Farm (6.85 bats/MW) are comparable to median estimates in Midwest region (WEST 2010). To be clear, while fatality rates estimated at the Judith Gap facility are higher than those at Spion Kop, statistical methods are not directly comparable.

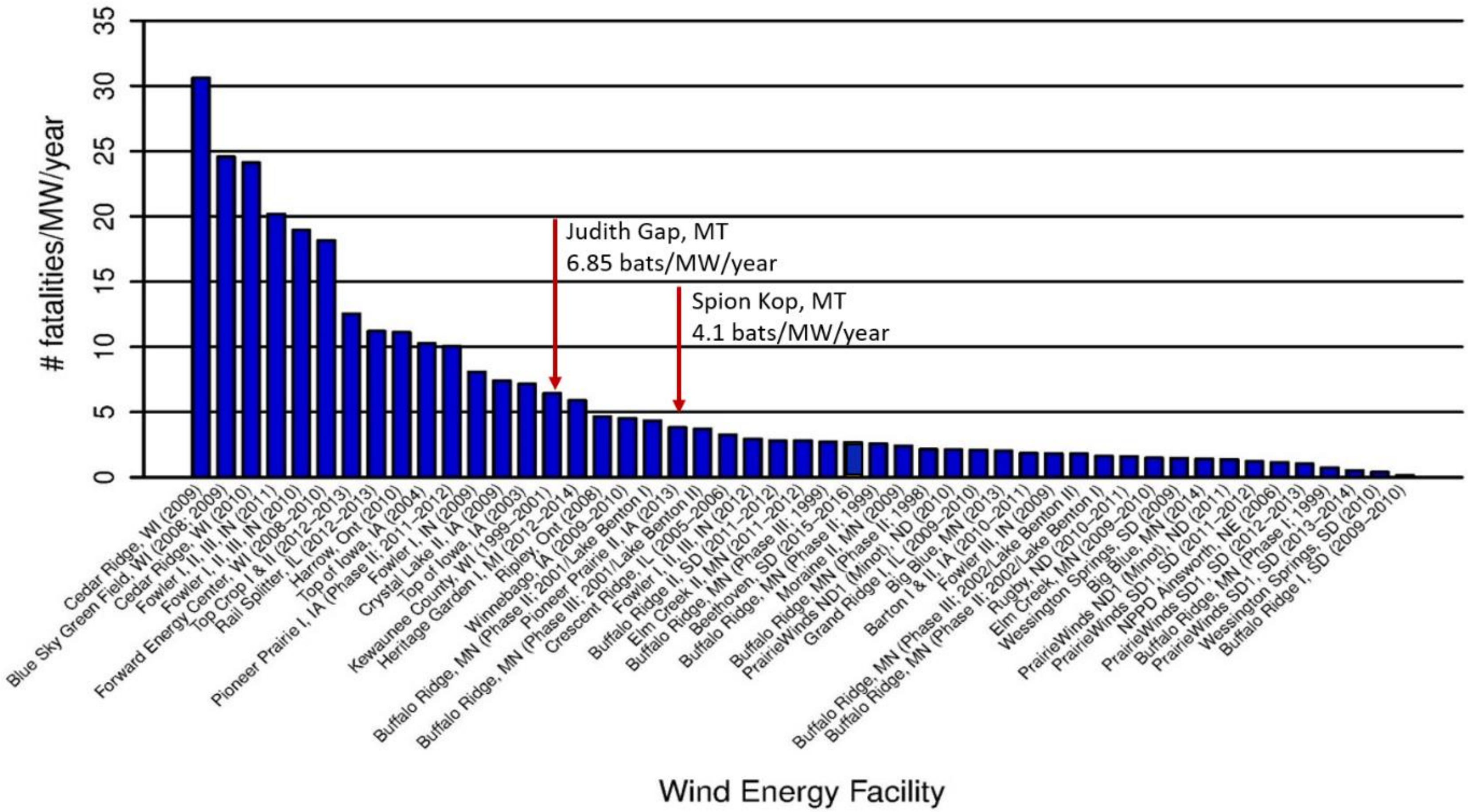


Figure 21. The estimated number of bat fatalities at Spion Kop and Judith Gap Wind Farms compared to fatality rates at 49 wind energy facilities in the Midwest. Figure comes from a fatality report for Beethoven Wind Energy Project (WEST 2016), used here by permission.

The BBCS assessed risk to bats as low and set the threshold for bat fatalities at 6 bats/MW/year, an actionable metric that if exceeded, would indicate a need for management or mitigation attention to reduce the number of fatalities (Madden & Harmata 2013 p. 29). While the observed two-year average fatality estimate of 4.1 bats/MW is below this threshold caution is warranted because bat fatality estimates differed between years. We can use the 95% CIs around the annual fatality estimates to account for the uncertainty around the two-year average. In the first year the point estimate was 5.5 bats/MW and the 95% CI (3.0 – 9.9 bats/MW) overlaps the fatality threshold. In the second year the point estimate was 2.6 bats/MW and the 95% CI (1.5 – 4.9 bats/MW) is below the threshold. Using the lower bound of the 95% CI from 2017 and the upper bound from 2016, the estimated number of bats killed at Spion Kop ranges from 60 – 397 bats each year. For these reasons, we assess the impact to bats using the Project area as higher than predicted in the BBCS and strategies to reduce the number of bat fatalities should be discussed with the TAC.

A lack of correlation between the pre-construction assessment of risk to bats and post-construction findings is not surprising. A recent synthesis of post-construction monitoring studies at wind farms found that pre-construction acoustic data cannot accurately predict bat fatality (Hein et al. 2013, Lintott et al. 2016). This implies that pre-construction assessments of risk are not useful. More importantly, there are no formal estimates of bat populations at local or regional scales, making it impossible to quantify the impact of a specific bat fatality estimate. As a result, attempts to categorize risk/impact as “low” or “high” may not be meaningful, even when fatality rates are comparable among wind farms.
Furthermore, simulations using population projection models for hoary bats suggest that their populations may not be able to sustain even low levels of fatality at wind farms (Frick et al. 2017). Best management practice is to take steps to minimize bat fatalities.

EVALUATION OF PRE-CONSTRUCTION SURVEYS

Compass Wind consultants conducted pre-construction surveys for birds and bats at Spion Kop from March 2010 – June 2012; these findings are summarized in the BBCS (Madden & Harmata 2013) and were used to assess risk to local bird and bat populations. Here we review pre-construction surveys in relation to post-construction monitoring results.

1. Eagle point count methodology followed the Draft USFWS Eagle Guidance released in 2011, the best available science at the time, and found relatively low raptor activity; post-construction surveys following new ECP guidelines (USFWS 2013) also suggest low raptor use and no raptor fatalities were found.
2. Pre-construction raptor nest monitoring is an important component of pre-construction surveys and appears to have been adequate in locating nests active prior to construction. Many of these nests were still active three years after construction and were monitored from 2015 -2017. Several new active raptor nests were identified through post-construction monitoring, including a Golden Eagle nest north of turbine 25 that was active only in 2015. Overall, we documented a decline in the number of active raptor nests within the project area. If a monitoring goal is to differentiate nest displacement as a result of the wind farm from variability in raptor nest occupancy over time then additional design elements would need to be incorporated, including searching for nests in a larger radius around the wind farm and potentially marking individuals.
3. Pre-construction surveys identified one lek in spring 2011; post-construction surveys documented this lek was still active and two additional leks were located. Pre-construction surveys were conducted from sunrise – 11:00,

whereas MFWP guidelines (MFWP 2016b) call for conducting surveys from one half hour before sunrise, up to two hours after sunrise after which birds tend to disperse. It is possible that leks were missed pre-construction because some surveys were conducted at a time when detectability was low, but conversations with landowners suggest that Sharp-tailed Grouse activity was low during the pre-construction phase and has been increasing across the past several years.

4. Pre-construction bat acoustic surveys were periodic but focused on the fall migratory period, documented hoary and silver-haired bats from August – early September and no bats were detected in mid-September and October. Post-construction acoustic monitoring conducted year-round documented these species through mid-October and found several bat species with low levels of activity during the winter months. This suggests that continuous year-round pre-construction surveys have value for accurately documenting species diversity and activity levels.

EVALUATION OF POST-CONSTRUCTION MONITORING PLAN

The recently released comprehensive summary of bat fatality data from 227 PCM studies at 146 wind facilities (AWWI 2018) allows us to evaluate the rigor of the PCM plan implemented at Spion Kop, with an eye toward monitoring impacts to bats.

1. Search radius size: we searched 160x160m plots (~ 80m radius); 90% of PCM studies used search plots with a radius of $\leq$ 100m; 40% of PCM studies searched plots with a 76-100m radius.
2. Fatality distance from turbine: for 23 studies with a search radius >100m, 38% of bats were found at 26-50m, 88% within 50m and ~98% within 76m of the turbine. This provides empirical evidence to justify a search plot radius of 50 – 80m when bats are the species of interest.
3. Timing of fatalities: in the mountain prairie region, ~80% of bat fatalities occurred July – September, with the highest number in August. We observed the same pattern, with >95% of bat fatalities found during this period (60% in August alone). This provides support for focusing curtailment during this this 3-month period.
4. Searcher efficiency: in the mountain prairie region, SE was ~50%; searcher efficiency rates were low in 2016 (34%) and comparable in 2017 (55%).
5. Search interval: in the mountain prairie region the search interval was > 14 days at a majority of wind projects (52%) and just 2 of 23 studies conducted searches $\leq$ 7 days (as we did at Spion Kop). Given the long carcass persistence times we observed, we probably could have lengthened the search interval to 8 – 14 days. However, if lengthening the search interval results in lower SE, it might not be worth the tradeoff.
6. Duration of PCM studies: in the mountain prairie region wind facilities typically conducted PCM studies for 6 – 12 months (81%). Nationwide only a handful of studies were conducted longer than 1 year (9%).

Post-construction monitoring implemented at Spion Kop appears to be rigorous compared to monitoring conducted at other wind facilities, especially with respect to plot size, search interval and study duration. This summary also provides empirical evidence to support some of the design features we selected (e.g. plot size) and suggests our findings are in line with other wind facilities in the region (e.g. SE rates and timing of fatalities).

SOURCES OF BIAS

There are many potential biases associated with fatality studies at wind farms. In this study, our approach for calculating fatality estimates followed methods outlined by Huso (2011) which account for total area searched, search interval, density weighted proportion, searcher efficiency and carcass persistence rates. Here we discuss different sources of bias and how they may have affected fatality estimates; we also offer suggestions that may be useful in designing post-construction monitoring studies at other wind farms in Montana.

Source of mortality

All carcasses found within search plots were used in the analysis, and all fatalities found within search plots were assumed to have been killed by collision with a wind turbine, including feather spots of birds. However, a post-mortem necropsy was not conducted for any fatalities. There is strong evidence that bats are attracted to wind turbines (Cryan et al. 2014), and that bat carcasses found beneath a wind turbine are likely a result of collision, but some of the bird fatalities could have been caused by predators or other natural causes. Many of the bird fatalities found were the feather spots of Sharp-tailed Grouse and Hungarian Partridge, species that do not fly high and spend most of the time on the ground. Additionally, no adjustments were made for fatalities that could have fallen outside of the search plots. The size of the search plots was based on the USFWS WEG (2012) which suggest that a distance equal to the height of the turbine captures a large percentage of fatalities. However, it is likely that some carcasses fell outside this distance, which would underestimate of fatality rates.

Seasonal changes in visibility

The vegetation, and therefore ground visibility, changed throughout the search season. With a wet spring, the grass was very thick and lush, making visibility very difficult early summer. However, by late summer/early fall the vegetation would dry up and ground visibility would become easier. The presence of cows also affected visibility; what was once considered “very difficult” visibility could change into “easy” within a matter of weeks. The grazing schedule changed throughout the project period with some turbines grazed in one season or year, and not the other. For instance, cows were present throughout most of the search season at turbine 18 in 2016, where a majority of the fatalities were found. However, there were no cows at turbine 18 in 2017 and fewer fatalities were found. Visibility was likely affected when (i.e., early or late in the season) and where (i.e., grazed turbines vs. non-grazed turbines) carcasses were found as well as searcher efficiency and carcass persistence rates. To address these changes throughout the search seasons, we conducted both searcher efficiency and carcass persistence trials concurrently within each search interval. We observed an increase in searcher efficiency mid to late search season, consistent with the changing vegetation. We also observed, in both years, a decrease in scavenging rates in the hot months of July and August, and an increase in scavenging in the fall. It is important to conduct bias trials throughout the entirety of the search season, ideally concurrent with each search interval, to account for seasonal changes in visibility and carcass removal by scavengers.

PCM Recommendation 1: Conduct bias trials throughout the entirety of the search season, ideally concurrent with each search interval, to account for seasonal changes in visibility and carcass removal by scavengers.

Value of high searcher efficiency rates

In many fatality studies, searcher efficiency carcasses are placed the night before or the morning of a search, and the trial is concluded at the end of the search. This is how searcher efficiency trials were conducted in 2016, giving the searchers only one chance to find a carcass. However, many of the fatalities found during systematic searches were older than one week, suggesting that searchers may miss a carcass at first but end up finding it later. In 2017, we had enough staff to place searcher efficiency carcasses at any time and check them for persistence until either found by a searcher or removed by a scavenger. This method also fits the Huso (2015) estimator assumption that if a carcass is missed on the first search, it may still be found in subsequent searches, though this probability decreases with time as carcasses decompose and become harder to see. This method gave searchers multiple chances to find a carcass and may help explain why the SE rate for bats was higher in 2017 than in 2016, though carcass type also had an influence (discussed in next section).

Regardless the cause, the substantially higher SE rate observed for bats (34% in 2016 vs. 55% in 2017) had an impact on fatality estimates. Despite finding a similar number of carcasses in both years (21 in 2016 vs. 22 in 2017 during systematic searches), the bat fatality estimate in 2017 (4.1 bats/turbine) was half the 2016 estimate (8.8 bats/turbine). The Huso estimator performs best when searcher efficiency is high; low SE tends to bias fatality estimates high, and extremely low SE rates (< 10%) are unreliable (Huso 2015). In this study, it appears that even a relatively small change in SE rate can impact both the fatality point estimate and width of the confidence interval.

PCM Recommendation 2: Use a design for SE trials that results in adequate searcher efficiency; while "adequate" is hard to quantify, the mean SE rate reported for wind farms in the mountain prairie region was ≥50% and is probably a good minimum target (AWWI 2018). The precision estimates of SE can be improved by (1) increasing the number of trial carcasses, (2) conducting carcass checks in a way that gives searchers multiple chances to find a carcass and (3) restricting searches to areas with higher visibility, though in this case the percentage of the plot searched must be factored in when generating a fatality estimate for the entire plot. Another option is to improve a searcher's ability to find carcasses by mowing search plots.

Surrogate vs. native carcasses in bias trials

There are potential biases associated with the number and type of carcasses used in searcher efficiency and carcass persistence trials and in this study, carcass type had an effect on searcher efficiency estimates. In 2016, surrogate carcasses were used to represent the range of birds and bats that could be found at the wind farm; we used mice and *Myotis* bats as surrogates for tree-roosting bats and these carcasses, proved more difficult to find than the larger species of silver-haired and hoary bats that were used in 2017 trials. As a result, SE estimates for bats were higher in 2017 than in 2016. We saw the reverse pattern for small and medium birds: SE rates declined in 2017 because the surrogate quail and chicken carcasses that we used in 2016 trials were easier to find than native passerines and small raptors used in 2017.

Research suggests carcass type also has an influence on the probability of being scavenged. In a study done by DeVault et al. (2017), chicken carcasses were nearly five times more likely to be scavenged than the carcasses of Red-tailed Hawks, despite the chicken carcasses being three times larger in weight, on average. Small carcasses tend to be scavenged more quickly than large carcasses (Santos et al. 2011, Zimmerman et al. 2012). However, our carcass persistence estimates for large birds, represented by chickens, in 2016 were nearly the same as our estimates for small birds, suggesting that our surrogate "raptors" are scavenged at the same rate as small, passerine-like birds. In 2017, 75% of all trial carcasses were native, including all raptors, and tree-roosting migratory bat carcasses from the previous year were used instead of *Myotis* spp. Carcass persistence estimates increased significantly (non-overlapping confidence intervals) for both carcass types; for raptors carcass persistence increased from 80% to 98%.

In a heuristic experiment exploring the carcass persistence sensitivities in the Huso Estimator (2011), we found there was a significant difference (non-overlapping confidence intervals) between the scavenging rates on both mice vs. bat carcasses and chickens vs. raptors. However, there was not a significant change in fatality estimates between using native or surrogate carcasses. Furthermore, fresh carcasses of native birds and bats are difficult to obtain, and we therefore had a smaller sample size for bias trials in 2017 than in 2016, which may have affected the results. Lastly, overall scavenging rates seemed lower in 2017 than in 2016. Preliminary results of a camera study done at Spion Kop to compare scavenging rates on bats, birds and mice show no significant difference in the probability of a scavenging event among carcass types, and most carcasses persisted for at least 7 days (results from this study to be reported separately).

Studies that use only surrogates for carcass persistence trails are likely to underestimate carcass persistence, which may lead to overestimating fatality rates. Using native bird carcasses will require that utilities apply for a SPUT permit, which takes time, but may be worthwhile if raptor fatalities are of concern and there is a need to obtain precise raptor fatality estimates.

PCM Recommendation 3: We recommend using fresh, native carcasses when available (especially tree-roosting bat carcasses rather than mice and raptor carcasses rather than chickens) and supplementing with surrogate species to achieve an adequate sample size. Realistic CP rates are especially important when there is a need to obtain precise fatality estimates.

IMPACT MANAGEMENT & OPTIONS FOR MITIGATION

Best Management Practices

The BBCS details the best management and advanced conservation practices that Compass and NW Energy employed to reduce the risk of project impacts during the pre-construction and construction phases (BBCS, p. 18 – 20). Practices included moving turbines 1 – 3 further from a ridge where non-eagle raptors have been observed soaring, moving turbines 18 – 20 further from a Ferruginous Hawk nest and Sharp-tailed Grouse lek, locating turbines along existing ranch roads where possible to minimize grassland fragmentation, minimizing lighting and using turbine lighting determined to be least attractive to birds and bats. In addition, NWE has implemented mitigation measures such as limiting attractants to scavenging raptors (e.g. livestock carcass removal) and working with landowners to implement grazing systems to improve habitat for wildlife (BBCS p. 30). The BBCS also anticipated the potential need for additional mitigation and minimization strategies and discussed both non-operational and operational mitigation measures that the TAC may consider (BBCS p. 31-32).

Post construction monitoring results revealed that impacts to birds are low: the estimated bird fatality rate was well below the threshold set in the BBCS in both monitoring years and 95% CIs are narrow. Estimated bat fatality rates are higher than those for birds. In the first year of monitoring the bat fatality estimate was slightly below the threshold set in the BBCS but the 95% CI overlapped it. In the second year of monitoring the fatality estimate was lower but given the vulnerability of bat populations best management practice is to minimize bat fatalities at wind farms. Here, we offer a mitigation framework and minimization options for consideration by the TAC.

Mitigation Framework

Unlike birds, in which strikes with tall buildings and cell towers are well documented, there is no evidence of human caused mortality to tree-roosting bats that is similar in magnitude to mortalities associated with wind turbines (Cryan & Barclay 2009). Assessing the impact of varying bat fatality rates at wind farms is difficult given the lack of information on the size and trends of regional bat populations, but there is widespread acknowledgement and concern over the potential impact of wind energy facilities on bat populations (Kunz et al. 2007, Baerwald et al. 2009, Cryan et al. 2014 and Arnett et al. 2016). In a recent paper, Frick et al. (2017) conducted simulations using population projection models and expert solicitation and found that mortality from wind farms may reduce the population size and increase the risk of extinction for hoary bats. Their results suggest that conservation measures to reduced mortality from collisions with wind turbines are necessary to maintain viable bat populations.

There is no current framework in the state of Montana for recognizing and reducing bat fatality rates, but the Alberta Environment and Sustainable Resource Development (ESRD) came out with guidelines in 2013. There is likely connectivity between Alberta and Montana bat populations, therefore, we find these guidelines appropriate guidance for the Spion Kop Wind Farm project.

To address fatalities at wind farms, Alberta Environment and Sustainable Resource Development (ESRD) has produced Bat Mitigation Framework for Wind Power Development (Alberta ESRD 2013). As per Alberta's Wildlife Act, wind power developers and ESRD-Wildlife branch are encouraged to reduce the risk to wildlife as much as possible. During seasons of high bat activity or where post-construction monitoring shows high numbers of bat fatalities, adjusting the turbine cut-in speeds may be necessary (Arnett et al. 2011). Initiation of discussions and consultations between the Alberta government and wind power developers regarding operational mitigation are based on a combination of several factors, including:

- Acoustic surveys indicating "1 to 2 migratory-bat passes/detector/night" resulting in pre-construction mitigation
- Acoustic surveys indicating "more than 2 migratory-bat passes/detector/night" resulting in both pre-construction and post-construction mitigation measures
- Post-construction surveys indicating a fatality rate of 4 to 8 bats/turbine per year of any combination of migratory bat species results in consultation with ESRD-Wildlife branch regarding mitigation and further monitoring.

According to the ESRD, projects with fatality rates that are greater than 8 bats per turbine are considered very high risk for bats based on bat population estimates and the sensitive listing of hoary and silver-haired bats. Furthermore, projects that kill less than 8 bats per turbine could still be considered high risk due to cumulative fatalities from multiple wind farms. Using this framework, and the criteria below, we conclude that observed bat fatality rates at Spion Kop are higher than predicted in the BBCS and offer curtailment as a minimization strategy for consideration by the TAC.

1. Using Alberta's framework for assessing risk, a bat fatality rate of 4 – 8 bats/turbine/year would result in a consultation regarding mitigation. The two-year mean per turbine estimate at Spion Kop was 6.5 bats/turbine.
2. The fatality threshold set in the BBCS was 6 bats/MW/year; while the observed average fatality estimate of 4.1 bats/MW is below this metric, fatality estimates varied between years and the 95% CI in 2016 overlapped the threshold (3.3 – 9.9 bats/MW).
3. The two-year mean estimate of the total number of bats killed at Spion Kop each year is 163 bats.

4. The bat fatality estimate at Spion Kop is substantially higher than the median estimate (2.29 bats/MW) from 27 wind farms in the Mountain Prairie region.

Curtailment

Curtailment is a post-construction mitigation measure that has been proven to reduce bat fatality at wind farms. Research shows that small increases in cut-in speeds, i.e. the speed at which electricity starts to be generated from the turbine, can substantially lower bat fatality. Several studies show that increasing cut-in speeds to between 5 m/s – 6.5 m/s results in lower bat fatality by 44 – 93% while the annual loss in power generation is minimal (Baerwald et al. 2009; Arnett et al. 2010; Arnett et al. 2011). The wind turbines at Spion Kop Wind Farm are currently set to a cut-in speed of 2.2 – 2.3 m/s.

Bat fatalities were discovered from July – October, but most fatalities (75%) were found during the peak migration season, August 1 through September 15. Post-construction bat acoustic data show that bat activity decreases as wind speed increases, a pattern corroborated by a statewide network of over 60 detectors in Montana and research at wind farms nationwide (Fig. 16 & 17).

At Spion Kop, the bat activity data derived from acoustic monitoring indicate that increasing the turbine cut-in speed to:

- 4 m/s would avoid 75% of bat activity
- 5 m/s would avoid 90% of bat activity
- 6 m/s would avoid 95% of bat activity

Options for continued monitoring

Monitoring Option 1: Annual Golden Eagle nest monitoring
The Golden Eagle nest located 1 km north of turbine 25 may increase risk to eagles in years it is active. Conducting two visits each year (in April and May) would help determine whether the nest is active.

Monitoring Option 2: Raptor fatality monitoring using scan methodology
While we assessed impacts on raptors as low it would be prudent, and relatively low effort, to continue monitoring for eagles and other large raptor fatalities. Recognizing the need for eagle fatality monitoring that is both cost-effective and scientifically rigorous, research is underway to develop a protocol that O&M staff can implement (Hallingstad et al. in PNWWRM XI. 2017, p. 77-79). A detailed protocol is not yet available, but the concept is that searchers walk the perimeter of a turbine, stopping at points in four cardinal directions and use binoculars to scan to 150m for carcasses. This protocol will work best at turbines with good visibility, but the methodology allows for calculating areas that are not "searchable" (i.e. viewable). Results presented at the Wind Wildlife Research Meeting in 2016 suggest that this method can produce reliable fatality estimates for large carcasses when count data is adjusted by a detection function (Hallingstad et al. in PNWWRM XI. 2017, p. 77-79). As with more intensive fatality monitoring, probability of detection is estimated using searcher efficiency trials, raptor persistence estimates and carcass distribution data (i.e. carcass distance from turbine).

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APPENDICES

APPENDIX A. Fatality datasheet for Spion Kop Wind Farm

Count for SE/CR Yes No **Incidental** Yes No

Fatality Report 2015

ID #: ______________________ **Searcher:** ______________________

(Date_speciescode_turbine_# found that day on that turbine,i.e. 1/1/2001_LABO_T1_1)

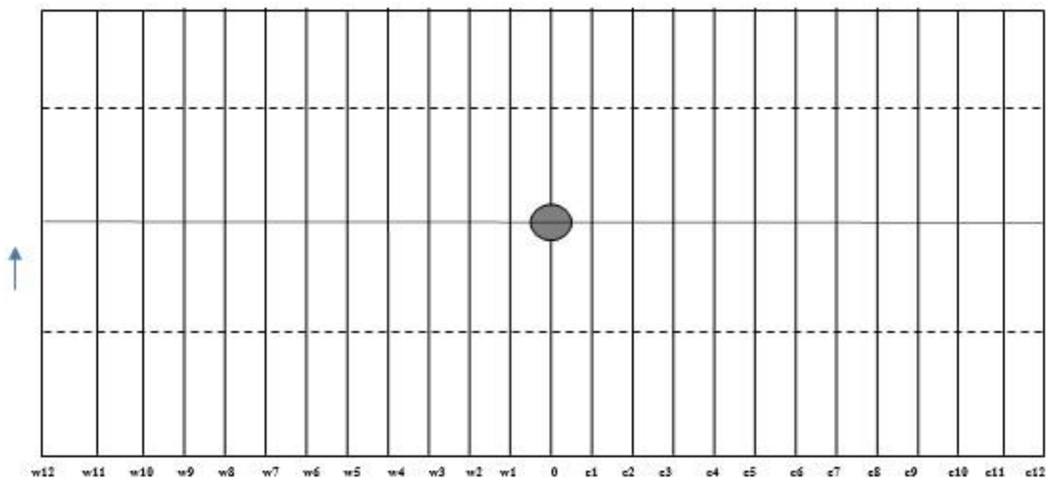
Date Found: ____________ **Time Found:** ______________ **Location: N**__________-__________

THE TURBINE

Turbine #: ______________

Quadrant: NE SE NW SW **Degree from turbine:** ________ **Distance (m):** __________

Note:Degrees should match quadrant. NE: 0 –90 SE: 91 – 180 SW: 181 – 270 NW: 271 – 359



VEGETATION (w/in 1 m² of carcass)

Dominant Cover (choose only one)

Bare Ground (gravel, concrete, dirt)
_______ Vegetation (clover, grass, blackberry)
______ Short (below ankle)
______ Medium (ankle to knee)
Tall (above knee)
_______ Large Rock/Boulders
_______ Brush Pile

Other: ______________________

% Veg: <10 11-25 26-50 50-75 75-99 100

THE TRANSECT

Transect #: **or** N/A

Perp. Distance to closest Transect (m): __________ **or** N/A

Found Outside of plot? Yes No

Visibility Index

Easy (e.g. ≥ 90% bare ground)
_______ Moderate (e.g., ≥ 25% bare ground with ≤ 15 cm ground cover height)
_______ Difficult (e.g., ≤ 25% bare ground with ≥ 30 cm ground cover height)
_______ Very Difficult (e.g., little or no bare ground, 25% of ground cover ≥ 30 cm)

Veg. Height (cm): Max_____ Dom.Avg.____

Road: Yes No **Pad:** Yes or No

Notes: ______________________________

THE CARCASS

Who Worked Up:____________________ **Date/Time Worked Up:**_______________ **Date/Time Recovered:**______________

Bird / Bat **Band/tag:**_______________ **Live / Fatality** **If Live:** Euthanized Released

Camera: ____________ **Photo Numbers if taken**: __________________If something interesting please take extra photos

Species: _____________________**(i.e.** *Myotis lucifugus*= **MYLU)**(If unknown or Myotis keep carcass and contact lead)
Age: A J U **Sex:** M F U
Repro: Preg Lact Post Lact Scrotal Non repro Unknown
Position: Face Up Face Down
Physical Condition at time of find: Complete Partial Feather Spot
Injury Type (circle one): No visible injuries Visible injuries (e.g. broken left wing, neck, laceration; explain below) Unknown
Describe injuries: ____

____

Carcass Condition:
_____ Bloody
_____ Wings pliable ____ Wings dry N/A
_____ No decay smell ____ Slight ___ Strong

Infestation:
______ None ____Maggot eggs_____ Maggots
______ Ants ______ Flies _____ Bees/Wasps
______ Beetles/Larvae _____ Grasshoppers
_____ Other ________________________________

Eyes:
_____ Round/fluid filled
_____ Dehydrated
_____ Sunken
_____ Empty

Estimated time of death:
______ Last night
______ 2 – 3 days
______ 4 – 7 days
______ 7 – 14 days
______ > 2 weeks
______ Unknown

Wing score: 0 (fewer than 5 scar spots) 1 (< 50% wing depigmented) 2 (> 50% wing with scar tissue)
3 (Deteriorated wing membrane and necrotic tissue. Isolated holes >0.5 cm) Unknown N/A (i.e.bird)

Additional Notes:

____

____

____

____

____

APPENDIX B. Federal Special Purpose Utility Permit required to collect bird fatalities and Spion Kop Wind Farm and place legally salvaged native bird trial carcasses for searcher efficiency and carcass persistence trials.

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
Migratory Bird Permit Office
P.O. Box 25486 DFC (60154) - Denver, CO 80225-0486
Tel: 303-236-8171 Fax: 303-236-8017
Email: permitsR6MB@fws.gov

FEDERAL FISH AND WILDLIFE PERMIT

1. PERMITTEE

NORTHWESTERN CORPORATION
dba NORTHWESTERN ENERGY
40 EAST BROADWAY
BUTTE, MT 59701
U.S.A.

2. AUTHORITY-STATUTES
16 USC 703-712

REGULATIONS
50 CFR Part 13
50 CFR 21.27

3. NUMBER
MB74992B-0

4. RENEWABLE: ☒ YES ☐ NO

5. MAY COPY: ☒ YES ☐ NO

6. EFFECTIVE
09/01/2016

7. EXPIRES
03/31/2019

8. NAME AND TITLE OF PRINCIPAL OFFICER *(If #1 is a business)*
ROBERT C ROWE
PRESIDENT AND CEO

9. TYPE OF PERMIT
MIGRATORY BIRD SPECIAL PURPOSE UTILITY PERMIT - WIND

10. LOCATION WHERE AUTHORIZED ACTIVITY MAY BE CONDUCTED

Spion Kop Wind Farm
7735 South Peak Road
Geyser, MT 59447

11. CONDITIONS AND AUTHORIZATIONS:

A. GENERAL CONDITIONS SET OUT IN SUBPART D OF 50 CFR 13, AND SPECIFIC CONDITIONS CONTAINED IN FEDERAL REGULATIONS CITED IN BLOCK #2 ABOVE, ARE HEREBY MADE A PART OF THIS PERMIT. ALL ACTIVITIES AUTHORIZED HEREIN MUST BE CARRIED OUT IN ACCORD WITH AND FOR THE PURPOSES DESCRIBED IN THE APPLICATION SUBMITTED. CONTINUED VALIDITY, OR RENEWAL, OF THIS PERMIT IS SUBJECT TO COMPLETE AND TIMELY COMPLIANCE WITH ALL APPLICABLE CONDITIONS, INCLUDING THE FILING OF ALL REQUIRED INFORMATION AND REPORTS.

B. THE VALIDITY OF THIS PERMIT IS ALSO CONDITIONED UPON STRICT OBSERVANCE OF ALL APPLICABLE FOREIGN, STATE, LOCAL, TRIBAL, OR OTHER FEDERAL LAW.

C. VALID FOR USE BY PERMITTEE NAMED ABOVE.

the following subpermittees are authorized: Sam Milodragovich, Kimberly Elizabeth Linnell, Kristina Smucker, and any other person who is under their direct supervision and guidance and is (1) employed by or under contract to you for the activities specified in this permit, or (2) otherwise designated a subpermittee by you in writing, may exercise the authority of this permit. Submit a list of subpermittees with annual report.

D. Possession and transport.

(1) You and subpermittees are authorized to collect, transport and temporarily possess carcasses and partial remains of migratory birds found at the location/property specified in Block 10 for monitoring migratory bird mortality associated with operation of the wind facility. To accurately determine species fatality rates, the monitoring study should include standardized carcass searches, searcher efficiency trials, and carcass removal by scavenger trials.

(2) You and subpermittees are not authorized to collect **Bald and Golden Eagles (Eagles) and federally listed Threatened or Endangered Species under the U.S. Endangered Species Act (see 50 CFR 17.11)** for the purpose of carcass persistence trials.

(3) You and subpermittees are not authorized to collect blood, tissue and feathers from **Bald and Golden Eagles (Eagles) and federally listed Threatened or Endangered Species under the U.S. Endangered Species Act (see 50 CFR 17.11)** for various analyses.

(4) For **Bald and Golden Eagles (Eagles) and federally listed Threatened or Endangered Species under the U.S. Endangered Species Act (see 50 CFR 17.11)**, you must call a U.S. Fish and Wildlife Service (Service), Office of Law Enforcement (OLE) special agent for instructions and approval BEFORE collecting or moving the carcass(es) or parts, unless you are working under a specific alternative protocol established by you and OLE. It may be necessary to preserve the carcass(es) or parts onsite until an agent or other Service or State representative arrives to collect them. Your OLE contact phone number is (406) 247-7355.

(5) For all other migratory birds, gather data required by Condition E below PRIOR to collecting or moving the carcass or its parts.

(Page 1 of 3)

☒ ADDITIONAL CONDITIONS AND AUTHORIZATIONS ALSO APPLY

12. REPORTING REQUIREMENTS

ANNUAL REPORT DUE: 01/31
and as outlined in Condition #11I

ISSUED BY	TITLE	DATE
[signature]	CHIEF, MBPO, REGION 6	08/31/2016

E. Data Collection.

(1) The following data must be recorded for each standardized carcass search:

(a) date
(b) start time
(c) end time
(d) interval since last search
(e) observers
(f) delineation of turbine area searched, including GPS coordinates in decimal degrees if known.
(g) weather data, include temperature (Centigrade), wind direction and speed, cloud cover and precipitation.

(2) For both standardized carcass searches *and* opportunistic finds outside of standardized searches, all relevant data associated with each carcass/part (s)/injured bird discovered or collected, must be recorded, including the information below. We request that you voluntarily collect bat injury and mortality information.

(a) discovery date
(b) collection date
(c) species, or if unknown, either the type of bird (e.g., gull, raptor) or "unknown"
(d) sex and age (hatchling, juvenile, adult), if known
(e) how carcass was located (during standardized carcass search or opportunistic or incidental find?)
(f) condition (alive or dead)
(g) description (If alive, indicate if sick or injured. If dead, indicate if intact; freshly killed (eyes moist); semi-fresh (stiff, eyes desiccated); partially decomposed feathers and/or bones; other)
(h) the GPS coordinates in decimal degrees using clearly identified datum (the standard position or level that measurements are taken from such as WGS 84) for the location where found, OR nearest turbine/pole/structure ID number
(i) type and configuration of structure or features found near bird/carcass and potentially responsible for injury/mortality (structure type; nameplate information; manufacturer, model number, height; presence/absence of guy wires; turbine, pole, structure ID#; etc.)
(j) ground distance (estimated or exact) carcass found from nearest pole, line, turbine, or other structure
(k) suspected cause of mortality/injury (collision with turbine, collision with wire, collision with other structure, barotrauma, electrocution, other)
(l) disposition (freezer onsite, left in place, buried, incinerated, rehabilitator, OLE, used in field trials, etc.)
(m) any special notes or additional information (e.g., if associated with a mortality event involving unusually high numbers of birds or unusual species groups; weather conditions at likely time of death, if known).

(3) All carcasses and partial remains you collect and transport must be bagged, labeled with a unique specimen identification number and the collector's name PRIOR to transport, unless you are working under a specific alternative protocol established by you and OLE. The data sheet with the information listed in Condition E(2) must be attached to or included in the bag.

F. **Trial specimens.** Migratory birds, **other than Eagles and federally listed Threatened or Endangered Species**, salvaged under this permit may be used for searcher efficiency and scavenger removal trials AFTER they have been reported to the Regional Migratory Bird Permit Office per Condition I(4).

You also may obtain lawfully acquired migratory bird specimens, other than Eagles and federally listed Threatened or Endangered Species from Region 6, U.S. Fish and Wildlife Service. A proper chain-of-custody form is to be accurately completed for each carcass transfer ensuring that each form is filled out entirely and filed on site.

G. **Injured/orphaned birds.** In the event migratory birds, including **Eagles and federally listed Threatened or Endangered Species**, are injured or orphaned, you must immediately contact a federally permitted migratory bird rehabilitator or a licensed veterinarian for instructions. Rehabilitation and/or veterinary costs for birds that may have been injured or orphaned by utility operations or infrastructure are the utility's responsibility. See Condition I for reporting instructions.

H. **Take and collection of live, non-injured migratory birds, eggs, or nests is not authorized by this permit.** In addition, this permit does not authorize the take, capture, harassment or disturbance of **Eagles and federally listed Threatened or Endangered Species**.

I. **Reporting.** You must report bird injuries and deaths in accordance with (1) - (6) below. We request that you voluntarily report bat injury and mortality information.

(1) How to report.

(a) Immediate (written follow-up) and quarterly reports. Until a new on-line reporting system is completed, you have three options for submitting reports:

(i) If you have an account with the Service's Bird Injury and Mortality Reporting System (BIMRS) for reporting injury and mortality incidents, you may report incidents in BIMRS at: <https://birdreport.fws.gov/>.
(ii) You may report the incident using the Avian Injury/Mortality Reporting System (AIMRS) database (form 3-202-17). Download the database at http://www.fws.gov/forms/3-202-17.pdf.
(iii) You may submit an Excel spreadsheet from your own database in lieu of using AIMRS provided all of the "required" information in AIMRS (in exact AIMRS format) is included.

(b) Annual report. Submit your annual report using the AIMRS database or you may submit an Excel spreadsheet from your own database in lieu of using the AIMRS database, provided all of the same information "required" in AIMRS (in exact AIMRS format) is included. If your company holds a BIMRS account, you may generate your annual report in Excel from BIMRS.

(2) **Immediate reports**

(a) Eagles and T&E Species. You must report any **Eagles and federally listed Threatened or Endangered Species** found dead or injured to your OLE special agent (see Condition D for contact information) or the general OLE phone number at (406) 247-7355 and your Ecological Services Field Office at (406) 449-5225; **immediately** if possible, but no later than 24 hours from discovery of the bird, or at the beginning of the next business day. Your report must include as much of the information from Condition E(2) as possible.

A written injury/mortality report, including any information not available at the time of your initial report, must be submitted to your migratory bird permit issuing office to include the data in Condition E(2) and/or as directed by your OLE special agent no later than **7 days** from the date of discovery and collection of the carcass or bird. **(Page 2 of 3 - MB74992B)**

A list of Threatened and Endangered species by State may be found in the Service's Threatened and Endangered Species System (TESS) database at: http://www.fws.gov/endangered.

(b) Significant mortality events. Report mortality events involving unusually high numbers of birds or unusual species groups to your migratory bird permit issuing office at (303) 236-8171 immediately if possible but not later than 48 hours from discovery of the birds, or at the beginning of the next business day.

(3) **Quarterly reports.** You must submit a report of all migratory birds, including Eagles and Threatened and Endangered Species already reported, discovered and/or collected to your migratory bird permit issuing office quarterly. Quarterly reports (Jan 1 - Mar 31, Apr 1 - Jun 30, Jul 1 - Sep 30) are due 7 days following the end of each quarter. The fourth quarter (Oct 1 - Dec 31) can be reported with the Annual Report per Conditions I(5) below. Your report should include as much of the data listed in Condition E(2) above as possible.

If you conducted no activity under your permit during a particular quarter, you must report "no activity conducted."

(4) **Trial specimens reports.** If you use carcasses of migratory birds collected under this permit for searcher efficiency or scavenger removal trials, you must report the mortality of the specimens you want to use to your migratory bird permit issuing office as follows:

(a) You may use specimens in the year in which you salvaged them if you first report the specimens you want to use to your migratory bird permit issuing office.
(b) You may use specimens that were salvaged and reported in prior years.
(c) Your report must include the unique specimen identification number and all the information in Condition E(2).

(5) **Annual Report.** You must submit a cumulative annual report of all dead and injured birds, **including Eagles and federally listed Threatened or Endangered Species**, discovered or collected, to your migratory bird permit issuing office by **January 31** following each calendar year in which the permit is in effect. Your annual report must include at a minimum the information required in Condition E(2).

(6) **Study Report.** At the conclusion of the monitoring study, you must submit a report describing the results of the study. The report should include analyses of searcher efficiency and scavenger trials, estimated fatality rates, and any discernable patterns in migratory bird fatalities. It should also include descriptions of any adjustments or measures taken to avoid or minimize mortalities, and any preliminary results of those modifications.

J. **Disposition of Carcasses and Parts.**

(1) In accordance with Condition D(4) above, the Service will advise you on disposition of **Eagles and federally listed Threatened or Endangered Species** specimens. The special agent will advise if they will recover an eagle carcass or if you need to ship the carcass to the Service. With PRIOR written authorization from an OLE special agent, you may contact the U.S. Fish and Wildlife Service, National Eagle and Wildlife Property Repository (NER) at (303) 287-2110 for shipping instructions. The written authorization from the special agent must accompany the Eagle if it is shipped to the NER. Disposition must be reported in your annual report to your migratory bird permit issuing office.

(2) **Migratory Bird carcasses** and parts (**other than Eagles and federally listed Threatened or Endangered Species**) collected during the calendar year (ending Dec 31) and documented in your records must be stored in the freezer at the location specified in Block 10 **until February 15** of the following year, except specimens used in searcher efficiency and scavenger removal trials that were previously reported to the migratory bird permit issuing office in accordance with Conditions F and I(4)(a).

After February 15, carcasses and parts may be:

(a) used for searcher efficiency and scavenger removal trials, provided carcasses used in trials have been reported to the Service in accordance with Condition I(4) above;
(b) turned over to the Service or State wildlife agency for official purposes, or,
(c) donated to a public scientific or educational institution or to an individual or entity authorized by Federal permit to acquire and possess migratory bird specimens.

After all permit requirements have been met, carcasses and parts (**except Eagles and federally listed Threatened or Endangered species**) that you do not transfer to another authorized party must be disposed of by burial or incineration.

K. **Renewal.** Any renewal request must include any proposed adjustments to the monitoring protocols, descriptions of any adjustments or measures taken to avoid or minimize mortalities, and any preliminary results of those modifications.

L. **Subpermittees.** Specified in Condition 11C above.

M. **Standard Conditions.** You and any subpermittees must comply with the attached Standard Conditions for Migratory Bird Special Purpose Utility Permits. These standard conditions are a continuation of your permit conditions and must remain with your permit.

For suspected illegal activity immediately contact the USFWS Law Enforcement at: (406) 247-7355

This permit does not, nor shall it be construed to, authorize lethal take or injury of migratory birds or limit or preclude the U.S. Fish and Wildlife Service from exercising its authority under any law, statute, or regulation, or from taking enforcement action against any individual, company, or agency. This permit is not intended to relieve any individual, company, or agency of its obligations to comply with any applicable Federal, State, Tribal, or local law, statute, or regulation. We strongly encourage you to implement all applicable measures found in current U.S. Fish and Wildlife Service, Wind Energy Guidelines found at: http://www.fws.gov/windenergy/

(Page 3 of 3 - MB74992B)

Appendix C. Complete list of fatalities discovered at Spion Kop Wind Farm and distance from turbine.

Date	Species	Turbine	Distance (m)	Type of Find	Condition
9/9/2015	Silver-haired bat	13	24	Pilot Study	Fresh
9/9/2015	Hoary bat	11	52	Pilot Study	Late Decomposition
9/11/2015	Hoary bat	3	52	Pilot Study	Fresh
9/14/2015	Green-winged Teal	13	36	Pilot Study	Late Decomposition
9/15/2015	Sharp-tailed Grouse	3	0	Pilot Study	Early Decomposition
9/15/2015	Hoary bat	11	36	Pilot Study	Fresh
9/22/2015	Sharp-tailed grouse	3	4	Pilot Study	Feather spot
10/15/2015	Hungarian Partridge	25	30	Pilot Study	Feather spot
4/22/2016	Hungarian Partridge	1	1	Incidental	Fresh
5/25/2016	Western Meadowlark	21	75	Carcass Search	Early Decomposition
7/12/2016	Hoary bat	18	31	Carcass Search	Fresh
7/26/2016	Hoary bat	18	60	Carcass Search	Late Decomposition
7/26/2016	Hoary bat	18	14	Incidental	Late Decomposition
8/1/2016	Hoary bat	14	19	Carcass Search	Early Decomposition
8/1/2016	Hoary bat	3	13	Carcass Search	Fresh
8/2/2016	Hoary bat	11	14	Carcass search	Early decomposition
8/2/2016	Hoary bat	11	9	Carcass search	Fresh
8/9/2016	Hoary bat	13	13	Carcass search	Late decomposition
8/9/2016	Hoary bat	11	43	Carcass search	Early decomposition
8/9/2016	Hoary bat	12	14	Incidental	Late decomposition
8/10/2016	Western Meadowlark	21	56	Carcass Search	Late decomposition
8/15/2016	Hoary bat	14	11	Carcass Search	Live animal (released)
8/16/2016	Hoary bat	13	16	Carcass Search	Early decomposition
8/22/2016	Hoary bat	10	14	Incidental	Early decomposition
8/23/2016	Hoary bat	18	30	Carcass Search	Early decomposition
8/23/2016	Silver-haired bat	20	16	Incidental	Late decomposition
8/23/2016	Silver-haired bat	20	16	Incidental	Early decomposition
8/29/2016	Hoary bat	3	44	Incidental	Early decomposition
8/29/2016	Hoary bat	5	37	Carcass Search	Early decomposition
8/31/2016	Hoary bat	21	0	Carcass Search	Early decomposition
9/6/2016	Hoary bat	14	79	Carcass search	Fresh
9/6/2016	Silver-haired bat	3	34	Carcass Search	Early decomposition
9/6/2018	UNK Bird	3	91	Carcass Search	Feather spot
9/12/2016	Silver-haired bat	14	65	Carcass Search	Early decomposition
9/19/2016	Silver-haired bat	15	17	Incidental	Late decomposition
9/20/2016	Silver-haired bat	18	17	Carcass Search	Late decomposition
9/20/2016	Silver-haired bat	18	40	Incidental	Late decomposition
9/21/2016	Silver-haired bat	6	62	Carcass Search	Fresh
9/21/2016	Hoary bat	25	72	Carcass Search	Early decomposition
9/29/2016	Silver-haired bat	18	51	Carcass search	Late decomposition
5/16/2017	Hungarian Partridge	6	77	Incidental	Feather spot
5/30/2017	Eurasian Collared-Dove	14	68	Carcass Search	Feather spot
5/30/2017	Western meadowlark	14	49	Carcass Search	Live animal (released)

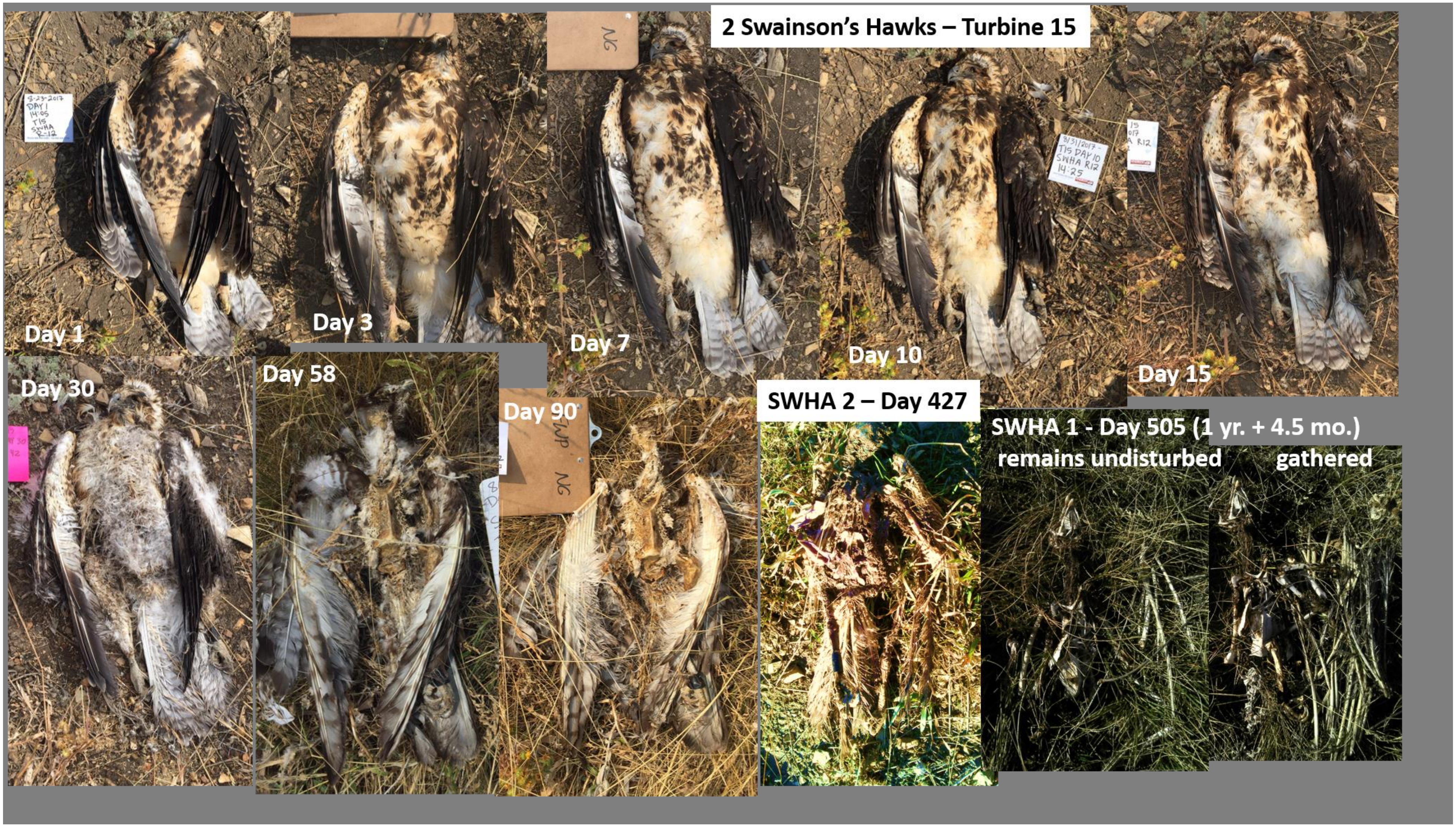
Date	Common Name	Turbine	Distance (m)	Type of Find	Condition
6/5/2017	Hungarian Partridge	5	35	Carcass Search	Late decomposition
6/19/2017	Hungarian Partridge	14	14	Carcass Search	Late decomposition
6/28/2017	Hoary bat	21	16	Carcass Search	Early decomposition
7/18/2017	Hungarian Partridge	18	34	Carcass Search	Feather spot
7/19/2017	Hoary bat	21	66	Carcass Search	Early decomposition
7/24/2017	White-throated Swift	14	36	Carcass Search	Fresh
7/24/2017	Thrush spp.	5	48	Carcass Search	Early Decomposition
7/26/2017	Silver-haired bat	23	26	Carcass Search	Fresh
7/27/2017	Hoary bat	6	31	Incidental	Late decomposition
8/2/2017	Hoary bat	25	22	Carcass search	Late decomposition
8/7/2017	Hoary bat	2	40	Carcass search	Late decomposition
8/7/2017	Western meadowlark	2	0	Carcass search	Early decomposition
8/8/2017	Hoary bat	11	25	Carcass search	Late decomposition
8/8/2017	Hoary bat	18	48	Incidental	Late decomposition
8/9/2017	Silver-haired bat	25	13	Carcass search	Late decomposition
8/10/2017	Hoary bat	24	27	Carcass search	Late decomposition
8/14/2017	Hoary bat	5	37	Incidental	Late decomposition
8/16/2017	Hoary bat	23	33	Carcass search	Early decomposition
8/22/2017	Western meadowlark	14	47	Carcass search	Feather spot
8/23/2017	Hoary bat	11	19	Carcass search	Early decomposition
8/24/2017	Hoary bat	23	11	Carcass search	Fresh
8/24/2017	Silver-haired bat	25	21	Carcass search	Fresh
8/24/2017	Hoary bat	25	38	Carcass search	Late decomposition
8/24/2017	Hoary bat	25	29	Carcass search	Early decomposition
8/25/2017	Hoary bat	9	7	Incidental	Late decomposition
8/29/2017	Hoary bat	13	57	Carcass search	Late decomposition
8/30/2017	Silver-haired bat	25	176	Carcass search	Late decomposition
8/30/2017	Hoary bat	10	140	Incidental	Late decomposition
8/30/2017	Hoary bat	12	38	Incidental	Late decomposition
8/30/2017	Hoary bat	12	52	Incidental	Late decomposition
8/30/2017	Hungarian Partridge	3	166	Incidental	Feather spot
8/31/2017	Silver-haired bat	19	240	Incidental	Fresh
9/4/2017	Silver-haired bat	3	13	Carcass search	Live animal (released)
9/4/2017	Hoary bat	14	43	Carcass search	Fresh
9/4/2017	Hoary bat	14	27	Carcass search	Late decomposition
9/4/2017	Hoary bat	2	50	Carcass search	Late decomposition
9/13/2017	Hoary bat	25	53	Carcass search	Late decomposition
9/14/2017	Hoary bat	9	25	Incidental	Early decomposition
9/18/2017	Silver-haired bat	2	82	Carcass search	Fresh
9/26/2017	Western meadowlark	13	81	Carcass search	Feather spot
9/26/2017	Western meadowlark	13	81	Carcass search	Feather spot
10/7/2017	Hoary bat	9	50	Incidental	Late decomposition
10/7/2017	Silver-haired bat	7	83	Incidental	Fresh
10/11/2017	UNK bird	13	69	Carcass search	Feather spot

Appendix D. List, locations and final disposition of native bird carcasses used in SE and CP trials at Spion Kop Wind Farm (9/2016 – 10/2017). Disposition for two carcasses is "Left in Place" because the area could not be searched.

Drop Date	Common Name	Turbine	Latitude	Longitude	Carcass disposition
7/31/2017	American Crow	4	47.33459	-110.65062	Scavenged
9/12/2017	American Robin	24	47.35492	-110.62434	Scavenged
6/12/2017	Black-capped Chickadee	11	47.33766	-110.637	Scavenged
9/27/2016	Canada Goose	20	47.34417	-110.62162	Scavenged
9/25/2016	Canada Goose	1	47.32506	-110.65449	Scavenged
9/27/2016	Canada Goose	24	47.35448	-110.62428	Scavenged
9/27/2016	Canada Goose	7	47.32682	-110.63454	Scavenged
9/13/2016	Canada Goose	24	47.35516	-110.62504	Scavenged
6/12/2017	Cedar Waxwing	18	47.339429	-110.614788	Scavenged
6/19/2017	Cooper's Hawk	22	47.350670	-110.623000	Removed
10/3/2016	Cooper's Hawk	11	47.3352	-110.63651	Left in place
6/14/2017	Cooper's Hawk	24	47.355000	-110.624700	Scavenged
8/22/2017	Dark-eyed Junco	15	47.34467	-110.64336	Scavenged
10/9/2016	Great Horned Owl	5	47.33668	-110.650908	Scavenged
10/9/2016	Great Horned Owl	14	47.34219	-110.64216	Scavenged
8/13/2017	Great Horned Owl	17	47.349342	-110.644125	Scavenged
10/11/2017	Great Horned Owl	6	47.324107	-110.633902	Scavenged
9/18/2017	Great Horned Owl	7	47.326362	-110.634318	Removed
6/19/2017	Great Horned Owl	25	47.35705	-110.626258	Removed
9/25/2016	Ring-billed Gull	1	47.3247	-110.65379	Scavenged
10/3/2016	Long-eared Owl	13	47.34099	-110.63979	Left in place
10/9/2016	Northern Flicker	2	47.32687	-110.65154	Scavenged
10/3/2016	Northern Pygmy Owl	11	47.33727	-110.63619	Scavenged
10/3/2016	Northern Pygmy Owl	13	47.34058	-110.63987	Scavenged
10/3/2016	Northern Saw-whet Owl	18	47.33926	-110.61504	Scavenged
10/3/2016	Osprey	13	47.34037	-110.64103	Scavenged
10/3/2016	Prairie Falcon	18	47.34036	-110.61562	Scavenged
9/25/2016	Rough-legged Hawk	15	47.34441	-110.64265	Removed
7/11/2017	Red-tailed Hawk	22	47.350440	-110.621958	Removed
10/9/2016	Red-tailed Hawk	3	47.33048	-110.65037	Scavenged
10/3/2016	Red-tailed Hawk	11	47.33795	110.63556	Scavenged
7/31/2017	Red-tailed Hawk	4	47.334145	-110.651067	Removed
9/25/2016	Spotted Towhee	4	47.33463	-110.65109	Removed
9/25/2016	Sharp-shinned Hawk	17	47.34921	-110.64381	Scavenged
6/14/2017	Sharp-shinned Hawk	22	47.3507	-110.62244	Scavenged
8/22/2017	Swainson's Hawk	15	47.344466	-110.643580	Removed
6/5/2017	Swainson's Hawk	15	47.344763	-110.643239	Removed
7/10/2017	Swainson's Hawk	20	47.34476	-110.62088	Scavenged
10/9/2016	Swainson's Hawk	2	47.3277	-110.65209	Scavenged

Drop Date	Common Name	Turbine	Latitude	Longitude	Carcass disposition
8/29/2017	Swainson's Thrush	10	47.33564	-110.63572	Scavenged
8/29/2017	Turkey Vulture	12	47.338945	-110.638231	Removed
10/5/2017	Turkey Vulture	12	47.339365	-110.638181	Removed
7/10/2017	Turkey Vulture	16	47.347214	-110.644900	Removed
10/5/2017	Turkey Vulture	16	47.347660	-110.644520	Removed
10/5/2017	Turkey Vulture	17	47.348917	-110.643943	Removed
7/11/2017	Turkey Vulture	24	47.354692	-110.624984	Removed
10/5/2017	Turkey Vulture	19	47.342810	-110.619566	Scavenged
10/5/2017	Turkey Vulture	20	47.344251	-110.621589	Scavenged
10/5/2017	Turkey Vulture	20	47.344491	-110.620909	Scavenged
10/5/2017	Turkey Vulture	19	47.342223	-110.619449	Scavenged
7/31/2017	Turkey Vulture	1	47.324531	-110.654056	Scavenged
9/18/2017	Turkey Vulture	6	47.324552	-110.633941	Removed
9/12/2017	Turkey Vulture	9	47.331420	-110.636860	Removed
10/11/2017	Turkey Vulture	9	47.331840	-110.636910	Removed
8/29/2017	Turkey Vulture	10	47.335772	-110.635719	Removed
10/5/2017	Turkey Vulture	10	47.335912	-110.635275	Removed
5/25/2016	Western Meadowlark	21	47.348121	-110.621515	Removed

Appendix E. Photos from extended raptor carcass persistence study. This series shows stages of decomposition for a Swainson's Hawk, and the final condition for two different hawks. SWHA 2 was the only carcass in this study to be found intact > 1 year after placement. SWHA 1 was more typical – for most carcasses only some combination of the keeled stern, long bones, skull and flight feather shafts remained.



Appendix F. Coordinates and summary information for non-eagle raptor nests monitored at Spion Kop Wind Farm (2015 – 2017).

Species code[1] _Nest ID	General location	Active pre-con	N years active post-con	Latitude NAD 83	Longitude NAD 83
FEHA_1	W side of Eagle Rock Rd, 1 mi. north of Williams Cr. Rd.	Y	2	47.290843	-110.660005
FEHA_2	South Peak Rd. at corner - lone tree S of road to turbines 18 - 25	Y	1	47.334614	-110.615213
HAWK_sp[2]	William's Creek Rd., SE of Project area; in cottonwood	Y	3	47.310239	-110.598795
RTHA_1	In coulee E of turbine 2; in small Douglas fir	Y	NONE	47.328130	-110.655061
RTHA_2	Pre-con report gives location as William's Cr. Rd, near ranch house; nest never located post-construction - no lat/longs available	Y	NONE	-	-
RTHA_3	William's Creek Rd., E of intersection with Eagle Rock Rd	N	NONE	47.283277	-110.651358
RTHA_4	W side of Eagle Rock Rd, 2 mi. north of Williams Cr. Rd.	N	2	47.306209	-110.657815
RTHA_5	Old homestead S of turbine 6; in a cottonwood	N	2	47.319031	-110.629413
RTHA_6	S side of South Peak Rd, 0.5 mi E of intersection with Eagle Rock Rd.	N	3	47.339193	-110.663289
SWHA_1	In coulee E of turbine 21; Harwood property	Y	NONE	47.349588	-110.611711
SWHA_2	E side of Eagle Rock Rd, 2 mi. north of Williams Cr. Rd.	Y	1	47.304011	-110.665597

[1] Species codes: FEHA – Ferruginous Hawk; RTHA – Red-tailed Hawk; SWHA – Swainson's Hawk; [2] The species using this nest site changed annually

Appendix G. Coordinates and summary information for Bald and Golden Eagle nests within a 10-mile radius of Spion Kop Wind Farm. Flights were conducted in early June 2015 and in both April & June 2016.

Nest ID[1]	General location	1st year monitored	2015	2016	Comments	Nest substrate	Latitude	Longitude
BE_1	McCarty Cr.	2011	-	FLEDGE	Not surveyed 2015; 2 large nestlings observed in June 2016	COTTONWOOD	47.261697	-110.479164
GE_1	Williams Cr. Rd.	2011	FLEDGE	FLEDGE	Nest has been active in most years since 2011; fledged 1 nestling in 2015 and 2016.	CONIFER	47.266859	-110.699231
GE_2	South Peak - N of turbine 25	2015	FLEDGE	INACTIVE	Fledged 2 nestlings in 2015; inactive in 2016	CLIFF	47.364568	-110.635440
GE_3	Govt Coulee	2015	FLEDGE	ACTIVE - FATE UNK	2 large nestlings observed in 2015; eggs observed in April 2016 but fate unknown	CONIFER	47.282568	-110.746799
GE_4	Belt Cr. south	2013	INACTIVE	FAIL	Eggs observed in April, nest blown out in June 2016	CLIFF	47.297264	-110.889355
GE_5	Limestone Canyon	2016	-	FAIL	Adult on eggs in April, nest blown out in June 2016; another nest in good condition nest nearby	CLIFF	47.165047	-110.697576
GE_6	Arrow Cr.	2014	-	FLEDGE	Not surveyed 2015; 2 large nestlings observed in June 2016	COTTONWOOD	47.307508	-110.415834
GE_7	Braun Cr.	2015	INACTIVE	INACTIVE	Nest in good condition with green boughs in both 2015 & 2016	CLIFF	47.386713	-110.540988
GE_8	Belt Cr. north	2013	FLEDGE	INACTIVE	3 nestlings observed in June 2015	CLIFF	47.322782	-110.909007
GE_9	Fall Cr.	2014	FLEDGE	INACTIVE	2 nestlings observed in June 2015	CLIFF	47.418708	-110.467542
GE_10	Willow Cr.	2011	-	INACTIVE		CLIFF	47.438743	-110.735666
GE_11	Hay Cr.	2014	-	INACTIVE	Not surveyed in 2015; Nest in very poor condition in 2016	CLIFF	47.286027	-110.567448

Nest ID[1]	General location	1st year monitored	2015	2016	Comments	Nest substrate	Latitude	Longitude
GE_12	Fall Cr.	2014	INACTIVE	INACTIVE		CLIFF	47.408332	-110.451913
GE_13	Fall Cr.	2014	INACTIVE	INACTIVE	Nest in good condition with green boughs in 2016	CLIFF	47.411448	-110.458283
GE_14	Unnamed trib. to Cottonwood Cr.	2014	-	INACTIVE		CLIFF	47.431392	-110.472665
GE_15	Chimney Cr.	2016	-	BUILDING	Nest in good condition with green boughs in 2016	CLIFF	47.435123	-110.468093

[1]BE – Bald Eagle; GE – Golden Eagle