Stateline Wind Project Wildlife Monitoring Annual Report

Results for the Period
July 2001 –
December 2002

Prepared for:

FPL Energy
Stateline Technical Advisory Committee
Oregon Office of Energy

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INTRODUCTION

This final annual report summarizes results of the avian and bat monitoring program for the Stateline Wind Project in both Oregon and Washington since the initiation of monitoring in July 2001. These results were summarized from data collected during the first complete year (one year in Oregon, more than one year in Washington) of a minimum two-year monitoring study, and are therefore considered preliminary.

FIELD METHODS

The methods used in the monitoring studies are found in FPL Energy *et al.* (2001) and in Oregon Energy Facility Siting Council (2001 and 2002). Those methods are summarized in this section.

Study Design

The sampling frame for standardized carcass searches[1] consisted of 399 (273 in Washington, 126 in Oregon) turbines that were in operation by January 1, 2002 within the Stateline Wind Project. Turbine plots representative of the project area were systematically selected and are being surveyed in Washington (20 plots, 60 turbines) and Oregon (21 plots, 64 turbines) (Tables 1 and 2, respectively). These plots typically contain three turbines, but some contain two or four turbines (Figure 1). One plot, PB 74-77, has three turbines located in Washington and one turbine in Oregon. Turbine PB 77 is listed as an Oregon turbine but PB 74-77 is counted as a Washington plot. Plot boundaries are delineated using a minimum distance of 63 meters from the turbines. Most adjacent turbines within a string are slightly over 70 m apart, and the boundary of the plot was typically extended to this adjacent turbine. The area of a typical three-turbine plot is approximately 0.8 acres. Approximately 33 acres are surveyed during each search period[2], with approximately 17 acres in Oregon and 16 acres in Washington. The 20 plots in Washington comprise approximately 27 percent[3] of the possible search area in Washington and the 21 plots in Oregon comprise approximate 58 percent[3] of the possible search area in Oregon.

A total of 233 turbine searches[4] were conducted in Washington from late July through December 31, 2001 (Table 3). Standardized searches on the Oregon sample of turbine plots began in January 2002 shortly after all Oregon turbines became operational; 1018 and 960 turbine searches[4] were conducted in Oregon and Washington, respectively, between January 1 and December 2002 (Table 4). Table 5 contains a list of additional turbines that are searched ("protocol searches") by FPL Energy (FPLE) on a quarterly basis using the Stateline Wildlife Response and Reporting System (WRRS) protocol. In addition, casualties discovered incidentally by maintenance personnel or others (project biologists during other activities) are reported and documented with the WRRS.

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[1] carcass searches conducted by WEST Inc. and Northwest Wildlife Consultants Inc.
[2] based on calculations of the total area within 63 m of the sampled turbines.
[3] approximate sampling fractions based on calculations of the total area within 63 m of all turbines.
[4] if a plot contains 3 turbines and was searched 3 times, the number of turbine searches would be reported as 9, although often half of the search area of adjacent turbines were also searched.

The original project design called for the use of permanent guyed meteorological towers. The design has been changed so that all permanent meteorological towers are unguyed structures. Therefore, these structures were not searched for casualties.

The study uses the following dates for defining seasons[5]:

Season	Dates
Spring/Migration	March 16 to May 15
Summer/Breeding	May 16 to August 15
Fall/Migration	August 16 to October 31
Winter	November 1 to March 15

Standardized Searches

Personnel trained in proper search techniques ("the searchers") conduct the standardized carcass searches ("standardized searches") by walking parallel transects. The searches are conducted within rectangular search plots with the long axis of the plot centered on the turbine string. All the area within a minimum of 63 meters from turbines was searched. Transects were initially set at 6 meters apart in the area to be searched. A searcher walks at a rate of approximately 45 to 60 meters per minute along each transect searching both sides out to three meters for casualties. Transect width and search speed were adjusted by habitat type.

All fatalities that meet one of the following criteria were included in the fatality estimates, unless cause of death was determined not to be wind project related:

- Intact – a carcass that is completely intact, is not badly decomposed and shows no sign of being fed upon by a predator or scavenger
- Scavenged – an entire carcass that shows signs of being fed upon by a predator or scavenger, or portions of a carcass in one location (e.g., wings, skeletal remains, legs, pieces of skin, etc.)
- Feather Spot – 10 or more feathers at one location indicating predation or scavenging

Some of the casualties that were discovered and used in fatality rate estimation may not be wind project related because cause of death could not be determined. Including these in the estimates could contribute to an overestimate of the wind project related fatality rates.

Wildlife Response and Reporting System (WRRS)

FPL's Stateline Wind Project Wildlife Response and Reporting System is a monitoring program set up for searching for, reporting, and handling avian and bat casualties found by maintenance personnel. A description of this system and associated data forms used for the Vansycle Ridge Wind Project and for the Stateline Project are found in FPL's application for a site certificate (Attachment P-6, Appendices B and C). This system includes systematic searches ("WRRS

[5] Seasons possibly different in order to keep a complete survey within a single season.

protocol searches") by maintenance personnel of a turbine sample set ("WRRS protocol search plots", Table 5) as well as reporting and documenting fatalities discovered incidentally. These incidental finds may include fatalities discovered by maintenance personnel or by others (e.g., project biologists) during activities other than carcass searching.

Carcass Removal Bias Experimental Trials

"Carcass removal" is the disappearance of a carcass from the search area due to predation, scavenging or other means such as farming activity. The objective of the carcass removal experimental trials[6] is to estimate the length of time avian and bat carcasses remain in the search area. Carcass removal studies were conducted during each season in the vicinity of the search plots. Estimates of carcass removal were used to adjust carcass counts for removal bias.

Field crews periodically placed carcasses in the project area to assess carcass removal rates by scavengers and by other means. Planted carcasses were not placed in the standardized search plots because they might be confused with wind turbine-related fatalities, especially if they have been scavenged. Planted carcasses were placed in the vicinity of standardized search plots but not so near as to attract scavengers to the search plots themselves. The planted carcasses were located randomly within the carcass removal trial plots. Each season, approximately 10 carcasses of birds of two size classes (20 total carcasses) were distributed in each of two habitat types (grassland/shrub-steppe and cultivated agriculture). Small carcasses (e.g., house sparrows, starlings, commercially available game bird chicks) simulated passerines and large carcasses (e.g., raptor carcasses provided by agencies, commercially available adult game birds or cryptically colored chickens) simulated large birds such as raptors, game birds and waterfowl.

Observer Detection Bias Experimental Trials

The objective of observer detection bias experimental trials[7] is to estimate the percentage of bird and bat fatalities that searchers are able to find. These trials were conducted in the same area in which standardized searches occur in both grassland/shrub-steppe and cultivated agriculture habitat types. Trials were conducted in each season. Estimates of observer detection rates were used to adjust the number of carcasses found, correcting for detection bias. Each season, approximately 10 carcasses of birds of two size classes (20 total carcasses) were distributed at plots classified into one of two habitat types (grassland/shrub-steppe and cultivated agriculture).

Personnel conducting searches did not know when trials were scheduled to be conducted. Before the beginning of a standardized search (described below), observer detection trial carcasses were placed at random locations. Each non-domestic carcass was discreetly marked so that it can be identified as an efficiency trial carcass after it was found. The number and location of the trial carcasses found during the standardized search were recorded. The number of efficiency trial carcasses available for detection during each trial was determined immediately after the trial by the person responsible for distributing the carcasses.

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[6] carcass removal trials are often referred to as scavenging bias trials, since most carcass removal is done by scavengers. However, removal could also be due to farm equipment or means other than by scavengers
[7] observer detection bias trials are often referred to as searcher efficiency trials.

Avian Use Surveys

During each standardized search, observers record birds detected in a ten-minute period at a station established at each standardized search plot (20 plots in Washington, 21 in Oregon) using standard variable circular plot point count survey methods. Surveys were conducted at various times during daylight hours. Additional observations of species of concern were made if observed during the standardized searches, but collecting this information was secondary to the actual searching for carcasses so the searchers were not distracted from their main task of finding carcasses. The first avian use survey was conducted the first week in August (2001).

Burrowing Owl Surveys

Burrowing owl surveys were conducted to document the presence of this species in relation to turbine locations. Burrowing owl survey methods varied between Oregon and Washington due to permitting agency requirements. In Washington, surveys were conducted during the breeding season (2002) within 1000 feet of turbines that were located in suitable habitat. In Oregon, surveys were conducted during the breeding season within suitable grassland habitat in association with the fatality monitoring plots. Two surveys for burrowing owls were conducted in both states between June 19 and July 23 in 2002. Taped burrowing owl vocalizations were played to enhance the ability to detect burrowing owls within and adjacent to the survey areas. Historic nest sites in Oregon were checked twice for use between April 5 and June 16 in 2002 as required in the Oregon EFSC permit.

Short-eared Owl Surveys

Driving surveys along the roads associated with the Stateline turbines (Oregon and Washington) were conducted one time during the breeding season to document short-eared owl presence in the study area. Surveys began after 1600 hrs (4:00 p.m.) and continued until dark. Surveys were conducted at driving speeds between 5 and 10 mph. on project roads. Surveyors looked for short-eared owls when accessing project roads via the main public roads (Hatch Grade Road and Dorran Road).

Raptor Nest Surveys

Aerial surveys for raptor nests were conducted to gather information on nesting species visible from the air, nest locations, timing, and success (if possible to determine) in the study area. Two aerial surveys were conducted by helicopter to locate nests visible from the air. The first surveys were conducted between May 5 and 17, 2002, and the second surveys were conducted between June 8 and 28, 2002. Surveys were conducted within a 5-mile buffer of Oregon and Washington turbines. In addition, active ferruginous hawk and Swainson's hawk nests within two miles of Stateline 1 turbines were also surveyed from the ground to determine nest success.

All potential raptor nests[8] were recorded, regardless of whether they were occupied. Notes were taken on the presence of adults, eggs, chicks, and fledglings. Nest structure type and other details were recorded. Nest sites were considered active during the first survey if adult birds

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[8] Stick nests or eyries potentially capable of supporting nesting large birds.

were observed perched or flying near the nest but the nest's contents were not visible. Breeding pairs are defined as incubating adult, eggs, chicks, or fledglings perched at the nest.

Established Grassland Monitoring Transect Surveys

A total of twenty transects were monitored both pre-construction (2001) and after commercial operation (2002) in Oregon to estimate displacement impacts, if any exist, to grassland nesting songbirds adjacent to wind turbine strings. Transects were located in suitable grassland habitat, were 300 m in length and were oriented perpendicular to the turbine string. Each transect was visited three times during the breeding seasons of 2001 and 2002.

STATISTICAL METHODS FOR FATALITY ESTIMATES

The estimate of the total number of wind facility-related fatalities are based on:

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

(2) Searcher efficiency expressed as the proportion of planted carcasses found by searchers

(3) Non-removal rates expressed as the length of time a carcass is expected to remain in the study area and be available for detection by the searchers

Definition of Variables

The following variables are used in the equations below:

- c_i the number of carcasses detected at plot *i* for the study period of interest (e.g., one year) for which the cause of death is either unknown or is attributed to the facility
- n the number of search plots
- k the number of turbines searched (includes the turbines centered within each search plot and a proportion of the number of turbines adjacent to search plots to account for the effect of adjacent turbines on the 63-meter search plot buffer area)
- $\bar{c}$ the average number of carcasses observed per turbine per year
- s the number of carcasses used in removal trials
- s_c the number of carcasses in removal trials that remain in the study area after 40 days
- se standard error (square of the sample variance of the mean)
- t_i the time (days) a carcass remains in the study area before it is removed
- $\bar{t}$ the average time (days) a carcass remains in the study area before it is removed
- d the total number of carcasses placed in searcher efficiency trials
- p the estimated proportion of detectable carcasses found by searchers
- I the interval between searches in days
- $\hat{\pi}_i$ the estimated probability that a carcass is both available to be found during a search and is found (*i* = 1 and 2; two estimators)
- m_i the estimated annual average number of fatalities per turbine per year, adjusted for removal and observer detection bias (*i* = 1 and 2; two estimators)

Observed Number of Carcasses

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

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

The final estimate of $\bar{c}$ and its standard error were calculated using bootstrapping (Manly *et al*. 1997). Bootstrapping is a computer simulation technique that is useful for calculating point estimates, variances and confidence intervals for complicated test statistics. For each iteration of the bootstrap, the plots were sampled with replacement, and $\bar{c}$ was calculated. A total of 5000 bootstrap iterations were used. The reported estimate is the mean of the 5000 bootstrap estimates. The standard deviation of the bootstrap estimates of $\bar{c}$ is the estimated standard error of $\bar{c}$ (se($\bar{c}$)).

Estimation of Carcass Removal

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

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

This estimator is the maximum likelihood estimator assuming the removal times follow an exponential distribution and there is right-censoring of data. In our application, any trial carcasses still remaining at 40 days are collected, yielding censored observations at 40 days. If all trial carcasses are removed before the end of the trial, then s_c is 0, and $\bar{t}$ is just the arithmetic average of the removal times.

The final estimate of $\bar{t}$, the estimated standard error, and 90% confidence limits were calculated using bootstrapping. For each iteration of the bootstrap, the removal times for the trial birds were sampled with replacement, and $\bar{t}$ is calculated. A total of 5000 bootstrap iterations were used. The standard deviation of the bootstrap estimates of $\bar{t}$ is the estimated standard error of $\bar{t}$ (se ($\bar{t}$)). Removal rates were estimated by carcass size (small and large) and season.

Estimation of Observer Detection Rates

Observer detection rates (i.e., searcher efficiency rates) are expressed as *p,* the proportion of trial carcasses that are detected by searchers. The standard error (square of variance) and 90% confidence limits were calculated by bootstrapping. A total of 5000 bootstrap iterations were used. Observer detection rates were estimated by carcass size and season.

Estimation of Facility-Related Fatality Rates

We provide two estimators of the facility-related fatality rates. Both estimators adjust the observed number of fatalities by dividing by an estimate of the probability a casualty is available to be picked up during a fatality search (probability it is not removed by a scavenger), and is observed (probability of detection). The first estimator (m_1) has been applied at other wind facilities, and was the estimator proposed in the Stateline Protocols (FPL Energy *et al.*, 2001, Oregon Energy Facility Siting Council 2001 and 2002). The estimated per turbine annual fatality rate (m_1) is calculated by:

$$m_1 = \frac{\bar{c}}{\hat{\pi}_1}, \text{ where} \tag{3}$$

where

$$\hat{\pi}_1 = \begin{cases} \dfrac{\bar{t} \cdot p}{I} & \text{if } I > \bar{t} \\ p & \text{if } I \le \bar{t} \end{cases}. \tag{4}$$

Based on computer simulations, this first estimator appears to provide an underestimate of true mortality when the interval between searches is similar to the mean carcass removal time.

We also calculated the average number of fatalities per turbine per year using a second estimator. The second estimator (m_2) has the following form:

$$m_2 = \frac{\bar{c}}{\hat{\pi}_2} \tag{5}$$

where $\hat{\pi}_2$ includes adjustments for both observer detection and scavenging bias and assuming that the carcass removal times t_i follow an exponential distribution. This estimator does not underestimate true mortality when the mean removal time is similar to or larger than the interval between searches. In the text we only discuss m_2.

We calculated fatality estimates for 1) all birds, 2) small birds, 3) large birds, 4) raptors, 5) grassland birds and 6) bats. The final reported estimates of m_1 and m_2 and associated standard errors and 90% confidence intervals were calculated using bootstrapping (Manly 1997), based on a computer program written in SAS.

Data collected in 2002 were also used to compare observed fatality rates between levels of two primary factors:

1) Juxtaposition within a string (end row/discontinuous versus mid row turbines);
2) Lighting (lit versus unlit turbines).

Differences in observed fatality rates (number/turbine/year) for the six groups (small birds, large birds, all birds, grassland birds, raptors, and bats) and associated 90% confidence intervals were estimated using bootstrapping.

RESULTS

This section summarizes the results of the Stateline monitoring in Oregon and Washington for data collected between July 2001 and December 2002. The monitoring plan as it is currently defined will continue at least through December 31, 2003. Therefore, these results are considered preliminary until two complete years of data are available. Overall, the Stateline fatality rate was estimated to be 1.7 birds per turbine per year, which is slightly less than the average fatality rate (1.8 birds per turbine per year) reported for other wind power generation facilities (Erickson *et al.* 2001).

Casualty Finds on Standardized Search Plots

Birds

Tables 6 and 7 contain a comprehensive list of bird fatalities observed between July 2001 and December 2002 on standardized search plots in Oregon and Washington. No state or federal Threatened, Endangered or Candidate bird species were found through December 2002. This list includes fatalities observed on standardized search plots during the searches, and fatalities observed incidentally (by FPL or contractors) on the standardized search plots. In Oregon, 45 bird casualties representing seventeen species have been documented during the searches since January 2002 (Table 6). Sixty-one bird casualties representing nineteen species have been documented in Washington since July 2001 (Table 7). Overall, 27 different species and three unidentified birds were found as casualties (Table 8). Horned lark comprised over 43% of the fatalities (46 fatalities), followed by golden-crowned kinglet (6), western meadowlark (6), white-crowned sparrow (5), red-tailed hawk (4), ring-necked pheasant (4) and gray partridge (4). These fatalities were found near 75 different turbines (i.e. closest turbine to fatality). The maximum number of fatalities found at any one turbine during searches to date was 3 fatalities found closest to turbine HGA7, HGC14, HGC24, HGH16, PB30 and PB39 (Table 9). Six raptors were found on standardized search plots, and were comprised of four red-tailed hawks, a Swainson's hawk and an American kestrel. The average distance from the bird casualties to the nearest turbine was 37 m.

Bats

Tables 11 and 12 contain a comprehensive list of bat fatalities observed between July 2001 and December 2002 on standardized search plots in Oregon and Washington. No bat casualties were found between January 1 and June 30, 2002 in Oregon or Washington during standardized searches. Twenty-five bat casualties representing three species (hoary bat, silver-haired bat, little brown bat) were documented on standardized search plots from late July through mid November 2001. An additional 29 casualties representing three species (hoary bat, silver-haired bat, big brown bat) and one unidentified species were found during searches in mid July 2002 through October 2002 (Tables 11 and 12). All casualties found in 2001 were located in Washington since Oregon monitoring did not start until January 2002. No state or federal Threatened, Endangered or Candidate bat species were found through December 2002. Individuals of one Oregon State-Sensitive species, the silver-haired bat, were found (see Table 11). Late summer and fall casualties probably reflect seasonal migration, documented for the life histories of both hoary and silver-haired bats. Most of the bat fatalities were observed prior to November 2001 and 2002, with only one carcass observed after November 2001 and before the following summer. The general time period from late summer through late September has consistently been identified as the peak period for bat mortality at wind projects (Johnson *et al.* 2003). Silver-haired and hoary bats comprised 92.6% of all fatalities (25 fatalities for each species), followed by big brown bat (2 fatalities), and little brown bat and unidentified bat (one fatality each) (Table 14). These fatalities were found near 47 different turbines. The largest number of bat casualties observed nearest any one turbine was four found closest to PB30 followed by three found closest to HGC14 and two found closest to BGC18 and PB53. No other turbines had more than one bat fatality recorded during this time period (Table 13). The average distance from the bat casualties to the nearest turbine for these fatalities was 20 m.

WRRS Casualty Finds

WRRS casualty finds (from protocol searches and incidental finds by FPL and other contractors) not found on standardized search plots are listed in Tables 10 and 15.

Birds

Twenty bird fatalities[9] (7 horned larks, 3 red-tailed hawks, 2 white-crowned sparrows, 2 gray partridge, 1 Canada goose, 1 white-throated swift, 1 ring-necked pheasant, 1 chukar, 1 European starling and an unidentified buteo or owl feather spot) were found incidentally or during a WRRS protocol search and reported between July 2001 and December 2002 (Table 10). An injured Swainson's hawk was found and was successfully rehabilitated and released. The unidentified buteo or owl feather spot was found 103 meters from the nearest turbine at the base of a fencepost along a barbed wire fence. It is not clear from this evidence whether or not this was a turbine-related fatality. It was 38 m outside the formal search area. One red-tailed hawk and 3 horned larks were found incidentally (not during a scheduled search) but were located on standardized carcass search plots (Tables 6 and 7). These fatalities are included in the estimation of annual bird fatality rates.

Bats

Twenty-two bat fatalities[10] were also reported incidentally or found during a protocol search between July 1, 2001 and December 2002 (Table 15), with four of the incidental finds discovered on standardized search plots. Most were found by FPL personnel or contractors and were reported using the WRRS.

Washington Ground Squirrels

No Washington ground squirrel fatalities were discovered.

[9] four of the incidental finds were discovered on standardized search plots and are listed in Tables 6 and 7.
[10] four of the incidental bat finds were discovered on standardized search plots and are listed in Tables 11 and 12

Observer Detection Bias Experimental Trials

In 2001, experimental observer detection bias trials were conducted on October 1, October 13, October 14, December 9, December 12 and December 15. In 2002, trials were conducted on February 19, February 21, April 5, April 7, May 3, May 19, July 16, July 17, August 12, and August 17, October 15, 16 and 17, November 4. We also included the data from a January 6, 2003 trial. Between October 2001 and January 6, 2003, data were obtained for 185 trial carcasses.

Observer detection rates of large birds ranged from 62% in summer to 91% in the winter, with an overall average of 80% (n=94). Observer detection rates of small birds ranged from 27% in summer to 55% in both winter and spring, with an overall average of 43% (n=91).

Carcass Removal Bias Experimental Trials

In 2001, experimental removal bias trials were started on September 1 and December 9. In 2002, trials were started on February 2, April 2, June 26, July 9, July 22, October 7, and October 14. Experimental trial carcasses were placed in the field (day 0) and typically checked on day 1, 2, 3, 4, 7, 10, 20, 30 and 40. Removal rates were low throughout the study period. Removal rates of large carcasses ranged from an average of 29.0 days prior to removal in the fall to 58.9[11] days in the summer. These estimates represent mean number of days carcasses remain in the search areas before removal (removal of entire carcass, or reduction to a feather spot that does not meet the definition of a casualty). Nearly half (41.4%) of the 99 large trial carcasses still remained at the end of the trial period (40 days). Small carcasses on average were removed quicker than large carcasses. (23.1 days versus 42.0 days). Small carcasses were removed quickest in the spring (16.4 days) and fall (16.9 days), followed by winter (27.2 days) and summer (35.1). Approximately 1 of every 5 small trial carcasses (19.8%) remained at the end of the trial period (40 days) (Table 16). Across all trial carcasses, removal was slowest in the summer (45.2) and winter (33.5), and fastest in the fall (22.1) and spring (27.9) (Table 16).

Fatality Estimates

Appendix A contains detailed calculations of the fatality estimates for 1) all birds, 2) small birds, 3) large birds, 4) raptors, 5) grassland birds and 6) bats. Summaries of the estimates, with standard errors and confidence intervals are found in Table 17. Estimates, standard errors and confidence intervals were calculated from the bootstrap distributions, which are found in Appendix B.

[11] the trials last for a maximum of 40 days, although some trial birds may remain (censored). Estimates of mean removal time can be greater than 40 days, because we make assumptions regarding the fate of birds that last at least 40 days (we assume an exponential distribution for removal times). The formula for mean removal time in the methods section can yield values greater than 40.

Small Birds

Eighty-seven small bird fatalities were observed on search plots between July 2001 and December 2002. The estimated average probability a small bird casualty remains until a scheduled search and is found is 0.353. The estimated number of small bird fatalities per turbine per year for the Stateline Wind Facility is 1.524 (1.157, 1.956)[12].

Large Birds

Nineteen large birds were observed on search plots between July 2001 and December 2002. The estimated average probability a large bird casualty remains until a scheduled search and is found is 0.697. The estimated number of large bird fatalities per turbine per year for the Stateline Wind Facility is 0.168 (0.104, 0.239).

All Birds

The all bird fatality estimate was obtained by summing the estimates for small and large birds. Based on the 106 bird casualties observed on the standardized search plots between July 2001 and December 2002, we estimate 1.686[13] bird fatalities per turbine per year (1.321, 2.122) for the Stateline Wind Project.

Raptors

Six raptor casualties were discovered on standardized search plots between July 2001 and December 2002. We estimate 0.053 raptor fatalities per turbine per year (0.016, 0.100) for the Stateline Wind Project. All of the raptor fatalities that were observed on standardized search plots were observed in Washington. Four of the fatalities were observed near HGA (3 red-tailed hawks, 1 Swainson's hawk). An additional 3 raptor fatalities that were not located on standardized search plots were reported incidentally. One of the three incidental raptor fatalities was located 103 m away from the nearest turbine below a fence.

Grassland Birds

Seventy-one grassland bird casualties[14] were observed on the standardized search plots between July 2001 and December 2002. We estimate 1.246 grassland bird fatalities per turbine per year (0.932, 1.624) for the Stateline Wind Project. Horned larks are estimated to comprise at least 65% of this mortality, and western meadowlarks are estimated to comprise 8%. No other single species is estimated to comprise more than 6% of the grassland bird fatalities.

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[12] upper and lower limits of 90% confidence intervals (bootstrapping)

[13] two European starlings, which are not protected under the Migratory Bird Treaty Act, were included in the estimate. By excluding these, our estimate would be approximately 1.65 bird fatalities per turbine per year.

[14] Includes all grassland nesting birds, as well as casualties identified as "unidentified bird", "unidentified passerine", "unidentified sparrow"

Bats

Fifty-four bat fatalities were observed on search plots between July 2001 and December 2002. Adjustments for observer detection bias and removal bias for bats were made using the estimates for small birds. The estimated average probability a small bird casualty remains until a scheduled search and is found is 0.353. We estimate 0.945 bat fatalities per turbine per year (0.646, 1.312) for the Stateline Wind Project.

Comparisons of Factors Affecting Mortality

Figures 2-3 show differences in observed fatality rates for levels of the two factors that were investigated:

1) Juxtaposition within a string (end row/discontinuous versus mid row turbines)
2) Lighting (lit versus unlit turbines).

Due to the small number of fatalities, we do not discuss results for raptors. In general, observed fatality rates for end row turbines were lower than mid-row turbines, and the differences were statistically significant for all birds ($p<0.10$). Observed fatality rates at lit turbines were larger than at unlit turbines for all birds, small birds, grassland birds and bats, although none of the differences were statistically significant ($p>0.10$).

Avian Use and Diversity Surveys

A standard 10-minute point count survey was conducted in conjunction with each carcass search. Approximately 740 counts have been conducted between August 2001 and December 2002. Results of the surveys conducted between August 2001 and December 2002 are reported in Tables 18-23. These data provide information on the species composition and levels of use of the project site. Thirty-five species were identified during the point counts at the Stateline Project Site (Table 18, August 2001 – December 2002). The mean number of species observed per survey (10-minute point count) was 0.875.

Avian Use by Species

A total of 2,262 individual bird detections within 1,087 separate groups were recorded from August 2001 through December 2002 (Table 20) during the point count surveys. Almost 76% of the observations were of horned larks, western meadowlarks, and Canada geese. All other species comprised less than 5% of the observations.

Mean use estimates (number of birds/10-minute survey) were calculated (using detections within 800 m of each point) by species and season, and grouped by bird size due to differences in the detectability of small and large birds (Table 21). Common raven (0.083), red-tailed hawk (0.068), chukar (0.039), ring-necked pheasant (0.034), northern harrier (0.029) and Swainson's hawk (0.024) were the large bird species with the highest summer use. The small bird species with the highest summer use were horned lark (1.959), western meadowlark (0.454), western kingbird (0.020), grasshopper sparrow (0.015) and unidentified bluebird (0.015).

During the fall, the large birds with the highest use (Table 21) were common raven (0.087), gray partridge (0.030), red-tailed hawk (0.022), Swainson's hawk (0.020) and northern harrier (0.019). The small bird species with the highest fall use were horned lark (1.632), western meadowlark (0.105) and American goldfinch (0.030).

During the winter, the five large birds with the highest use (Table 21) were Canada goose (0.317), gray partridge (0.088), common raven (0.048), chukar (0.041) and red-tailed hawk (0.038). The small bird species with the highest winter use were horned lark (1.124), western meadowlark (0.164), European starling (0.012) and winter wren (0.008).

During the spring, the large birds with the highest use (Table 21) were common raven (0.092), red-tailed hawk (0.086), ring-billed gull (0.037), rough-legged hawk (0.025), ring-necked pheasant (0.019) and northern harrier (0.019). The small bird species with the highest spring use were horned lark (1.086), western meadowlark (0.565), European starling (0.079) and violet-green swallow (0.073).

Frequency of Occurrence by Species

Table 22 contains the estimated frequency of occurrence by species and season (August 2001 – December 2002). This parameter measures how often a species is observed during 10-minute point count surveys (% of surveys). During the summer, common raven (7.8%), red-tailed hawk (4.9%), ring-necked pheasant (2.4%), northern harrier (2.4%) and Swainson's hawk (2.0%) were observed during more than one percent of the surveys. Small bird species observed during more than one percent of the surveys were horned lark (47.2%), western meadowlark (24.4%) and western kingbird (1.5%).

During the fall, the large birds observed during more than one percent of the surveys were common raven (5.7%), Swainson's hawk (2.0%), northern harrier (1.9%) and red-tailed hawk (1.4%). The only small bird species observed during more than one percent of the surveys were horned lark (45.5%) and western meadowlark (9.6%).

During the winter, rough-legged hawk (3.6%), common raven (3.6%), red-tailed hawk (3.4%) and northern harrier (2.9%) were observed during more than two percent of the surveys. The only small bird species observed during more than one percent of the surveys were horned lark (42.8%) and western meadowlark (9.9%).

During the spring, common raven had the highest frequency of occurrence (8.6%) for large birds, followed by red-tailed hawk (8.0%), rough-legged hawk (2.5%), ring-necked pheasant (1.9%), northern harrier (1.9%) and golden eagle (1.8%). Small bird species observed during more than one percent of the surveys were horned lark (53.1%), western meadowlark (42.1%) and savannah sparrow (1.3%).

Avian Use by Seasons and Groups

Mean use data by season and avian group are presented in Table 23 (August 2001 through December 2002). Higher overall avian use occurred in the summer (2.79) and spring (2.21) compared to the fall (1.99) and winter (1.94).

Passerines - Passerines were the most abundant avian group observed during all seasons. Passerines showed higher abundance in the summer (2.50) compared to spring (1.86), fall (1.79) and winter (1.33). Passerines made up over 84.0% of the avian use in all of the seasons except in the winter, when use was 68.3%. They were observed between 47.8% (winter) and 72.3% (spring) of the surveys for all of the seasons.

Raptors - Raptor use was second highest to passerines in the spring (0.19) and summer (0.13), third to passerines and corvids in the fall (0.07) and fourth to passerines, waterfowl and gamebirds in the winter (0.11). Raptor use was similar for all seasons with the most abundant species being red-tailed hawk in all seasons except in the fall when the Swainson's hawk was the most abundant. In all seasons, raptors made up less than nine percent of the avian use, and were observed between 6.1% (fall) and 16.7% (spring) of the surveys for the seasons. A large kettle of Swainson's hawks was observed in the fall outside the 800 m viewshed near turbine string HGB. It should also be noted that several large groups of red-tailed hawks and Swainson's hawks were observed incidentally in early September to the north of the project near HGA.

Waterfowl/waterbird - The majority of waterfowl/waterbird use occurred in the winter, and consisted primarily of several groups of Canada geese. A large group of American white pelicans (40) were observed during the summer and in the spring a large group of unidentified gulls (30) were observed but were outside the 800 meter viewing shed, and therefore not included in the use estimates.

Corvids – Corvid use was second highest to passerines in the fall (0.09) and third to passerines and raptors in the spring (0.10) and summer (0.09). The most abundant species for all seasons was the common raven.

Burrowing Owl Surveys

Two new burrowing owl sites were discovered during the 2002 burrowing owl surveys. Both are located in Washington. One is approximately 350 feet to HGC-14 and the other is approximately 750 feet to HGH-9.

Six historic burrowing owl nest sites were checked for activity, three in Washington and three in Oregon. One site in Washington supported two breeding pairs so it is identified as two historic sites.

One historic nest site in Washington was active again in 2002. The active site had a complex of three burrows located approximately 365 feet from turbine HGF-1. It was not possible to determine if there were one or two breeding pairs. Ten birds were seen on June 16 in 2002, and most were juveniles. The other historic nest sites located in Washington are located approximately 1,600 feet east of turbine string PB along a closed farm road. Previous years' observations indicate that the site likely supported two breeding pairs in 2001 within close proximity to each other. No burrowing owls were found there in 2002 but a new site with three burrows was found south of this historic area. Two adults were observed during the June 19, 2002 survey; none were observed July 1, 2002.

In Oregon, three historic nest sites were checked. One of the three sites was active. A new active site was discovered in 2002 during pre-construction surveys conducted for Stateline expansion. The site was very near (1,300 feet) one of the two inactive historic sites. The other inactive historic nest site in Oregon has not been active since 1999.

Short-eared Owl Surveys

Driving surveys to document short-eared owls were conducted on April 11 and April 17, 2002. Surveys were conducted at speeds between 5 and 10 mph. on project roads. Public roads traveled near the project roads were driven a normal driving speed for the road but the surveyor looked for owls while driving. Approximately 21 miles of project roads were surveyed in 6.5 hours; most roads were traveled twice during the survey (ingress and egress). No owls were detected during these surveys. A project site security guard said he observed short-eared owls flying from areas near turbine strings HGE and HGF over Hatch Grade Road west to turbine string HGG.

Raptor Nest Surveys

Burrowing owl nesting activity is described above. The first aerial survey of the Stateline project area for other raptors, encompassing both Oregon and Washington turbines and a 5-mile buffer, was conducted in early May 2002, and the 2nd survey was conducted in June 2002. No eagle or falcon nests were observed during the 2002 aerial survey. Follow-up ground-based monitoring was conducted for ferruginous hawk and Swainson's hawk nests within two miles of the turbines. Tables 24 and 25 provide summary results for the 2001 and 2002 surveys. A very similar number of active buteo nests were observed in 2001 compared to 2002 within 5-miles (30 versus 32) and within 2-miles (11 versus 12) of the existing Stateline turbines (Table 24).

Two of the three ferruginous hawk nests that were within 2 miles of Stateline 1 turbines and that were active in 2001 successfully fledged young in 2002 (Table 25). The other nest, which was approximately ¼ mile from an Oregon turbine, was apparently abandoned in June, 2002. One ferruginous hawk nest site, which was not active in 2001, was active in 2002 and successfully fledged 2 young. This site was approximate 3 miles from the nearest Stateline 1 turbine, and within 1.75 miles of Stateline 2 turbines built in Oregon during the fall of 2002. A new active ferruginous hawk nest site[15] was documented in 2002 within 0.75 mile of the existing Vansycle B turbine strings and the breeding pair successfully fledged 3 young. Two Swainson's hawk nests (both in Oregon) located within 2 miles of Stateline 1 turbines were monitored from the ground. Both were active but not successful in 2001. In 2002 one of these was not active; the other was active but did not produce young.

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[15] this nest is not listed in Table 25 because it is more than 2 miles from Stateline 1 and 2 turbines

Established Grassland Monitoring Transect Surveys

Twenty transects were monitored both pre-construction (2001) and after the start of commercial operation (2002) in Oregon to estimate displacement impacts, if any, to grassland nesting songbirds. Several additional transects were monitored before construction, but turbines were either not built, or habitat was impacted, so transect monitoring did not continue and therefore, these data are not included. Table 26 contains the mean number of observations recorded during the pre-operation and during the first year of operation for four species (grasshopper sparrow, horned lark, western meadowlark, and savannah sparrow) with adequate information for statistical analysis for each species and for all grassland passerines combined. Grassland species combined had very similar overall use estimates in the pre and post-construction periods (0.578/survey to 0.583/survey). Two species had estimated increases in use during the post-construction period (horned lark and savannah sparrow) while two species showed decreases (grasshopper sparrow and western meadowlark). Only grasshopper sparrow had a statistically significant change[16] ($p<0.10$), with a decrease in use of approximately 40% (0.139/5000 m^2 to 0.085/5000 m^2) in 2002. We believe most of this effect is due to the permanent loss of habitat from roads and turbine pads and the temporary loss of habitat along the road shoulder, and from underground trenching and other activities.

Transects were located in areas where construction impacts were expected to be as minimal as possible, yet typical for a wind project. However, we estimated that approximately 25 m of the first 50 m of the transect (50% of the first sub-segment) is currently disturbed either permanently (road and turbine pad) or temporarily by the road shoulder, underground trenching between turbines, or other activities. Based on preliminary data, grassland passerines as a group showed a statistically significant decline ($p<0.10$) in use in the first 50 m sub-segment (Table 27, Figure 4); 0.717/survey versus 0.300/survey. Most of the difference is likely due to the temporary and permanently disturbed habitat near the turbines. Although temporarily disturbed areas were reseeded, this revegetation is not likely to produce similar habitat to pre-construction conditions for several years.

Estimates of grassland songbird use were similar before and after construction in the other segments, with a relatively large but not quite statistically significant increase in the 5th and 6th sub-segments (area greater than 200 m from turbines). Grasshopper sparrows and western meadowlarks showed a significant decrease in use within the first 50 m of the turbines (Table 27, Figures 4 and 5). Grasshopper sparrow densities were low in the 2nd sub-segment pre-construction (0.083/survey) but since no grasshopper sparrows were observed during the operational surveys in the 2nd sub-segment, the effect was considered statistically significant.

These preliminary results suggest a relatively small-scale impact of the wind facility on grassland breeding passerines, with a large portion of the impact due to the direct loss of habitat from turbine pads and roads and temporary disturbance of habitat between turbines and road shoulders. The level of displacement to grassland birds from the development of the Stateline wind facility and its associated operations will be further elucidated after future surveys are conducted.

[16] two-tailed test on the difference between pre- and post-construction use.

SUMMARY/DISCUSSION

This report summarizes results of over one year of monitoring on the Stateline Wind Project. These results come from the first complete year of a minimum two-year monitoring study, and are therefore considered preliminary. Additional confidence in estimates and patterns in the data will be gained after the 2003 monitoring year.

All bird casualties observed within the search plots were included in the fatality estimates, unless cause of death could be determined, and this cause was not related to the wind facility. True cause of death is unknown for most of the fatalities. Several of the horned lark fatalities are suspected to be vehicle kills and not wind turbine kills, given the locations of the finds (e.g., juveniles near or along the road). An unknown number of the fatalities are likely caused by other factors not related to the wind facility (e.g., kills by raptors and long-tailed weasels). We expect that to be the case for some of the upland gamebirds.

Carcass removal rates at the Stateline Wind Project were low relative to most other wind projects, including Buffalo Ridge, Minnesota (Johnson *et al.* 2002) and Foote Creek Rim, Wyoming (Young *et al.* 2003). The rates were also relatively similar to the estimates obtained from the study of the Vansycle Wind Project (Erickson *et al.* 2000). Observer detection rates for the Stateline Facility were comparable to rates observed at the Vansycle Wind Project (Erickson *et al.* 2000). Observer detection rates may be reduced in the next few years, due to the increased vegetation cover in temporarily disturbed areas of the project.

There is likely some background[17] mortality that is included in the fatality rate estimates. To the best of our knowledge, reference or background mortality has been estimated only once during baseline studies of new wind projects. During a four-year study at Buffalo Ridge (MN), 2,482 fatality searches were conducted on study plots without turbines to estimate reference mortality in the study area, and 31 avian fatalities comprised of 15 species were found (Johnson *et al.* 2002). Reference mortality consisted of eight upland gamebirds, seven doves, five sparrows, three waterfowl, three raptors, two blackbirds, one waterbird, one shorebird, and one unidentified bird. The exact cause of death of many birds found in reference plots could not be determined; however, most birds appeared to have been killed by predators or vehicles. Reference mortality was estimated to average 1.1 per plot per year, compared to 0.98, 2.27 and 4.45 fatalities per turbine search plot per year in the Phase 1, 2 and 3 wind plants, respectively (Johnson *et al.* 2002). These numbers indicate that estimates of turbine mortality likely include some fatalities not related to turbine collision, and therefore the estimates should be considered conservative (over-estimates) of true avian collision mortality at wind plants.

The overall bird mortality estimate of 1.686 fatalities per turbine per year for the Stateline Wind Project is near the average estimate reported for other wind projects (1.825, Erickson *et al.* 2001). Nearly half of the mortality is comprised of horned larks, a very common yearlong resident songbird, and over half of the bird observations from point counts were horned larks. No other individual species comprised more than 5% of the fatalities. Two European starlings, which are not protected under the Migratory Bird Treaty Act (MBTA), were included in the

[17] fatalaties that were caused by factors unrelated to the Stateline Wind Project (e.g., predator kills, farm equipment collisions)

fatality estimate. By excluding these, the fatality estimate for the Stateline Wind Project would be approximately 1.66 fatalities per turbine per year.

The six raptor fatalities[18] observed on the standardized search plots equated to an overall estimate of 0.05 raptor fatalities per turbine per year for the project. Three additional raptor fatalities were found outside standardized search plots. All nine raptor fatalities were observed in Washington. Four of the six raptor fatalities found on standardized search plots were observed near string HG-A. It is unclear whether the perceived higher mortality at HGA is due to factors related to that location or random chance. The fire that burned Hatch Grade Canyon and adjacent slopes may have increased prey availability (e.g., pocket gophers and deer mice) and increased raptor use. There were also some relatively large groups of raptors observed in the project area in early September, 2002. For example, on September 6, 2002, a large kettle of Swainson's hawks (approximately 25) was observed near string HGB soaring on thermals. On September 3, a group of seven red-tailed hawks and a group of seven Swainson's hawks were observed hunting agriculture fields near HGA in conjunction with active field cultivation. This possible pattern of higher raptor mortality to the north of the Stateline facility (near HGA and in Washington in general) will be better understood after the second year of monitoring.

We compared observed fatality rates among levels of two primary factors, juxtaposition of turbines within a turbine string and lighting of turbines. These were not experiments, so cause of significant differences cannot be inferred from this observation data. These results are considered preliminary, and should be strengthened with the additional data collection in 2003.

There appeared to be a pattern of higher observed fatality rates for mid row turbines compared to end row turbines and the differences were statistically significant for the "all bird" group ($p<0.10$). One earlier study of raptor mortality suggested higher mortality rates for end row turbines (Orloff and Flannery 1992 and 1996), but other more recent studies have suggested higher mortality rates at mid-row turbines (Thelander and Rugge 2000, Anderson *et al.* 2000).

Tall structures that are lighted are suspected of attracting nocturnal migrating birds, especially during inclement weather (Kerlinger 2000). We investigated whether the annual observed fatality rates tended to differ for lit turbines compared to unlit turbines. Observed fatality rates at lit turbines were higher than at unlit turbines for the "all bird" group, small birds, grassland birds and bats, although none of the differences were statistically significant ($p>0.10$).

Two of the three ferruginous hawk nests that were within 2 miles of Stateline 1 turbines and were active in 2001 successfully fledged young in 2002. The other nest, which was approximately ¼ mile from a turbine, was apparently abandoned in June, 2002. A new active ferruginous hawk nest was documented in 2002 within ½ mile of the Vansycle B turbine strings, and 3 young were successfully fledged. One of two Swainson's hawk nests that are within 2 miles of Stateline 1 turbines was active in 2002, however, neither of these nests were successful in 2001 or 2002. The preliminary results from Stateline currently corroborate results from other studies (Erickson *et al.* 2002) that have suggested no large-scale displacement impacts to nesting

[18] five were found during standardized searches, and one was found on a standardized search plot but not during a scheduled search (reported incidentally)

raptors. Additional data on nesting occupancy and success collected in 2003 will allow for better assessment of the potential impacts to nesting raptors.

Preliminary results suggest a relatively small-scale impact of the wind facility on grassland nesting passerines, with a large portion of the impact due to the direct loss of habitat from turbine pads and roads and temporary disturbance of habitat between turbines and road shoulders. Small-scale displacement impacts to grassland nesting birds have been documented in two other studies (Leddy *et al.* 1999, Johnson *et al.* 2000). The level of displacement to grassland birds from the development of the Stateline wind facility and its associated operations will be further elucidated after future surveys are conducted. However, although temporarily disturbed areas were reseeded, this revegetation is not likely to produce similar habitat to pre-construction conditions for several years.

Bat fatality estimates at Stateline (0.946 bat fatalities/turbine/year) were slightly higher than estimates from Vansycle (0.74 bat fatalities/turbine/year), although the estimates are lower than other large new wind projects (Johnson *et al.* 2003). No bat casualties were found between January 1 and June 30, 2002 in Oregon or Washington during standardized searches. Late summer and fall casualties probably reflect seasonal migration, documented for the life histories of both hoary and silver-haired bats, the two species that comprised 92.6% of the fatalities.

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[19] indicates this person is a primary voting member of the Stateline Technical Advisory Committee

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Table 1. List of Washington turbines sampled during the standardized searches from July 2001 through December 31, 2002.

Count	Turbine ID	Dominant Habitat[a]	Turbine Position[b]	FAA Light	Carcass Plot ID	Count	Turbine ID	Dominant Habitat[a]	Turbine Position[b]	FAA Light	Carcass Plot ID
1	HGA7	AD	M	0	HGA 7-9	31	PB15	GR	D	1	PB 15-17
2	HGA8	AD	M	0	HGA 7-9	32	PB16	GR	M	1	PB 15-17
3	HGA9	AD	M	0	HGA 7-9	33	PB17	GR	M	0	PB 15-17
4	HGB1	GR	E	1	HGB 1-3	34	PB28	GR	M	0	PB 28-30
5	HGB2	GR	M	0	HGB 1-3	35	PB29	GR	M	0	PB 28-30
6	HGB3	GR	M	0	HGB 1-3	36	PB30	GR	M	1	PB 28-30
7	HGB12	GR	M	0	HGB 12-14	37	PB39	GR	M	0	PB 39-41
8	HGB13	GR	M	0	HGB 12-14	38	PB40	GR	M	0	PB 39-41
9	HGB14	GR	E	1	HGB 12-14	39	PB41	GR	M	0	PB 39-41
10	HGA20	AD	M	0	HGA 20-22	40	PB51	GR	M	0	PB 51-53
11	HGA21	AD	M	0	HGA 20-22	41	PB52	GR	M	0	PB 51-53
12	HGA22	AD	M	0	HGA 20-22	42	PB53	GR	M	1	PB 51-53
13	HGC11	GR	M	0	HGC 11-14	43	PB74	GR	M	0	PB 74-77
14	HGC12	GR	M	0	HGC 11-14	44	PB75	GR	M	0	PB 74-77
15	HGC13	GR	M	0	HGC 11-14	45	PB76	GR	M	0	PB 74-77
16	HGC14	GR	E	1	HGC 11-14	46	WSA19	GR	M	0	WSA 19-21
17	HGC24	GR	M	0	HGC 24-26	47	WSA20	GR	M	0	WSA 19-21
18	HGC25	GR	M	1	HGC 24-26	48	WSA21	GR	M	0	WSA 19-21
19	HGC26	GR	M	0	HGC 24-26	49	WSA43	GR	M	0	WSA 43-45
20	HGD4	GR	M	0	HGD 4-6	50	WSA44	GR	M	0	WSA 43-45
21	HGD5	GR	M	0	HGD 4-6	51	WSA45	GR	M	1	WSA 43-45
22	HGD6	GR	E	1	HGD 4-6	52	WSB4	GR	E	1	WSB 4-6
23	HGG1	GR	E	1	HGG 1-3	53	WSB5	GR	M	0	WSB 4-6
24	HGG2	AD	M	0	HGG 1-3	54	WSB6	GR	M	0	WSB 4-6
25	HGG3	AD	E	1	HGG 1-3	55	WSB16	GR	M	0	WSB 16-18
26	HGH16	SS	E	1	HGH 16-18	56	WSB17	GR	M	0	WSB 16-18
27	HGH17	SS	M	0	HGH 16-18	57	WSB18	GR	M	0	WSB 16-18
28	HGH18	SS	M	0	HGH 16-18	58	WSB29	GR	M	1	WSB 29-31
29	PB4	GR	D	0	PB 4-5	59	WSB30	GR	M	0	WSB 29-31
30	PB5	GR	M	1	PB 4-5	60	WSB31	GR	M	0	WSB 29-31

[a] AD=agriculture dry, GR=grassland (crested wheatgrass or native bunchgrass), SS=Shrub/steppe
[b] Turbine position: E=end-row, D=discontinuous/saddle, M=mid-row

Table 2. List of Oregon turbines sampled during the standardized searches from January 1, 2002 through December 31, 2002.

Count	Turbine ID	Dominant Habitat[a]	Turbine Position[b]	FAA Light	Carcass Plot ID	Count	Turbine ID	Dominant Habitat[a]	Turbine Position[b]	FAA Light	Carcass Plot ID
1	BGB16	GR	E	1	BGB 16-18	33	HGK10	AD	D	0	HGK 7-10
2	BGB17	GR	M	0	BGB 16-18	34	HGL1	AD	E	1	HGL 1-2
3	BGB18	GR	M	0	BGB 16-18	35	HGL2	GR/AD	D	0	HGL 1-2
4	BGB22	GR	M	0	BGB 22-23	36	HGM1	SS	E	1	HGM 1-4
5	BGB23	GR	E	1	BGB 22-23	37	HGM2	GR	M	0	HGM 1-4
6	BGC16	GR	M	1	BGC 16-19	38	HGM3	GR	M	0	HGM 1-4
7	BGC17	GR	M	0	BGC 16-19	39	HGM4	GR	M	0	HGM 1-4
8	BGC18	GR	M	0	BGC 16-19	40	HGM8	GR	M	0	HGM 8-9
9	BGC19	GR	E	1	BGC 16-19	41	HGM9	GR	D	0	HGM 8-9
10	HGJ6	AD	M	1	HGJ 6-8	42	HGM15	GR	M	0	HGM 15-18
11	HGJ7	AD	M	0	HGJ 6-8	43	HGM16	GR	M	0	HGM 15-18
12	HGJ8	AD	D	0	HGJ 6-8	44	HGM17	GR	M	0	HGM 15-18
13	HGJ13	AD	M	0	HGJ 13-15	45	HGM18	GR	E	1	HGM 15-18
14	HGJ14	AD	M	0	HGJ 13-15	46	HGN8	GR	M	0	HGN 8-9
15	HGJ15	AD	M	0	HGJ 13-15	47	HGN9	GR	E	1	HGN 8-9
16	HGJ19	AD	M	0	HGJ 19-21	48	PB77	GR	E	1	PB 74-77
17	HGJ20	AD	M	0	HGJ 19-21	49	PB81	GR	M	0	PB 81-83
18	HGJ21	AD	M	1	HGJ 19-21	50	PB82	GR	M	1	PB 81-83
19	HGJ27	GR/AD	D	0	HGJ 27-29	51	PB83	GR	M	0	PB 81-83
20	HGJ28	GR/AD	M	1	HGJ 27-29	52	PB87	GR	E	1	PB 87-90
21	HGJ29	GR/AD	M	0	HGJ 27-29	53	PB88	GR	M	0	PB 87-90
22	HGJ33	GR/AD	M	1	HGJ 33-35	54	PB89	GR	M	0	PB 87-90
23	HGJ34	GR/AD	M	0	HGJ 33-35	55	PB90	GR	E	1	PB 87-90
24	HGJ35	GR/AD	M	0	HGJ 33-35	56	PB95	GR	D	1	PB 95-97
25	HGJ40	GR/AD	M	0	HGJ 40-42	57	PB96	GR	D	0	PB 95-97
26	HGJ41	GR/AD	M	0	HGJ 40-42	58	PB97	GR	E	1	PB 95-97
27	HGJ42	GR/AD	D	0	HGJ 40-42	59	WSB45	GR	M	0	WSB 45-47
28	HGK2	AD	E	1	HGK 2-3	60	WSB46	GR	M	1	WSB 45-47
29	HGK3	AD	E	1	HGK 2-3	61	WSB47	GR	M	0	WSB 45-47
30	HGK7	AD	M	0	HGK 7-10	62	WSB52	GR	D	1	WSB 52-54
31	HGK8	AD	M	0	HGK 7-10	63	WSB53	GR	M	0	WSB 52-54
32	HGK9	AD	M	1	HGK 7-10	64	WSB54	GR	M	0	WSB 52-54

[a] AD=agriculture dry, GR=grassland (crested wheatgrass or native bunchgrass), SS=Shrub/steppe
[b] Turbine position: E=end-row, D=discontinuous/saddle, M=mid-row

Table 3. List of standardized search plots surveyed and effort from July through December 31, 2001 in Washington.

Plot ID	# Turbines Completely Searched[a]	Effective # Turbines Searched[b]	# Plot Searches	Effective # Turbine Searches
HGA 7-9	3	4	1	4
HGA 20-22	3	3.5	2	7
HGB 1-3	3	3.5	2	7
HGB 12-14	3	3.5	2	7
HGC 11-14	4	4.5	8	36
HGC 24-26	3	4	8	32
HGD 4-6	3	3.5	8	28
HGG 1-3	3	3	2	6
HGH 16-18	3	3.5	2	7
PB 4-5	2	3	2	6
PB 15-17	3	3.5	5	17.5
PB 51-53	3	4	7	13
PB 28-30	3	4	7	28
PB 39-41	3	4	7	28
PB 74-77 (74-76)	3	3.5	1	3.5
WSA 19-21	3	3.5	5	17.5
WSA 43-45	3	3.5	5	17.5
WSB 4-6	3	3.5	2	7
WSB 16-18	3	4	2	8
WSB 29-31	3	4	3	12
Total	60	73.5	81	292

[a] # turbines that are searched at least out to 63 m in all directions

[b] effective # of turbines searched. Most adjacent turbines within a string are slightly over 70 m apart, and the boundary of the standardized search plot was typically extended to this adjacent turbine.

Table 4. List of standardized search plots surveyed and effort from January 1 through December 2002 by state.

Plot ID	# Turbines Completely Searched	Effective # Turbines Searched	# Plot Searches	Effective # Turbine Searches
Oregon				
BGB 16-18	3	3.5	16	56
BGB 22-23	2	2.5	16	40
BGC 16-19	4	4.5	16	72
HGJ 6-8	3	3.5	16	56
HGJ 13-15	3	4	16	64
HGJ 19-21a	3	3	15	45
HGJ 27-29a	3	3.5	15	52.5
HGJ 33-35	3	4	16	64
HGJ 40-42	3	3.5	16	56
HGK 2-3	2	2	16	32
HGK 7-10	4	4.5	16	72
HGL 1-2	2	2	16	32
HGM 1-4	4	4	16	64
HGM 8-9	2	2.5	16	40
HGM 15-18	4	4.5	16	72
HGN 8-9	2	2.5	16	40
PB 74-77 (77)	1	1	16	16
PB 81-83	3	4	16	64
PB 87-90	4	4	16	64
PB 95-97	3	3	16	48
WSB 45-47	3	3.5	16	56
WSB 52-54	3	3.5	16	56
Oregon total	64	73	350	1161.5
Washington				
HGA 7-9	3	4	16	64
HGA 20-22	3	3.5	16	56
HGB 1-3	3	3.5	16	56
HGB 12-14	3	3.5	16	56
HGC 11-14	4	4.5	16	72
HGC 24-26	3	4	16	64
HGD 4-6	3	3.5	16	56
HGG 1-3	3	3	16	48
HGH 16-18	3	3.5	16	56
PB 4-5	2	3	16	48
PB 15-17	3	3.5	16	56
PB 28-30	3	4	16	64
PB 39-41	3	4	16	64
PB 51-53	3	4	16	64
PB 74-77 (74-76)	3	3.5	16	56
WSA 19-21	3	3.5	16	56
WSA 43-45	3	3.5	16	56
WSB 4-6	3	3.5	16	56
WSB 16-18	3	4	16	64
WSB 29-31	3	4	16	64
Washington total	60	73.5	320	1176
Total	124	146.5	670	2337.5

[a] one survey period was missed due to construction and maintenance activities in the area

Table 5. List of Oregon and Washington turbines sampled during the WRRS protocol searches from January 1 through December 31, 2002.

OREGON WRRS Search Plots				WASHINGTON WRRS Search Plots			
Count	Turbine ID	Dominant Habitat[a]	Turbine Position[b]	Count	Turbine ID	Dominant Habitat	Turbine Position
1	BGB20	GR	M	1	HGB5	GR	M
2	HGJ11	AD	M	2	HGB10	GR	M
3	HGJ24	GR/AD	M	3	HGC4	GR	M
4	HGJ37	GR/AD	M	4	HGC9	GR	M
5	HGK5	AD	M	5	HGC18	GR	M
6	HGK12	AD	M	6	HGD1	GR	E
7	HGL4	GR	M	7	HGE3	GR	M
8	HGM6	GR	M	8	HGE8	GR	E
9	HGM12	GR	M	9	HGG10	AD	M
10	HGN6	GR	M	10	HGH8	SS	M
11	PB79	GR	M	11	HGH13	AD	M
12	PB92	GR	M	12	HGH21	GR	E
13	WSB49	GR	M	13	PB7	GR	M
				14	PB12	GR	M
				15	PB20	GR	M
				16	PB25	GR	D
				17	PB33	GR	D
				18	PB37	GR	M
				19	PB55	GR	M
				20	PB60	GR	D
				21	PB67	GR	D
				22	PB72	GR	M
				23	WSA13	GR	E
				24	WSA17	GR	M
				25	WSA25	GR	M
				26	WSA35	GR	M
				27	WSA40	GR	M
				28	WSB9	GR	M
				29	WSB14	GR	M
				30	WSB22	GR	M
				31	WSB27	GR	M
				32	WSB35	GR	M
				33	HGA1	AD	E
				34	HGA14	AD	M

[a] AD=agriculture dry, GR=grassland, SS=Shrub/steppe (draft, and will be updated)
[b] Turbine position: E=end-row, D=discontinuous/saddle, M=mid-row

Table 6. List of avian fatalities observed on standardized search plots in Oregon from January 1 through December 31, 2002.

Date	Species	Nearest Turbine	Distance to Nearest Turbine(m)	FAA Lit
01/22/2002	western meadowlark	HGM2	58	N
02/18/2002	horned lark	PB87	51	Y
02/21/2002	ring-necked pheasant	HGJ35	68	N
03/19/2002	horned lark	HGN8	14	N
04/07/2002	black-billed magpie	BGC19	42	Y
04/16/2002	horned lark	PB81	29	N
04/17/2002	horned lark	WSB52	42	Y
04/18/2002	horned lark	BGB17	69	N
04/19/2002	horned lark[a]	HGN9	24	Y
04/27/2002	horned lark	HGN8	40	N
05/03/2002	golden-crowned kinglet	PB97	55	Y
05/13/2002	horned lark	HGL1	20	Y
05/13/2002	horned lark	HGM18	20	Y
05/13/2002	horned lark	HGM18	45	Y
05/18/2002	yellow-rumped warbler	WSB45	46	N
05/19/2002	unidentified bird	HGJ40	46	N
05/21/2002	horned lark	HGM2	26	N
06/17/2002	ring-necked pheasant	HGJ18	18	N
06/17/2002	horned lark	HGJ8	11	N
06/19/2002	ring-necked pheasant	HGM9	45	N
07/21/2002	horned lark	HGM17	17	N
08/16/2002	ring-necked pheasant	HGL2	50	N
08/19/2002	grasshopper sparrow	BGC18	25	N
08/19/2002	house wren	HGM8	20	N
08/19/2002	chukar	HGM9	43	N
08/20/2002	horned lark	WSB45	44	N
09/01/2002	horned lark	HGJ21	35	Y
09/03/2002	horned lark	BGB16	88	Y
09/04/2002	mallard	HGN9	27	Y
09/15/2002	golden-crowned sparrow	WSB47	42	N
09/18/2002	white-crowned sparrow	HGJ12	60	Y
09/19/2002	unidentified sparrow	BGB16	39	Y
09/19/2002	white-crowned sparrow	HGK9	39	Y
10/02/2002	horned lark	WSB46	53	Y
10/02/2002	horned lark	WSB48	25	N
10/03/2002	golden-crowned kinglet	BGB19	66	N
10/03/2002	horned lark	BGC17	22	N
10/05/2002	ruby-crowned kinglet	HGJ21	34	Y
10/16/2002	horned lark	HGJ7	40	N
10/18/2002	gray partridge	HGL2	48	N
10/19/2002	Macgillivray's warbler	WSB53	59	N
10/21/2002	winter wren	BGB23	51	Y
10/21/2002	chukar	HGM14	6	N
11/04/2002	horned lark	PB95	10	Y
11/06/2002	European starling	BGB23	18	Y

[a] found on a standardized search plot but not during scheduled search

Table 7. List of avian fatalities observed standardized search plots in Washington from July 2001 through December 31, 2002.

Date	Species	Nearest Turbine	Distance to Nearest Turbine(m)	FAA LIT
08/21/2001	horned lark	PB30	39	Y
10/01/2001	white-crowned sparrow	HGC24	56	N
10/03/2001	horned lark	PB50	25	N
10/14/2001	golden-crowned kinglet	HGC23	37	N
10/15/2001	dark-eyed junco	PB39	43	N
11/14/2001	unidentified passerine	HGB13	29	N
11/14/2001	western meadowlark	PB39	66	N
11/14/2001	horned lark	WSA22	17	Y
12/11/2001	unidentified passerine	PB16	53	Y
12/12/2001	golden-crowned kinglet	WSA44	30	N
01/14/2002	gray partridge	PB15	69	Y
02/18/2002	western meadowlark	HGD6	62	Y
02/18/2002	horned lark[a]	PB39	33	N
02/21/2002	horned lark	HGB13	23	N
02/21/2002	horned lark	HGB4	25	N
03/13/2002	unidentified passerine	HGG3	20	Y
03/22/2002	horned lark	HGB11	26	N
04/01/2002	European starling	HGA7	66	N
04/01/2002	horned lark	HGC14	32	Y
04/01/2002	western meadowlark	HGC14	66	Y
04/01/2002	horned lark	HGD4	38	N
04/02/2002	horned lark	PB29	15	N
04/17/2002	gray partridge	WSA43	39	N
04/20/2002	winter wren	HGD5	28	N
05/01/2002	white-crowned sparrow	PB17	64	N
05/01/2002	horned lark	PB28	32	N
05/01/2002	house wren	PB29	41	N
05/01/2002	horned lark	PB30	18	Y
05/02/2002	horned lark	HGC24	59	N
05/02/2002	horned lark	PB41	47	N
05/03/2002	horned lark	HGH16	17	Y
05/05/2002	horned lark	WSA19	35	N
05/07/2002	horned lark	WSB31	32	N
06/06/2002	red-tailed hawk[a]	HGH17	10	N
06/15/2002	horned lark	HGA22	6	N
06/17/2002	yellow-rumped warbler	HGH16	67	Y
06/17/2002	horned lark	HGH18	38	N
06/20/2002	horned lark	WSA21	24	N
07/16/2002	horned lark	PB76	58	N
07/18/2002	horned lark	WSB16	18	N
08/12/2002	Swainson's hawk	HGA9	27	N
08/13/2002	great blue heron	HGC25	57	Y
08/13/2002	horned lark[a]	WSA21	10	N
08/19/2002	gray partridge	HGB12	33	N

[a] found on a standardized search plot but not during scheduled search

Table 7(continued). List of avian fatalities observed on standardized search plots in Washington from July 2001 through December 31, 2002.

Date	Species	Nearest Turbine	Distance to Nearest Turbine(m)	FAA LIT
08/31/2002	red-tailed hawk	HGA20	70	N
09/04/2002	American kestrel	WSB16	24	N
09/16/2002	red-tailed hawk	HGA6	33	N
09/16/2002	Swainson's thrush	HGA7	53	N
10/01/2002	vesper sparrow	PB30	51	Y
10/01/2002	house finch	WSA44	14	N
10/02/2002	golden-crowned kinglet	WSB29	29	Y
10/03/2002	savannah sparrow	PB41	31	N
10/03/2002	vesper sparrow	PB53	26	Y
10/04/2002	red-tailed hawk	HGA22	45	N
10/04/2002	white-crowned sparrow	HGA7	40	N
10/04/2002	western meadowlark	HGC14	50	Y
10/07/2002	red-winged blackbird	HGH16	25	Y
10/16/2002	golden-crowned kinglet	PB40	32	N
10/16/2002	western meadowlark	PB50	3	N
10/20/2002	horned lark	WSA19	17	N
11/01/2002	horned lark	HGC24	23	N

[a] found on a standardized search plot but not during scheduled search

Table 8. Summary of avian fatality composition based on fatalities observed on standardized search plots from July 2001 through December 2002).

Species	# Fatalities	% Composition
horned lark	46	43.4
golden-crowned kinglet	6	5.7
western meadowlark	6	5.7
white-crowned sparrow	5	4.7
gray partridge	4	3.8
ring-necked pheasant	4	3.8
red-tailed hawk	4	3.8
unidentified passerine	3	2.8
house wren	2	1.9
yellow-rumped warbler	2	1.9
European starling	2	1.9
chukar	2	1.9
vesper sparrow	2	1.9
winter wren	2	1.9
golden-crowned sparrow	1	0.9
grasshopper sparrow	1	0.9
black-billed magpie	1	0.9
great blue heron	1	0.9
dark-eyed junco	1	0.9
house finch	1	0.9
American kestrel	1	0.9
mallard	1	0.9
red-winged blackbird	1	0.9
ruby-crowned kinglet	1	0.9
savannah sparrow	1	0.9
Swainson's hawk	1	0.9
Swainson's thrush	1	0.9
unidentified bird	1	0.9
unidentified sparrow	1	0.9
Macgillivray's warbler	1	0.9
Grand Total	106	100.0

Table 9. List of turbines and number of avian fatalities observed on standardized search plots from July 2001 through December 2002.

Turbine	# Fatalities	Turbine	# Fatalities
HGA7	3	HGD4	1
HGC14	3	HGD5	1
HGC24	3	HGD6	1
HGH16	3	HGG3	1
PB30	3	HGH17	1
PB39	3	HGH18	1
BGB16	2	HGJ12	1
BGB23	2	HGJ18	1
HGA22	2	HGJ35	1
HGB13	2	HGJ40	1
HGJ21	2	HGJ7	1
HGL2	2	HGJ8	1
HGM2	2	HGK9	1
HGM18	2	HGL1	1
HGM9	2	HGM14	1
HGN8	2	HGM17	1
HGN9	2	HGM8	1
PB29	2	PB15	1
PB41	2	PB16	1
PB50	2	PB17	1
WSA19	2	PB28	1
WSA21	2	PB40	1
WSA44	2	PB53	1
WSB16	2	PB76	1
WSB45	2	PB81	1
BGB17	1	PB87	1
BGB19	1	PB95	1
BGC17	1	PB97	1
BGC18	1	WSA22	1
BGC19	1	WSA43	1
HGA20	1	WSB29	1
HGA6	1	WSB31	1
HGA9	1	WSB46	1
HGB11	1	WSB47	1
HGB12	1	WSB48	1
HGB4	1	WSB52	1
HGC23	1	WSB53	1
HGC25	1		

Table 10. WRRS protocol and incidental avian casualty discoveries from July 2001 through December 31, 2002 that were not observed on standardized search plots.

Date[a]	Species	Nearest Turbine	Distance to Nearest Turbine(m)
09/20/2001	white-throated swift	WSB25	9
12/09/2001	unidentified raptor[b]	HGC20	103
01/25/2002	Canada goose	HGB6	51
03/27/2002	horned lark	PB44	2
03/27/2002	horned lark	PB44	4
04/04/2002	gray partridge	WSB38	22
04/25/2002	white-crowned sparrow	WSB34	65
04/25/2002	white-crowned sparrow	WSB26	44
05/02/2002	red-tailed hawk[c]	HGC9	30
05/07/2002	horned lark	WSA26	55
07/11/2002	horned lark	HGJ32	30
10/04/2002	ring-necked pheasant	HGE1	3
10/06/2002	chukar	HGC15	2
10/20/2002	gray partridge	WSB42	26
10/22/2002	red-tailed hawk	HGG11	18
11/01/2002	European starling[c]	PB37	0
	INJURED BIRDS		
04/26/2002	Swainson's hawk (injured, fully recovered and released)	HGK9	base of turbine

[a] date that project biologist identified and collected the bird. Date discovered by FPL personnel or contractor was often earlier.
[b] found well outside search area and was located near a fence, heavily scavenged
[c] found on a WRRS protocol search plot during a protocol search

Table 11. List of bat fatalities found on standardized search plots in Oregon from January 1 through December 2002.

Date	Species	Nearest Turbine	Distance to Nearest Turbine(m)	FAA LIT
07/22/2002	silver-haired bat	WSB52	19	Y
08/19/2002	silver-haired bat	BGC16	25	Y
08/19/2002	silver-haired bat	BGC18	28	N
08/19/2002	hoary bat	HGM4	27	N
08/20/2002	silver-haired bat	WSB46	27	Y
09/04/2002	big brown bat	HGM16	15	N
09/06/2002	unidentified bat[a]	HGK2	0	Y
09/20/2002	hoary bat	WSB54	18	N
09/24/2002	hoary bat	PB88	10	N
09/26/2002	silver-haired bat	PB84	35	N
09/26/2002	silver-haired bat	PB97	10	Y
10/02/2002	silver-haired bat	BGB21	25	N
10/03/2002	hoary bat	BGB17	26	N
10/03/2002	hoary bat	BGC17	52	N
10/03/2002	hoary bat	BGC18	22	N
10/05/2002	hoary bat	HGJ14	16	N
10/19/2002	silver-haired bat	WSB53	7	N
10/21/2002	silver-haired bat	HGM9	28	N

[a] found on a standardized search plot but not during scheduled search

Table 12. List of bat fatalities found on standardized search plots in Washington from July 2001 through December 2002.

Date	Species	Nearest Turbine	Distance to Nearest Turbine(m)	FAA LIT
08/18/2001	hoary bat	HGC25	31	Y
08/20/2001	hoary bat	HGC11	9	N
08/29/2001	hoary bat	HGD4	15	N
08/30/2001	hoary bat	HGC14	19	Y
08/30/2001	hoary bat	HGC14	20	Y
08/31/2001	hoary bat	PB29	33	N
08/31/2001	hoary bat	PB30	32	Y
08/31/2001	silver-haired bat	PB30	29	Y
08/31/2001	hoary bat	PB41	12	N
09/17/2001	little brown bat	HGC10	11	Y
09/18/2001	silver-haired bat	PB15	32	Y
09/18/2001	hoary bat	PB18	6	N
09/18/2001	hoary bat	PB27	31	N
09/18/2001	silver-haired bat	PB30	20	Y
09/20/2001	hoary bat	PB42	33	N
09/20/2001	silver-haired bat	PB50	15	N
09/20/2001	silver-haired bat	WSA44	14	N
09/27/2001	silver-haired bat[a]	PB16	3	Y
10/01/2001	silver-haired bat	HGC14	12	Y
10/01/2001	hoary bat	HGC23	31	N
10/02/2001	silver-haired bat	PB28	26	N
10/02/2001	silver-haired bat	PB40	15	N
10/03/2001	silver-haired bat	WSA45	27	Y
10/15/2001	silver-haired bat	PB31	21	N
11/15/2001	silver-haired bat	WSB19	13	Y
08/13/2002	big brown bat[a]	WSA19	10	N
08/30/2002	hoary bat	HGD6	16	Y
08/31/2002	hoary bat	PB6	25	N
09/01/2002	hoary bat	PB53	16	Y
09/04/2002	hoary bat	WSB4	16	Y
09/14/2002	silver-haired bat	PB30	30	Y
09/14/2002	silver-haired bat[a]	PB53	4	Y
09/15/2002	hoary bat	WSB16	20	N
09/20/2002	silver-haired bat	WSB7	5	N
09/24/2002	silver-haired bat	PB76	8	N
10/22/2002	hoary bat	HGB1	23	Y

[a] found on a standardized search plot but not during scheduled search

Table 13. List of turbines and number of bat fatalities observed on standardized search plots from July 2001 through December 2002.

Turbine	# Fatalities	Turbine	# Fatalities
PB30	4	PB28	1
HGC14	3	PB29	1
BGC18	2	PB31	1
PB53	2	PB40	1
BGB17	1	PB41	1
BGB21	1	PB42	1
BGC16	1	PB50	1
BGC17	1	PB6	1
HGB1	1	PB76	1
HGC10	1	PB84	1
HGC11	1	PB88	1
HGC23	1	PB97	1
HGC25	1	WSA19	1
HGD4	1	WSA44	1
HGD6	1	WSA45	1
HGJ14	1	WSB16	1
HGK2	1	WSB19	1
HGM16	1	WSB4	1
HGM4	1	WSB46	1
HGM9	1	WSB52	1
PB15	1	WSB53	1
PB16	1	WSB54	1
PB18	1	WSB7	1
PB27	1		

Table 14. Summary of bat fatality composition based on fatalities observed on standardized search plots from July 2001 through December 2002.

Species	# Fatalities	% Composition
silver-haired bat	25	46.3
hoary bat	25	46.3
big brown bat	2	3.7
unidentified bat	1	1.9
little brown bat	1	1.9
Grand Total	54	100.0

Table 15. WRRS protocol and incidental bat casualty discoveries that were not observed on standardized search plots from July 2001 through December 31, 2002.

Date[a]	Species	Nearest Turbine	Distance to Nearest Turbine(m)
08/30/2001	unidentified bat	HGC8	22
08/30/2001	hoary bat	HGC28	8
09/25/2001	silver-haired bat	PB47	29
10/10/2001	silver-haired bat [b]	HGC18	3
10/10/2001	hoary bat	HGC20	6
05/26/2002	silver-haired bat	WSB41	2
07/11/2002	silver-haired bat	HGC7	25
08/06/2002	hoary bat	WSB49	24
08/30/2002	silver-haired bat	WSA38	22
09/11/2002	hoary bat	BGC13	25
09/14/2002	hoary bat	WSB50	5
09/14/2002	silver-haired bat	WSB20	15
09/14/2002	silver-haired bat	PB59	10
09/14/2002	silver-haired bat	PB68	1
09/14/2002	hoary bat	PB6	5
09/22/2002	hoary bat	HGJ10	10
10/2/2002	hoary bat [b]	WSA40	4
10/18/2002	hoary bat [b]	PB33	26

[a] date that project biologist identified and collected the bird. Date discovered by FPL personnel or contractor was often earlier.
[b] found on a WRRS protocol search plot during a protocol search

Table 16. Summary of results of the observer detection and carcass removal experimental trials conducted from October 2001 through December 31, 2002.

Observer Detection Rates

	Large Birds			Small Birds		
Season	# Placed	# Found	%Found	# Placed	# Found	% Found
Fall 2001-2002	30	23	77	29	11	38
Winter 2001-02	23	21	91	20	11	55
Spring 2002	20	18	90	20	11	55
Summer 2002	21	13	62	22	6	27
Overall	94	75	80	91	39	43

Carcass Removal Rates

Season	# Placed	Mean Removal Time (Days)	% Remaining 40 Days	% Remaining 30 Days
Large Birds				
Fall 2001&2002	29	29.0	24.1	34.5
Winter 2001-02	20	42.8	45.0	50.0
Spring	20	45.6	45.0	45.0
Summer	30	58.9	53.3	60.0
Overall	99	42.0	41.4	47.5
Small Birds				
Fall 2001&2002	31	16.9	6.5	16.1
Winter 2001-02	20	27.2	20.0	35.0
Spring	20	16.4	15.0	20.0
Summer	30	35.1	36.7	36.7
Overall	101	23.1	19.8	26.7
All Birds				
Fall 2001&2002	60	22.1	15.0	25.0
Winter 2001-02	40	33.5	32.5	42.5
Spring	40	27.9	30.0	32.5
Summer	60	45.2	45.0	48.3
Overall	200	31.0	30.5	37.0

Table 17. Annual fatality rate estimates based on Stateline monitoring in 2001 and 2002.

Parameter/Calculation	Number / Estimate	SE	90% Confidence Intervals LL	UL
Small Birds				
# fatalities observed	87			
unadjusted per turbine annual fatality estimate	0.531	0.055	0.442	0.622
per turbine annual fatality estimate	1.524	0.247	1.157	1.956
Large Birds				
# fatalities observed	19			
unadjusted per turbine annual fatality estimate	0.116	0.028	0.073	0.165
per turbine annual fatality estimate	0.168	0.041	0.104	0.239
All Birds				
# fatalities observed	106			
unadjusted per turbine annual fatality estimate	0.647	0.060	0.551	0.748
per turbine annual fatality estimate	1.686	0.243	1.321	2.122
Raptors				
# fatalities observed	6			
unadjusted fatalities per turbine per year	0.037	0.018	0.012	0.069
per turbine annual fatality estimate	0.053	0.026	0.016	0.100
Grassland Birds				
# fatalities observed	71			
unadjusted fatalities per turbine per year	0.434	0.050	0.353	0.517
per turbine annual fatality estimate	1.246	0.212	0.932	1.624
Bats				
# fatalities observed	54			
unadjusted fatalities per turbine per year	0.329	0.057	0.238	0.427
per turbine annual fatality estimate	0.945	0.204	0.646	1.312

Table 18. List of avian species observed during fixed-point surveys (August 2001 – December 2002).

Species/Group	Scientific Name	Species/Group	Scientific Name
Ferruginous hawk	*Buteo regalis*	violet-green swallow	*Tachycineta thalassina*
red-tailed hawk	*Buteo jamaicensis*	western kingbird	*Tyrannus verticalis*
rough-legged hawk	*Buteo lagopus*	western meadowlark	*Sturnella neglecta*
Swainson's hawk	*Buteo swainsoni*	white-crowned sparrow	*Zonotrichia leucophrys*
northern harrier	*Circus cyaneus*	winter wren	*Troglodytes troglodytes*
golden eagle	*Aquila chrysaetos*	American white pelican	*Pelecanus erythrorhyncos*
American kestrel	*Falco sparverius*	Canada goose	*Branta canadensis*
prairie falcon	*Falco mexicanus*	ring-billed gull	*Larus delawarensis*
American goldfinch	*Carduelis tristis*	American crow	*Corvus brachyrhynchos*
American robin	*Turdus migratorius*	black-billed magpie	*Pica pica*
barn swallow	*Hirundo rustica*	common raven	*Corvus corax*
Bewick's wren	*Thryomanes bewickii*	chukar	*Alectoris chukar*
cliff swallow	*Petrochelidon pyrrhonota*	gray partridge	*Perdix perdix*
European starling	*Sturnus vulgaris*	ring-necked pheasant	*Phasianus colchicus*
grasshopper sparrow	*Ammodramus savannarum*		
horned lark	*Eremophila alpestris*	unidentified buteo	
red-winged blackbird	*Agelaius phoeniceus*	unidentified bluebird	
rock wren	*Salpinctes obsoletus*	unidentified finch	
savannah sparrow	*Passerculus sandwichensis*	unidentified passerine	
Say's phoebe	*Sayornis saya*	unidentified sparrow	
tree swallow	*Tachycineta bicolor*	unidentified gull	

Table 19. Mean use, mean # species/survey, total number of species, and total number of fixed-point surveys conducted by season and overall from August 2001 through December 31, 2002.

Season	# Species/ Survey	Mean Use[a]	# Species	# Surveys Conducted
Summer	0.984	2.789	20	167
Fall	0.711	1.988	17	204
Winter	0.742	1.941	16	203
Spring	1.304	2.210	20	162
Overall	0.875	2.180	36	736

[a] # observations per 10-minute survey

Table 20. Avian species observed while conducting avian surveys from August 2001 through December 2002.

Species/Group	Summer # obs.	Summer # groups	Fall # obs.	Fall # groups	Winter # obs.	Winter # groups	Spring # obs.	Spring # groups	Grand Total # obs.	Grand Total # groups
Waterfowl/Waterbird										
American white pelican	40	1	0	0	0	0	0	0	40	1
Canada goose	0	0	20	1	129	7	0	0	149	8
ring-billed gull	0	0	0	0	0	0	6	1	6	1
Unidentified gull	0	0	0	0	0	0	30	1	30	1
Subtotal	40	1	20	1	129	7	36	2	225	11
Raptors										
Buteos										
Swainson's hawk	9	7	29	5	0	0	5	4	43	16
ferruginous hawk	1	1	1	1	0	0	3	2	5	4
red-tailed hawk	21	15	16	10	11	10	29	25	77	60
rough-legged hawk	0	0	1	1	5	5	6	6	12	12
unidentified buteo	3	3	12	10	2	2	19	15	36	30
Subtotal	34	26	59	27	18	17	62	52	173	122
Eagles										
golden eagle	0	0	0	0	3	2	3	3	6	5
Falcons										
American kestrel	1	1	1	1	0	0	2	2	4	4
prairie falcon	0	0	0	0	2	2	0	0	2	2
Subtotal	1	1	1	1	2	2	2	2	6	6
Other raptors										
northern harrier	6	5	10	9	7	7	4	4	27	25
Raptor Subtotal	41	32	70	37	30	28	71	61	212	158
Passerines										
American goldfinch	0	0	11	3	1	1	0	0	12	4
American robin	0	0	1	1	0	0	0	0	1	1
Bewick's wren	0	0	0	0	1	1	0	0	1	1
European starling	2	1	0	0	3	1	13	1	18	3
Say's phoebe	1	1	0	0	0	0	0	0	1	1
barn swallow	0	0	1	1	0	0	0	0	1	1
cliff swallow	2	1	0	0	0	0	0	0	2	1
grasshopper sparrow	3	2	0	0	0	0	0	0	3	2
horned lark	389	151	496	158	262	139	176	131	1323	579
red-winged blackbird	0	0	0	0	0	0	1	1	1	1
rock wren	1	1	0	0	0	0	1	1	2	2
savannah sparrow	0	0	0	0	0	0	2	2	2	2
tree swallow	1	1	0	0	0	0	0	0	1	1
unidentified bluebird	3	1	0	0	0	0	0	0	3	1
unidentified finch	0	0	0	0	1	1	0	0	1	1
unidentified passerine	0	0	1	1	1	1	1	1	3	3
unidentified sparrow	0	0	2	2	0	0	0	0	2	2
violet-green swallow	0	0	0	0	0	0	12	1	12	1
western kingbird	4	3	0	0	0	0	1	1	5	4
western meadowlark	93	70	23	20	34	26	91	84	241	200
white-crowned sparrow	0	0	2	2	0	0	3	1	5	3
winter wren	0	0	0	0	2	2	0	0	2	2
Subtotal	499	232	537	188	305	172	301	224	1642	816

Table 20 (*continued*). Avian species observed while conducting avian surveys from August 2001 through December 31, 2002.

Species/Group	Summer # obs.	Summer # groups	Fall # obs.	Fall # groups	Winter # obs.	Winter # groups	Spring # obs.	Spring # groups	Grand Total # obs.	Grand Total # groups
Corvids										
American crow	1	1	0	0	0	0	0	0	1	1
black-billed magpie	0	0	0	0	0	0	2	1	2	1
common raven	17	17	53	29	15	12	26	21	111	79
Subtotal	18	18	53	29	15	12	28	22	114	81
Upland Gamebirds										
Chukar	8	1	5	2	10	1	0	0	23	4
gray partridge	0	0	11	2	22	3	0	0	33	5
ring-necked pheasant	7	6	1	1	2	2	3	3	13	12
Subtotal	15	7	17	5	34	6	3	3	69	21
Grand Total	613	290	697	260	513	225	439	312	2262	1087

Table 21. Avian species observed within 800 m of observer and estimated mean use for large and small birds from August 2001 through December 31, 2002).

Large Birds							
Summer		**Fall**		**Winter**		**Spring**	
Species/Group	**Use[a]**	**Species/Group**	**Use**	**Species/Group**	**Use**	**Species/Group**	**Use**
common raven	0.083	common raven	0.087	Canada goose	0.317	common raven	0.092
red-tailed hawk	0.068	gray partridge	0.030	gray partridge	0.088	red-tailed hawk	0.086
chukar	0.039	red-tailed hawk	0.022	common raven	0.048	ring-billed gull	0.037
ring-necked pheasant	0.034	Swainson's hawk	0.020	chukar	0.041	rough-legged hawk	0.025
northern harrier	0.029	northern harrier	0.019	red-tailed hawk	0.038	ring-necked pheasant	0.019
Swainson's hawk	0.024	chukar	0.014	rough-legged hawk	0.036	northern harrier	0.019
American crow	0.005	unidentified buteo	0.005	northern harrier	0.029	Swainson's hawk	0.018
ferruginous hawk	0.005	ring-necked pheasant	0.003	ring-necked pheasant	0.008	golden eagle	0.018
American kestrel	0.005	American kestrel	0.003	prairie falcon	0.008	unidentified buteo	0.013
				golden eagle	0.004	black-billed magpie	0.012
						American kestrel	0.012

Small Birds							
Summer		**Fall**		**Winter**		**Spring**	
Species/Group	**Use**	**Species/Group**	**Use**	**Species/Group**	**Use**	**Species/Group**	**Use**
horned lark	1.959	horned lark	1.632	horned lark	1.124	horned lark	1.086
western meadowlark	0.454	western meadowlark	0.105	western meadowlark	0.164	western meadowlark	0.565
western kingbird	0.020	American goldfinch	0.030	European starling	0.012	European starling	0.079
grasshopper sparrow	0.015	unidentified sparrow	0.005	winter wren	0.008	violet-green swallow	0.073
unidentified bluebird	0.015	white-crowned sparrow	0.005	American goldfinch	0.004	white-crowned sparrow	0.019
cliff swallow	0.010	American robin	0.003	unidentified finch	0.004	savannah sparrow	0.013
European starling	0.010	barn swallow	0.003	unidentified passerine	0.004	rock wren	0.006
rock wren	0.005	unidentified passerine	0.003	Bewick's wren	0.004	red-winged blackbird	0.006
Say's phoebe	0.005					unidentified passerine	0.006
tree swallow	0.005					western kingbird	0.006

[a] # observations per 10-minute survey

Table 22. Avian species observed within 800 m of observer and estimated frequency of occurrence for large and small birds from August 2001 through December 31, 2002.

Large Birds							
Summer		Fall		Winter		Spring	
Species/Group	% freq.[a]	Species/Group	% freq.	Species/Group	% freq.	Species/Group	% freq.
common raven	7.8	common raven	5.7	common raven	3.6	Common raven	8.6
red-tailed hawk	4.9	Swainson's hawk	2.0	rough-legged hawk	3.6	red-tailed hawk	8.0
ring-necked pheasant	2.4	northern harrier	1.9	red-tailed hawk	3.4	rough-legged hawk	2.5
northern harrier	2.4	red-tailed hawk	1.4	northern harrier	2.9	ring-necked pheasant	1.9
Swainson's hawk	2.0	chukar	0.5	Canada goose	1.7	Northern harrier	1.9
American crow	0.5	gray partridge	0.5	gray partridge	1.2	golden eagle	1.8
chukar	0.5	unidentified buteo	0.5	ring-necked pheasant	0.8	unidentified buteo	1.3
ferruginous hawk	0.5	ring-necked pheasant	0.3	prairie falcon	0.8	Swainson's hawk	1.2
American kestrel	0.5	American kestrel	0.3	chukar	0.4	American kestrel	1.2
				golden eagle	0.4	ring-billed gull	0.6
						black-billed magpie	0.6
Small Birds							
Summer		Fall		Winter		Spring	
Species/Group	% freq.	Species/Group	% freq.	Species/Group	% freq.	Species/Group	% freq.
horned lark	47.2	horned lark	45.5	horned lark	42.8	horned lark	53.1
western meadowlark	24.4	western meadowlark	9.6	western meadowlark	9.9	western meadowlark	42.1
western kingbird	1.5	American goldfinch	0.8	winter wren	0.8	savannah sparrow	1.3
grasshopper sparrow	1.0	unidentified sparrow	0.5	American goldfinch	0.4	rock wren	0.6
cliff swallow	0.5	white-crowned sparrow	0.5	European starling	0.4	white-crowned sparrow	0.6
European starling	0.5	American robin	0.3	unidentified finch	0.4	European starling	0.6
rock wren	0.5	barn swallow	0.3	unidentified passerine	0.4	red-winged blackbird	0.6
Say's phoebe	0.5	unidentified passerine	0.3	Bewick's wren	0.4	unidentified passerine	0.6
tree swallow	0.5					violet-green swallow	0.6
unidentified bluebird	0.5					western kingbird	0.6

[a] % of 10-minute surveys species/group is recorded

Table 23. Mean use, percent composition and percent frequency of occurrence for avian groups by season from August 2001 through December 31, 2002.

Mean Use (#/10 minute survey)				
Species/Group	**Summer**	**Fall**	**Winter**	**Spring**
Waterfowl/Waterbirds	0.00	0.00	0.32	0.04
Buteos	0.10	0.05	0.07	0.14
Northern Harriers	0.03	0.02	0.03	0.02
Eagles	0.00	0.00	0.00	0.02
Large Falcons	0.00	0.00	0.01	0.00
Small Falcons	0.00	0.00	0.00	0.01
Raptors	0.13	0.07	0.11	0.19
Corvids	0.09	0.09	0.05	0.10
Passerines	2.50	1.79	1.33	1.86
Gamebirds	0.07	0.05	0.14	0.02
Overall	2.79	1.99	1.94	2.21
Group Composition (%)				
Species/Group	**Summer**	**Fall**	**Winter**	**Spring**
Waterfowl/Waterbirds	0.0	0.0	16.3	1.7
Buteos	3.5	2.4	3.8	6.4
Northern Harriers	1.0	1.0	1.5	0.8
Eagles	0.0	0.0	0.2	0.8
Large Falcons	0.0	0.0	0.4	0.0
Small Falcons	0.2	0.1	0.0	0.6
Raptors	4.7	3.5	5.9	8.6
Corvids	3.1	4.4	2.5	4.7
Passerines	89.5	89.8	68.3	84.1
Gamebirds	2.6	2.3	7.0	0.9
% Frequency				
Species/Group	Summer	Fall	Winter	Spring
Waterfowl/Waterbirds	0.0	0.0	1.7	0.6
Buteos	6.8	3.9	6.9	13.0
Northern Harriers	2.4	1.9	2.9	1.9
Eagles	0.0	0.0	0.4	1.8
Large Falcons	0.0	0.0	0.8	0.0
Small Falcons	0.5	0.3	0.0	1.2
Raptors	8.8	6.1	10.6	16.7
Corvids	8.3	5.7	3.6	9.2
Passerines	55.9	51.1	47.8	72.3
Gamebirds	2.9	1.4	2.4	1.9

Table 24. Summary of number of active buteo nests within 5-miles of Stateline 1 turbines and number of active and successful buteo nests within 2-miles of Stateline 1 turbines.

	within 5-miles of Stateline 1 turbines		within 2-miles of Stateline 1 turbines			
	2001	2002	2001		2002	
Species	**# Active**	**# Active**	**# Active**	**# Successful**	**# Active**	**# Successful**
Washington						
Red-tailed hawk	9	11	5	na[a]	7	na
Ferruginous hawk	1	1	1	1	1	1
Swainson's hawk	5	6	0	na	0	0
subtotal	15	18	6		8	
Oregon						
Red-tailed hawk	6	5	1	na	1	na
Ferruginous hawk	5	5	2	2	2	1
Swainson's hawk	4	4	2	0	1	0
subtotal	15	14	5		4	
Overall						
Red-tailed hawk	15	16	6	na	8	na
Ferruginous hawk	6	6	3	3	3	2
Swainson's hawk	9	10	2	0	1	0
Total	30	32	11		12	

[a] not applicable. Note: in 2002 only special status species were monitored for success

Table 25. Ferruginous hawk and Swainson's hawk nesting data for nests active in 2001 or 2002 that are located within 2-miles of Stateline 1 or 2 turbines.

Species and record #	Distance from nearest existing turbine (Stateline 1 or 2)	2001	2002
Washington			
Ferruginous hawk (#5)	~1 mile from HG-A string	successful 2 young fledged	successful 2 young fledged
Oregon			
Ferruginous hawk (#21)	~ 1/2 mile from HG-J string	successful 3 young fledged	successful 4 young fledged
Ferruginous hawk (#15)	~1/4 mile from HG-K string	successful 2 young fledged	active not successful
Swainson's hawk (#11)	~1 and ¾ miles from HG-K string, near Stateline 2 turbines	active not successful	not active
Swainson's hawk (#82)	~1/4 mile from HG-K and HG-J strings	active not successful	active not successful
Ferruginous hawk (#137)	~1 and ¾ miles from Stateline 2 turbines[a]. Not within 2-miles of Stateline 1 turbines.	not active	successful 2-young fledged

[a] Stateline 2 was constructed fall of 2002

Table 26. The mean index to density for pre- and post- construction and their differences, the standard errors and 90% confidence intervals for the difference based on each year of surveys of monitoring transects (pre-construction surveys in 2001, post-construction surveys in 2002).

Species/Group	Pre Mean[a]	Post mean[a]	Diff mean[a]	Std. Err.	90% Conf Ints[b] LCL	UCL
grasshopper sparrow	0.139	0.083	-0.056[c]	0.026	-0.101	-0.011
horned lark	0.289	0.350	0.061	0.062	-0.046	0.168
Savannah sparrow	0.025	0.047	0.022	0.016	-0.006	0.050
western meadowlark	0.122	0.092	-0.031	0.031	-0.085	0.023
Subtotal Grassland	0.578	0.583	0.006	0.084	-0.139	0.151

[a] # observations/survey/5000 m^2
[b] Student's t intervals with 19 degrees of freedom
[c] significantly different than 0 and negative, suggesting a negative impact due to the wind facility

Table 27. The mean index to density for pre- and post-construction and their differences, the standard errors and 90% confidence intervals for the difference by subsegment based on each year of surveys of monitoring transects (pre-construction surveys in 2001, post-construction surveys in 2002).

Species/Group	Subsegment	Pre-mean	Post-mean	Diff-mean	Std. Err	90% LCL	90% UCL
grasshopper sparrow	1: 0-50 m	0.300	0.017	-0.28[a]	0.103	-0.461	-0.105
	2: 51-100 m	0.083	0.000	-0.083[a]	0.041	-0.154	-0.012
	3: 101-150 m	0.083	0.083	0.000	0.054	-0.093	0.093
	4: 151-200 m	0.117	0.067	-0.050	0.065	-0.162	0.062
	5: 201-250 m	0.150	0.100	-0.050	0.070	-0.171	0.071
	6: 251-300 m	0.100	0.233	0.133	0.082	-0.009	0.275
horned lark	1: 0-50 m	0.333	0.283	-0.050	0.165	-0.335	0.235
	2: 51-100 m	0.367	0.333	-0.033	0.143	-0.280	0.214
	3: 101-150 m	0.283	0.267	-0.017	0.078	-0.152	0.118
	4: 151-200 m	0.167	0.217	0.050	0.091	-0.107	0.207
	5: 201-250 m	0.183	0.333	0.150	0.089	-0.004	0.304
	6: 251-300 m	0.400	0.667	0.267	0.191	-0.063	0.597
savannah sparrow	1: 0-50 m	0.033	0.000	-0.033	0.033	-0.090	0.024
	2: 51-100 m	0.017	0.033	0.017	0.029	-0.033	0.067
	3: 101-150 m	0.017	0.000	-0.017	0.017	-0.046	0.012
	4: 151-200 m	0.050	0.033	-0.017	0.051	-0.105	0.071
	5: 201-250 m	0.017	0.083	0.067	0.046	-0.013	0.147
	6: 251-300 m	0.017	0.133	0.117	0.056	0.020	0.214
western meadowlark	1: 0-50 m	0.050	0.000	-0.050[a]	0.027	-0.097	-0.003
	2: 51-100 m	0.067	0.067	0.000	0.042	-0.073	0.073
	3: 101-150 m	0.150	0.100	-0.050	0.074	-0.178	0.078
	4: 151-200 m	0.100	0.067	-0.033	0.041	-0.104	0.038
	5: 201-250 m	0.167	0.183	0.017	0.092	-0.142	0.176
	6: 251-300 m	0.200	0.133	-0.067	0.107	-0.252	0.118
Subtotal Grassland	1: 0-50 m	0.717	0.300	-0.417[a]	0.206	-0.773	-0.061
	2: 51-100 m	0.533	0.467	-0.067	0.184	-0.385	0.251
	3: 101-150 m	0.533	0.450	-0.083	0.125	-0.299	0.133
	4: 151-200 m	0.450	0.383	-0.067	0.132	-0.295	0.161
	5: 201-250 m	0.517	0.717	0.200	0.122	-0.011	0.411
	6: 251-300 m	0.717	1.183	0.467	0.276	-0.010	0.944

[a] significantly different than 0 and negative, suggesting a negative impact due to the wind facility

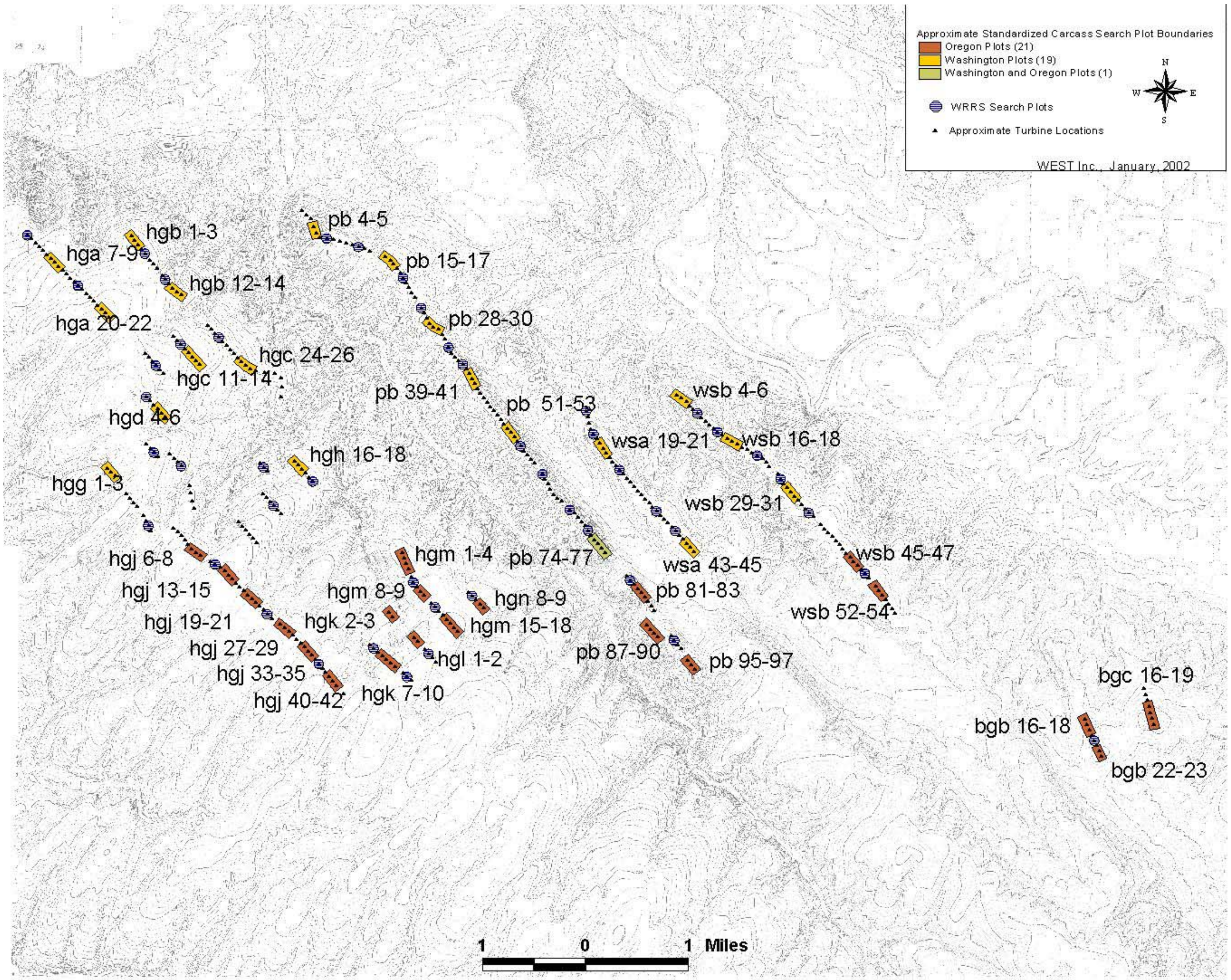


Figure 1. Layout of casualty search plots for the Stateline Project for monitoring from July 2001 through December 31, 2002.

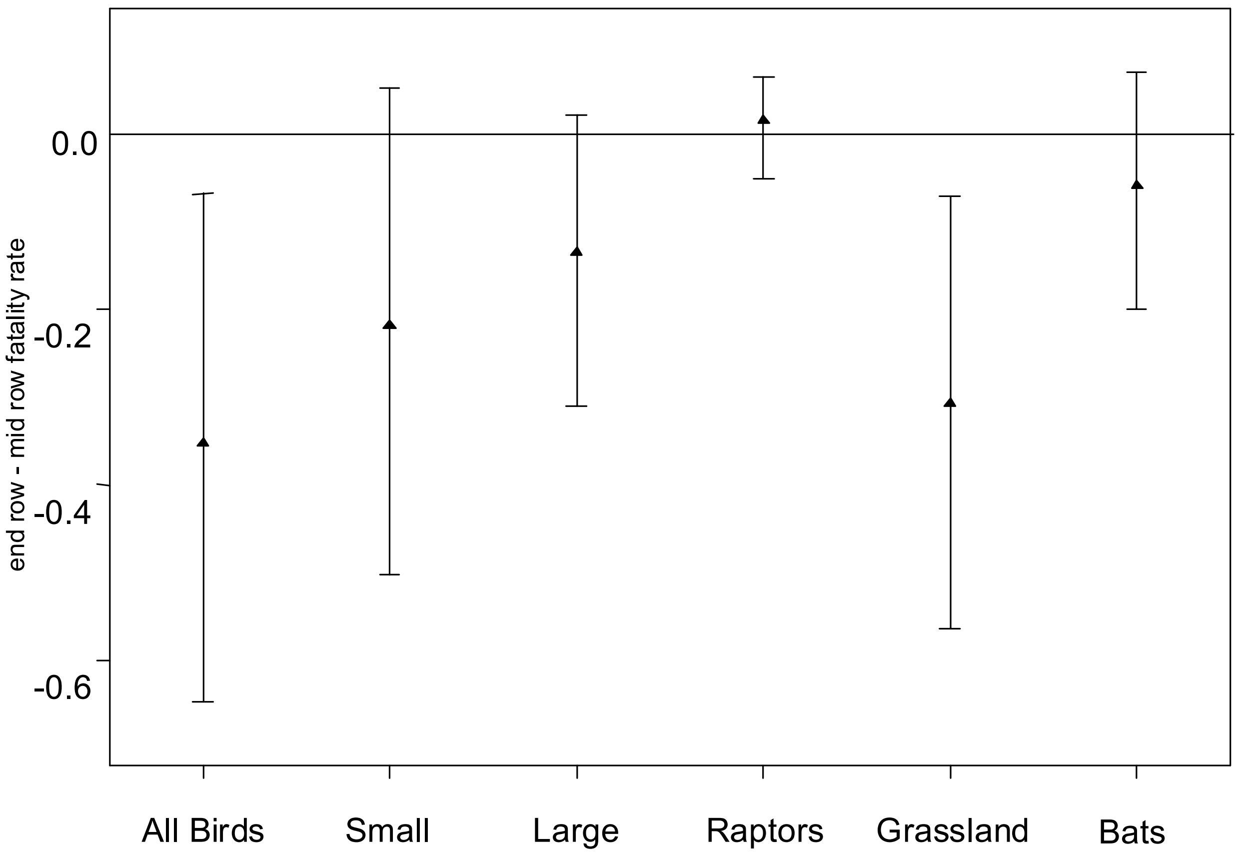


Figure 2. Difference in fatality rates and 90% confidence limits for end row/discontinuous turbines and mid row turbines. Confidence intervals that do not overlap the value 0 indicate statistically significant differences in the fatality rates.

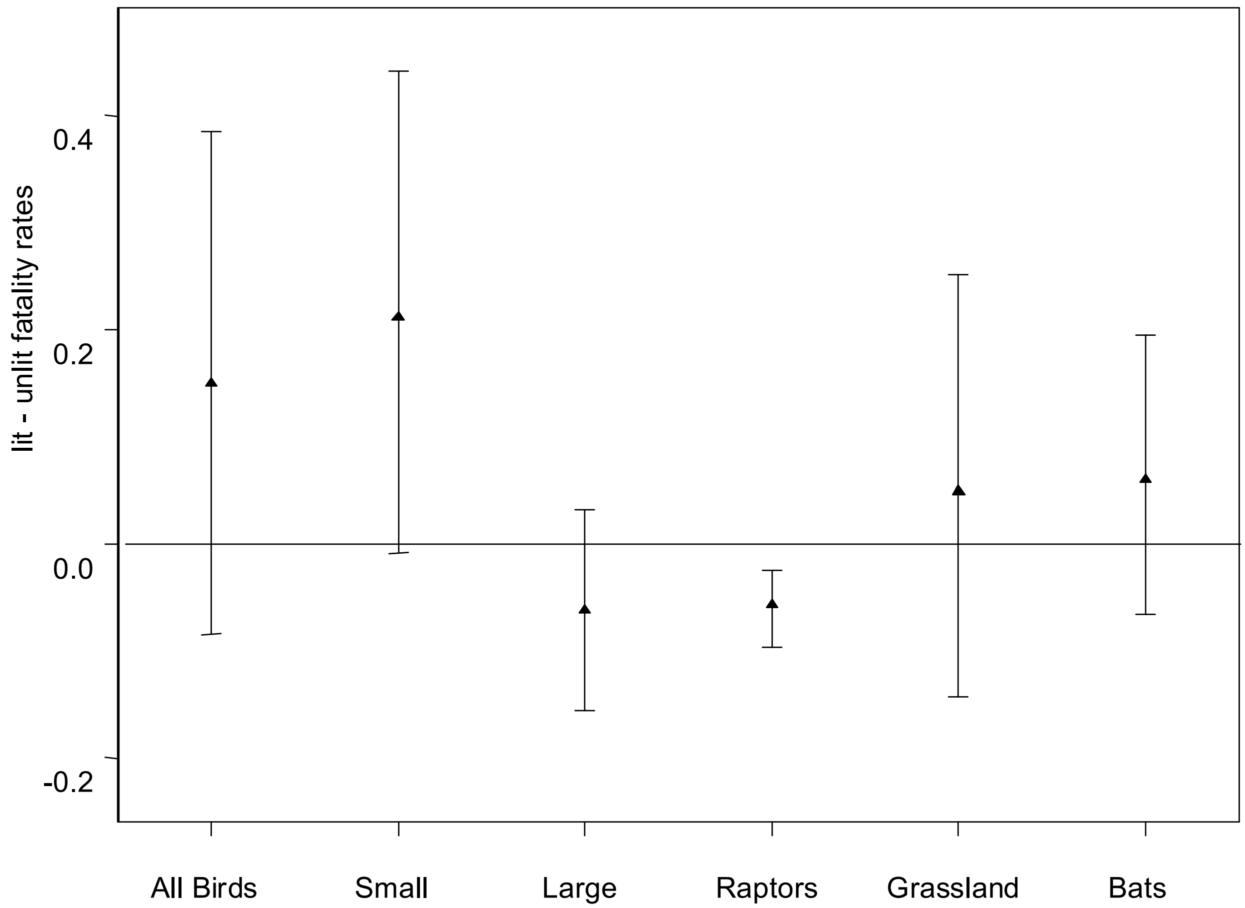


Figure 3. Difference in fatality rates and 90% confidence limits for lit and unlit turbines. Confidence intervals that do not overlap the value 0 indicate statistically significant differences in the fatality rates.

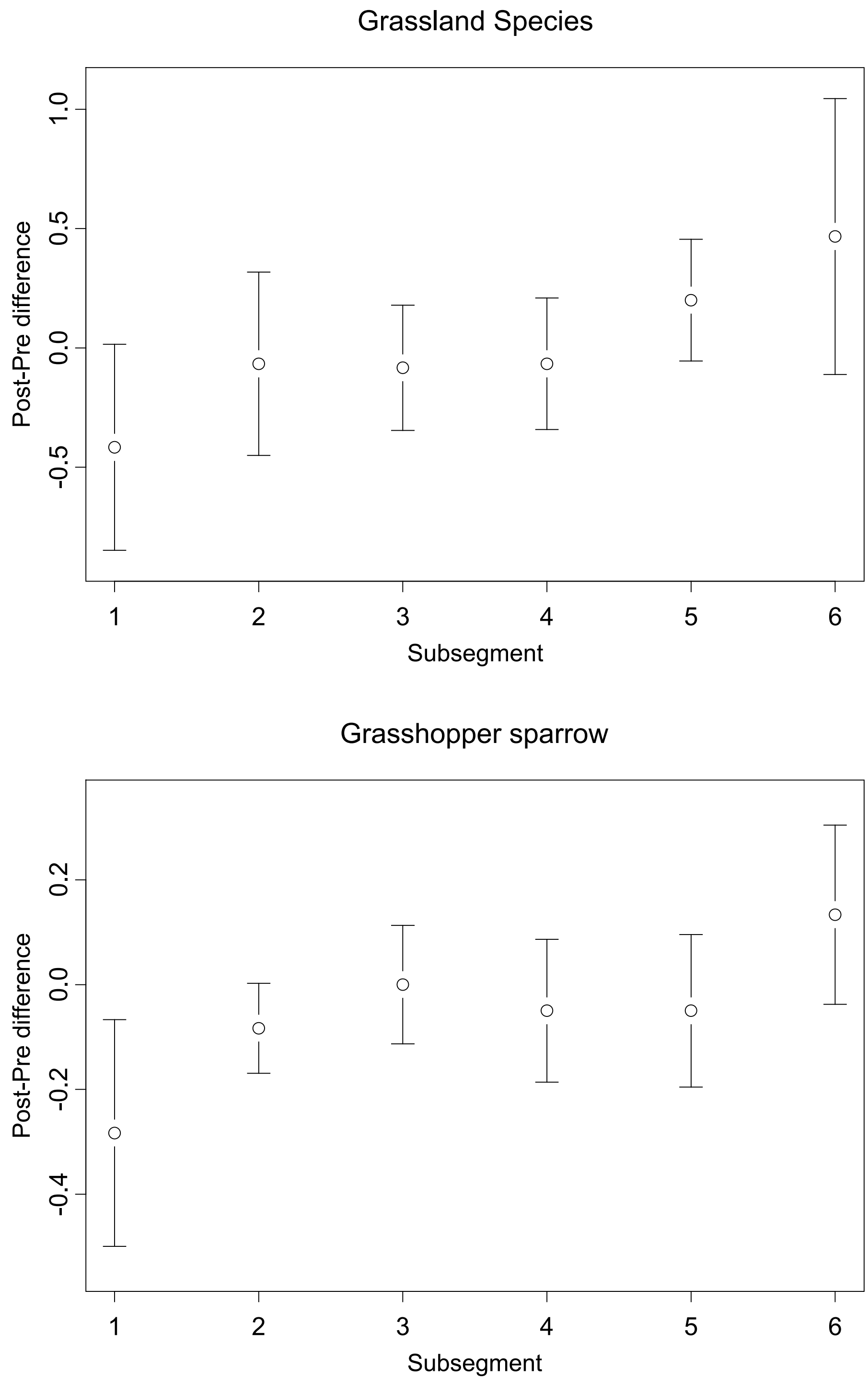


Figure 4. Differences in mean use (post-construction minus pre-construction) and 90% confidence intervals for grassland birds combined and for grasshopper sparrows. Subsegment 1: 0 – 50 m from turbine string; 2: 51-100 m; 3: 101-150 m; 4: 151-200 m; 5: 201-250 m; 6: 251-300 m. Confidence intervals that do not overlap the value 0 indicate statistically significant differences in the fatality rates.

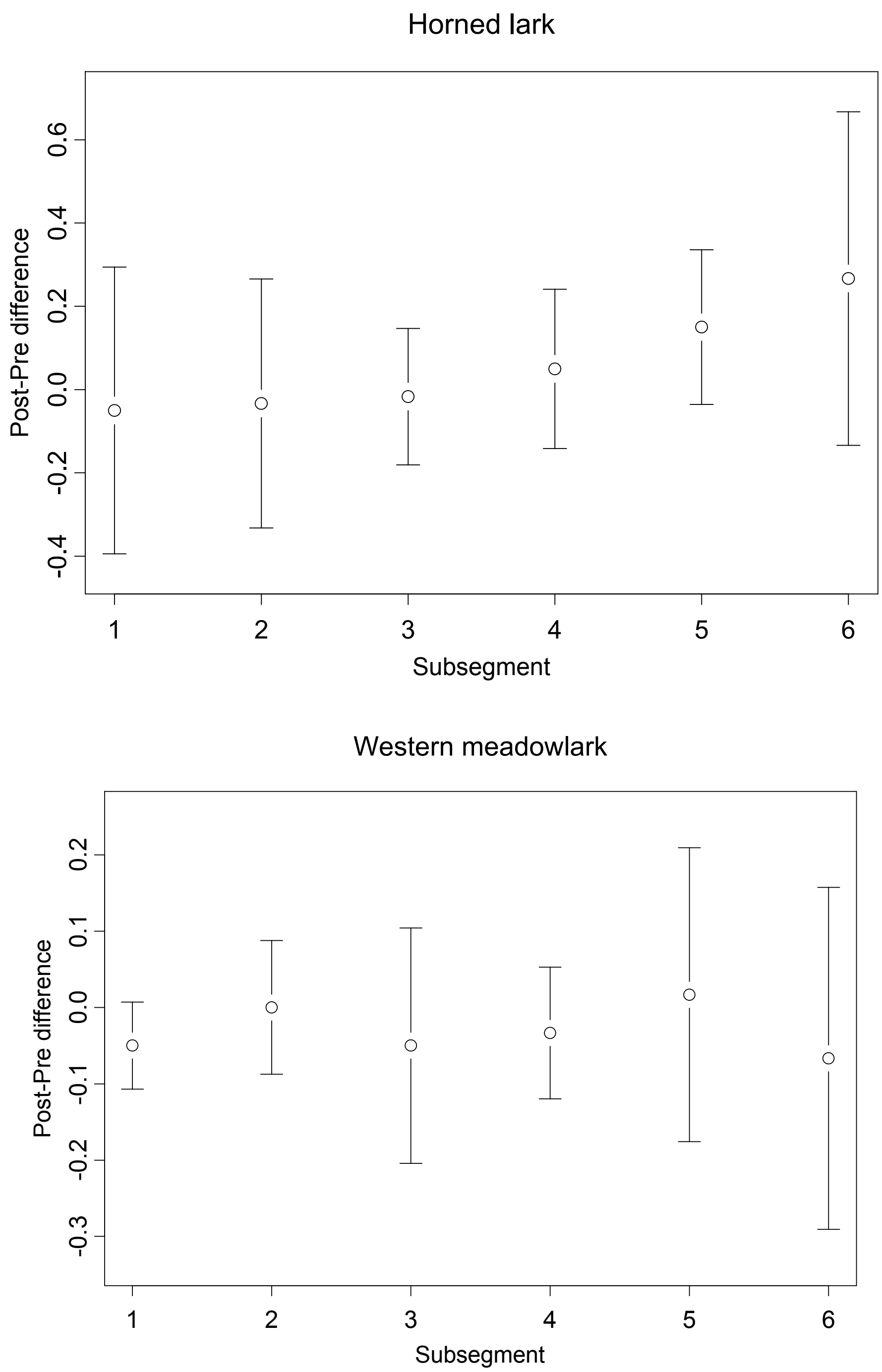


Figure 5. Differences in mean use (post-construction minus pre-construction) and 90% confidence intervals for horned lark and western meadowlark. Subsegment 1: 0– 50 m from turbine string; 2: 51-100 m; 3: 101-150 m; 4: 151-200 m; 5: 201-250 m; 6: 251-300 m. Confidence intervals that do not overlap the value 0 indicate statistically significant differences in the fatality rates.

APPENDIX A - DETAILED FATALITY RATE CALCULATIONS

Small Birds

Label	Parameter/Calculation	Number or Estimate	SE	90% Confidence Intervals LL	UL	Estimate Calculation
A	effective # turbines searched	146.50				
B	# fatalities observed	87				
C	average # days between searches	22.80				
D	average # months surveyed	13.30				
E	unadjusted fatalities per turbine per year	0.531	0.055	0.442	0.622	~(12*B)/(A*D)
F	observer detection rate	0.429	0.052	0.341	0.516	
G	mean removal time (days)	23.185	2.715	19.115	27.904	
Estimator 1						
H	probability a bird casualty is available and detected	0.412	0.055	0.320	0.505	~(G*F)/C
I	bias adjustment	2.472	0.353	1.978	3.129	~1/H
J	per turbine annual fatality estimate	1.313	0.235	0.973	1.732	~E/H or ~E*I
Estimator 2						
K	probability a bird casualty is available and detected	0.353	0.042	0.286	0.423	
L	bias adjustment	2.871	0.350	2.372	3.493	~1/K
M	per turbine annual fatality estimate	1.524	0.247	1.157	1.956	~E/K or E*L

Large Birds

Label	Parameter/Calculation	Number or Estimate	SE	90% Confidence Intervals LL	UL	Estimate Calculation
A	effective # turbines searched	146.50				
B	# fatalities observed	19				
C	average # days between searches	22.80				
D	average # months surveyed	13.30				
E	unadjusted fatalities per turbine per year	0.116	0.028	0.073	0.165	~(12*B)/(A*D)
F	observer detection rate	0.800	0.041	0.734	0.862	
G	mean removal time (days)	42.515	6.163	33.519	53.347	
Estimator 1						
H	probability a bird casualty is available and detected	0.800	0.041	0.734	0.862	~(G*F)/C
I	bias adjustment	1.253	0.066	1.160	1.362	~1/H
J	per turbine annual fatality estimate	0.146	0.036	0.090	0.206	~E/H or ~E*I
Estimator 2						
K	probability a bird casualty is available and detected	0.697	0.034	0.640	0.752	
L	bias adjustment	1.439	0.071	1.330	1.562	~1/K
M	per turbine annual fatality estimate	0.168	0.041	0.104	0.239	~E/K or E*L

Raptors

Label	Parameter/Calculation	Number or Estimate	SE	90% Confidence Intervals LL	UL	Estimate Calculation
A	effective # turbines searched	146.50				
B	# fatalities observed	6				
C	average # days between searches	22.80				
D	average # months surveyed	13.30				
E	unadjusted fatalities per turbine per year	0.037	0.018	0.012	0.069	~(12*B)/(A*D)
F	observer detection rate	0.800	0.041	0.734	0.862	
G	mean removal time (days)	42.515	6.163	33.519	53.347	
Estimator 1						
H	probability a bird casualty is available and detected	0.800	0.041	0.734	0.862	~(G*F)/C
I	bias adjustment	1.253	0.066	1.160	1.362	~1/H
J	per turbine annual fatality estimate	0.048	0.023	0.014	0.086	~E/H or ~E*I
Estimator 2						
K	probability a bird casualty is available and detected	0.697	0.034	0.640	0.752	
L	bias adjustment	1.439	0.071	1.330	1.562	~1/K
M	per turbine annual fatality estimate	0.053	0.026	0.016	0.100	~E/K or E*L

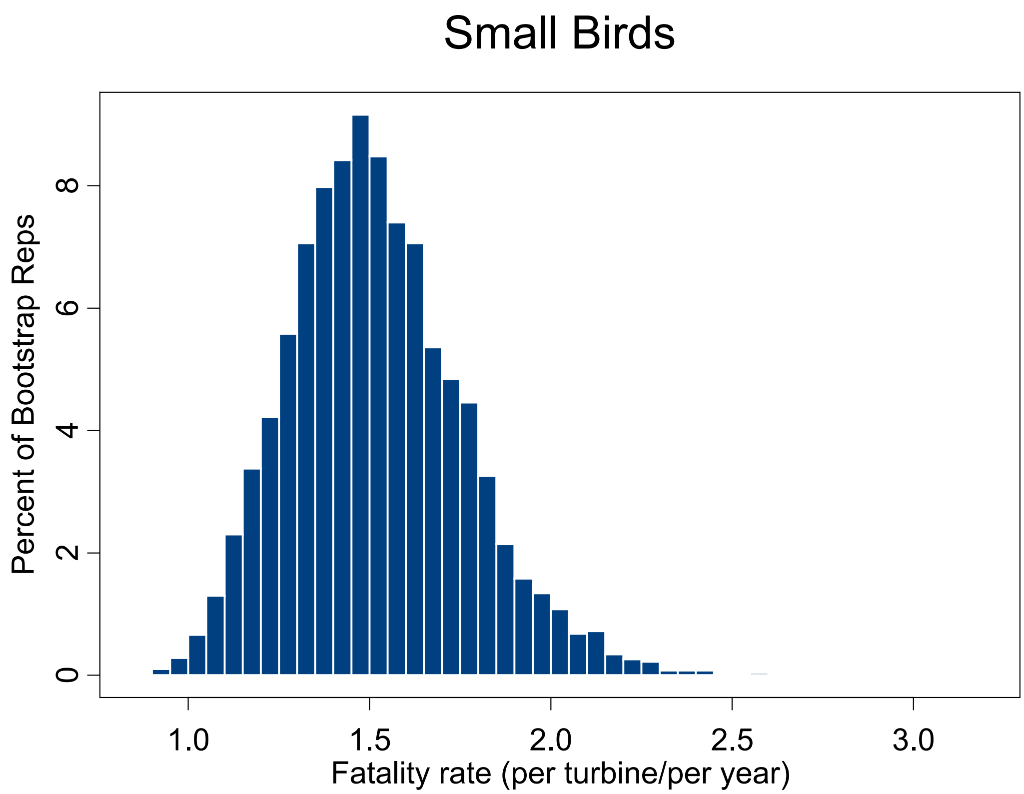
Grassland Birds

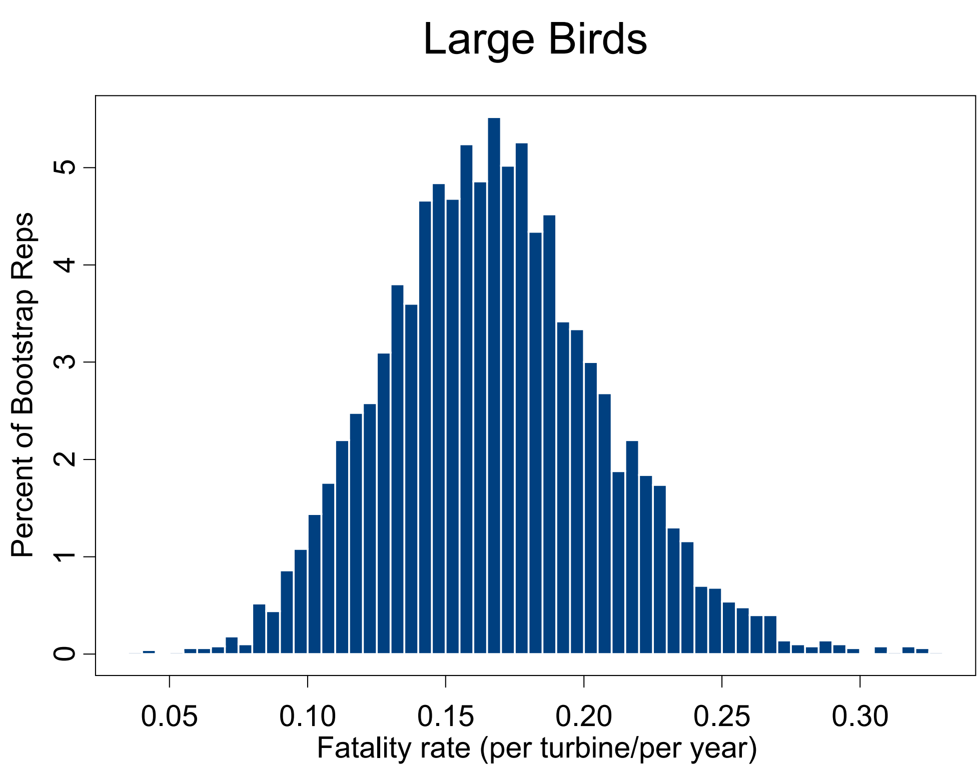
Label	Parameter/Calculation	Number or Estimate	SE	90% Confidence Intervals LL	UL	Estimate Calculation
A	effective # turbines searched	146.50				
B	# fatalities observed	71				
C	average # days between searches	22.80				
D	average # months surveyed	13.30				
E	unadjusted fatalities per turbine per year	0.434	0.050	0.353	0.517	~(12*B)/(A*D)
F	observer detection rate	0.43	0.05	0.34	0.52	
G	mean removal time (days)	23.19	2.715	19.115	27.904	
Estimator 1						
H	probability a bird casualty is available and detected	0.412	0.055	0.320	0.505	~(G*F)/C
I	bias adjustment	2.472	0.353	1.978	3.129	~1/H
J	per turbine annual fatality estimate	1.073	0.201	0.785	1.432	~E/H or ~E*I
Estimator 2						
K	probability a bird casualty is available and detected	0.35	0.04	0.29	0.42	
L	bias adjustment	2.871	0.350	2.372	3.493	~1/K
M	per turbine annual fatality estimate	1.246	0.212	0.932	1.624	~E/K or E*L

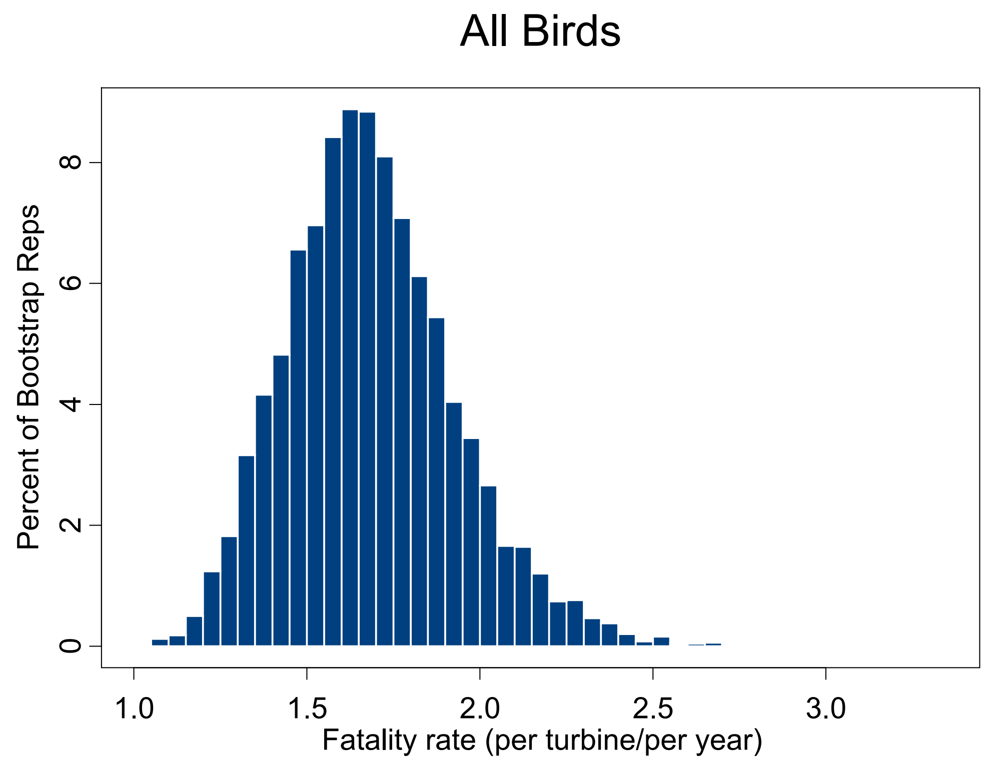
Bats

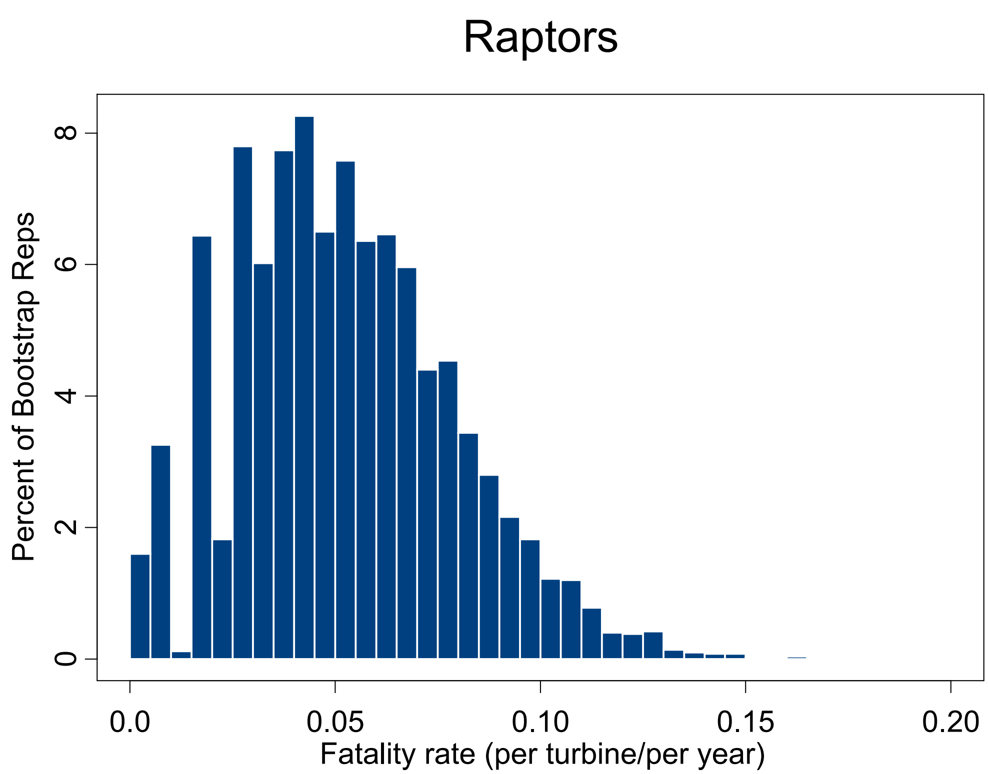
Label	Parameter/Calculation	Number or Estimate	SE	90% Confidence Intervals	UL	Estimate Calculation
A	effective # turbines searched	146.50				
B	# fatalities observed	54				
C	average # days between searches	22.80				
D	average # months surveyed	13.30				
E	unadjusted fatalities per turbine per year	0.329	0.057	0.238	0.427	~(12*B)/(A*D)
F	observer detection rate	0.429	0.052	0.341	0.516	
G	mean removal time (days)	23.19	2.715	19.115	27.904	
Estimator 1						
H	probability a bird casualty is available and detected	0.412	0.055	0.320	0.505	~(G*F)/C
I	bias adjustment	2.472	0.353	1.978	3.129	~1/H
J	per turbine annual fatality estimate	0.813	0.186	0.548	1.150	~E/H or ~E*I
Estimator 2						
K	probability a bird casualty is available and detected	0.353	0.042	0.286	0.423	
L	bias adjustment	2.871	0.350	2.372	3.493	~1/K
M	per turbine annual fatality estimate	0.945	0.204	0.646	1.312	~E/K or E*L

APPENDIX B - BOOTSTRAP DISTRIBUTION GRAPHS

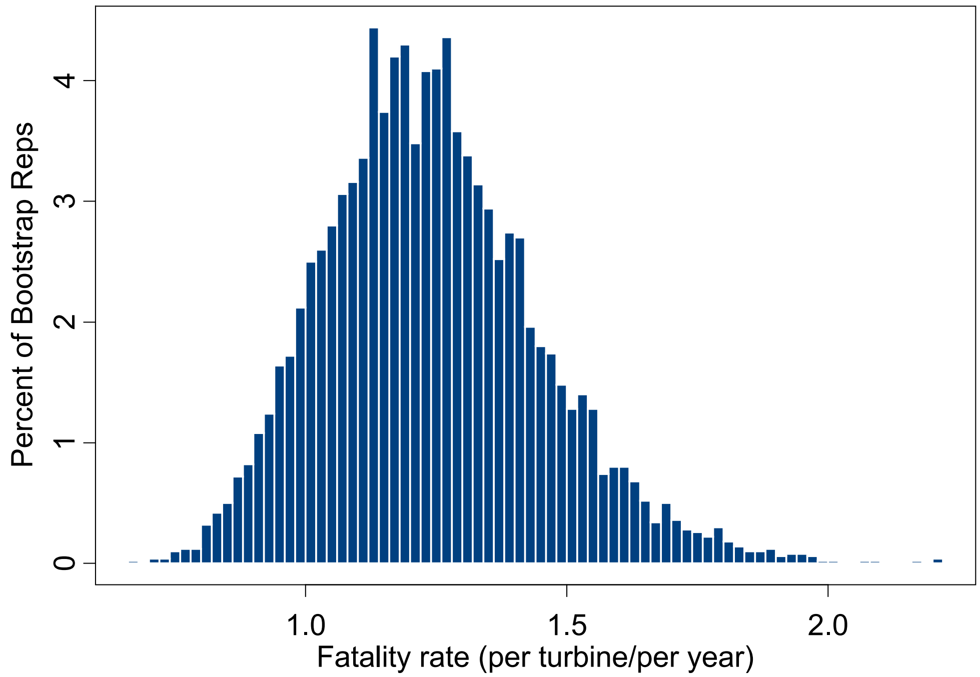




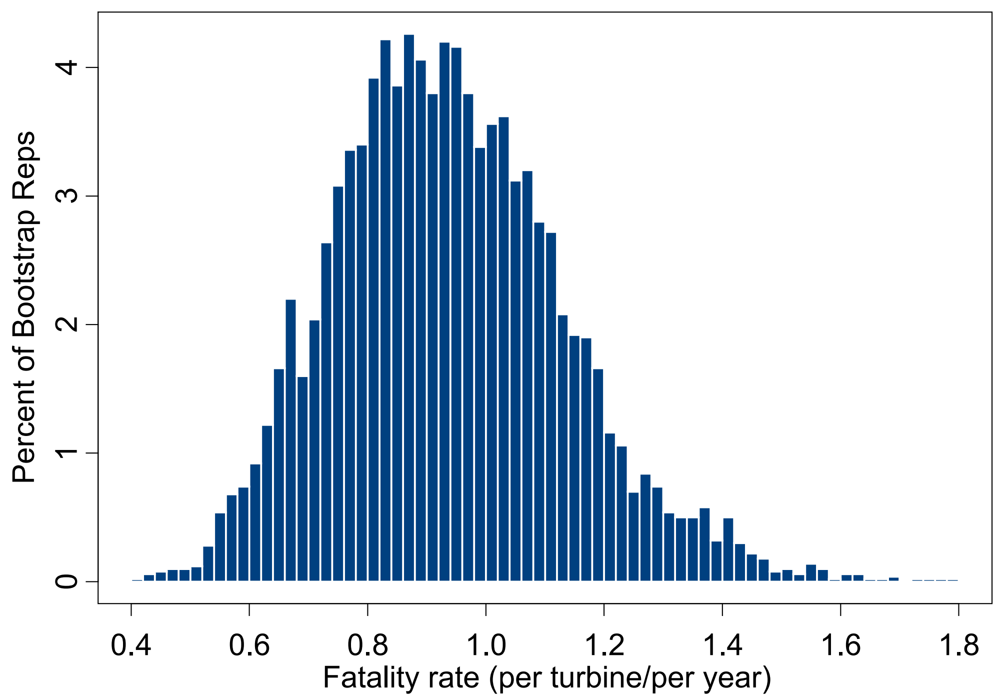

All Birds
Percent of Bootstrap Reps
0
2
4
6
8
1.0
1.5
2.0
2.5
3.0
Fatality rate (per turbine/per year)

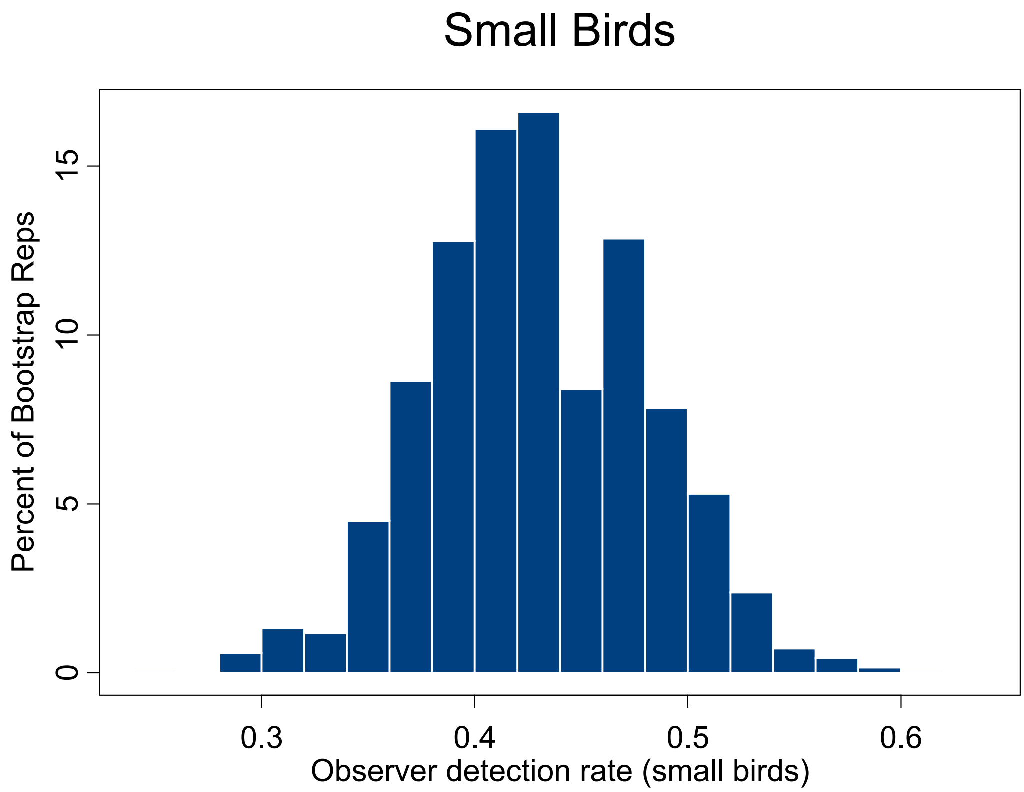

Raptors
Percent of Bootstrap Reps
0
2
4
6
8
0.0
0.05
0.10
0.15
0.20
Fatality rate (per turbine/per year)

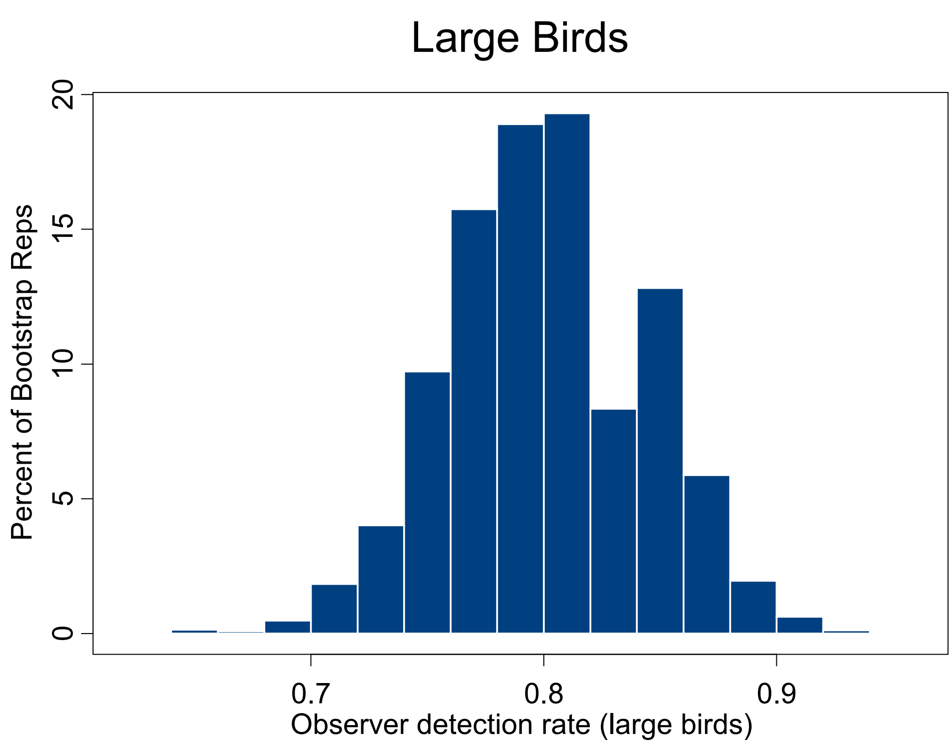
Grassland Birds



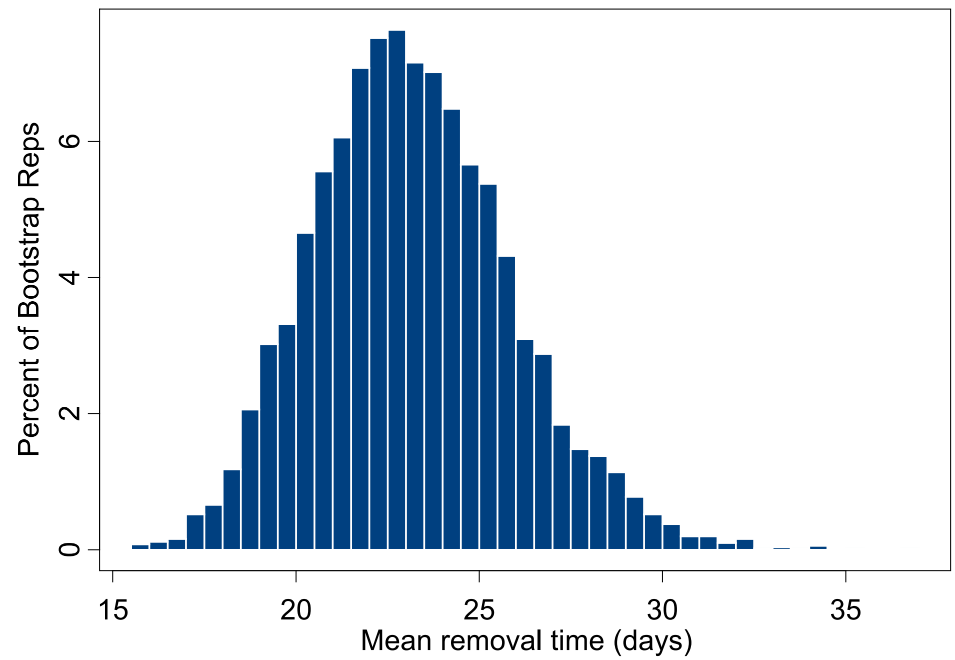
Bats



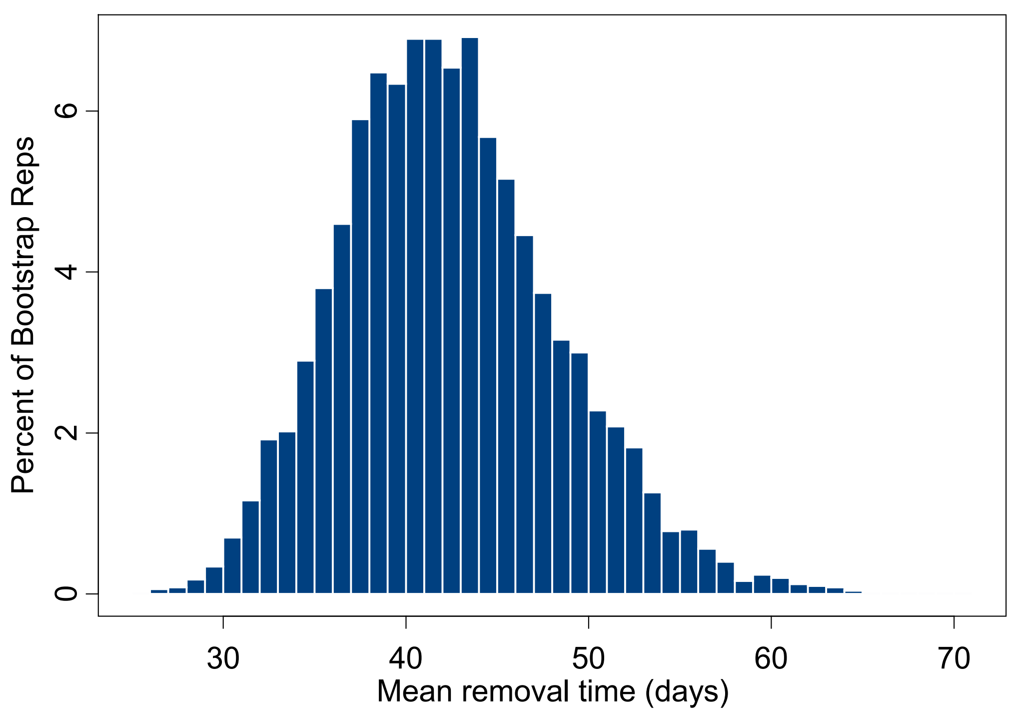

Small Birds
Percent of Bootstrap Reps
0
5
10
15
0.3
0.4
0.5
0.6
Observer detection rate (small birds)

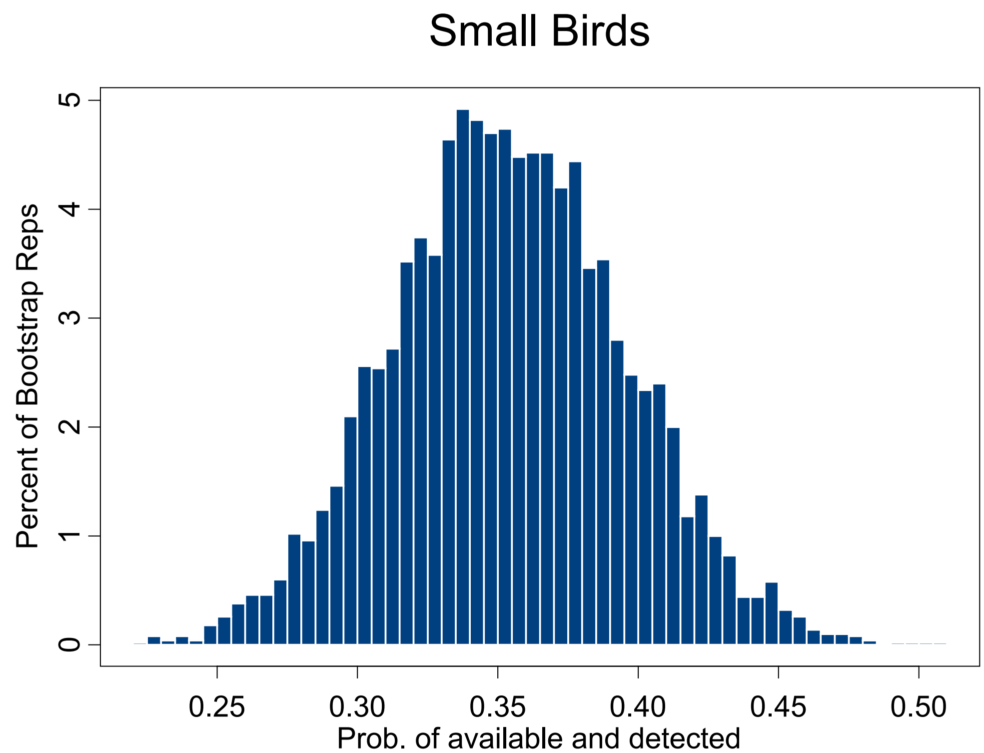

Large Birds
Percent of Bootstrap Reps
0
5
10
15
20
0.7
0.8
0.9
Observer detection rate (large birds)

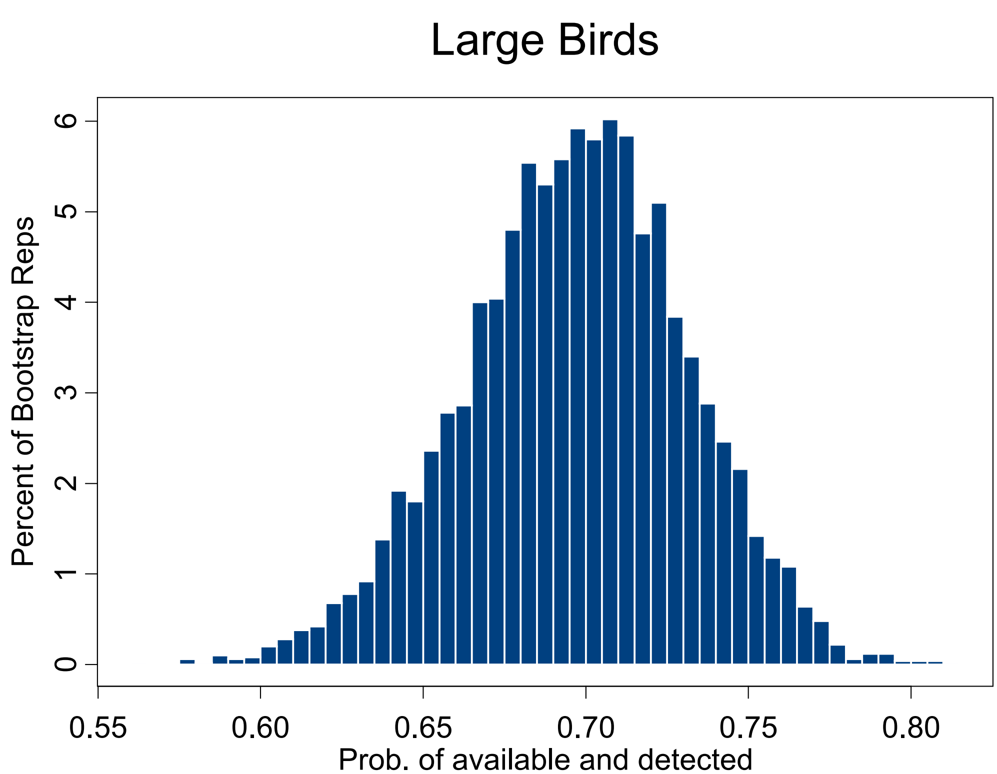
Small Birds



Large Birds




Small Birds
Percent of Bootstrap Reps
0
1
2
3
4
5
0.25
0.30
0.35
0.40
0.45
0.50
Prob. of available and detected


Large Birds
Percent of Bootstrap Reps
0
1
2
3
4
5
6
0.55
0.60
0.65
0.70
0.75
0.80
Prob. of available and detected