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Western EcoSystems Technology (WEST) provides environmental and statistical consulting services and contract research nationally and internationally for industry, government, and private organizations. We offer clients a unique combination of field ecology and statistics to help solve ongoing and contemporary natural resource problems.

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This report presents a comprehensive summary of wildlife fatality rates at wind energy facilities throughout the United States and Canada. These data are drawn from Renew, a database summarizing the direct impacts of renewable energy on wildlife, maintained by Western EcoSystems Technology (WEST). The full database contains the results of 646 fatality monitoring reports, archiving bat and bird fatalities associated with wind facilities over the last 25 years. The database contains a mix of confidential (23%) and public (77%) data, of which the latter is summarized in the following pages.

This is the second in a series of annual reports to update and expand the information contained herein. New this year are data from Canada, fatality rates estimated using GenEst, and a summary of what is known about fatalities of northern long-eared bats at wind facilities. This widespread and once common species is of special concern throughout its range in the United States and Canada, where disease-driven population declines have resulted in federal protections and special consideration in planning for wind development. We view this as the most current and comprehensive summary of fatalities for this species, and hope our readers find it a useful reference.

The primary intended use of this document is as a resource for wind energy companies and other stakeholders to compare fatality rates among similar facilities. WEST has published previous versions of these summaries in individual project reports, but we synthesize them here to provide a complete overview of fatality rates in the United States and Canada. To this end, our report is organized by region and by species group. We also highlight some of the analytical applications and challenges the Renew database is poised to address.

Our vision is for this database to be a trusted and comprehensive source for contextualizing fatality rates at any renewable energy facility in the world. By displaying this information publicly, we hope to engage in collaborative projects with stakeholders interested in the responsible development of wind energy and the reduction of its impacts on wildlife.
Fatalities at Wind Facilities

Northern Long-eared Bat

The northern long-eared bat (*Myotis septentrionalis*) is a federally protected species that occurs throughout the eastern United States and much of Canada. The first known fatalities of northern long-eared bats at a wind energy facility occurred in the central Allegheny Mountains in August 2003. Since then, there have been 56 total fatalities of northern long-eared bats reported throughout the range of the species.

When interpreting this summary, it is important to understand monitoring effort, species composition, and the impacts of disease on northern long-eared bat populations. The monitoring of wildlife fatalities at wind facilities is expensive, difficult, and usually voluntary. These factors result in imperfect detection of wildlife fatalities, particularly for cryptic species like the northern long-eared bat. It is likely that additional northern long-eared bat mortality has occurred at wind facilities throughout the range of the species. That being stated, northern long-eared bats account for less than 1% of all bat fatalities recorded in the United States and Canada. While northern long-eared bats were historically one of the most common bat species in North America, the fungal disease white-nose syndrome has drastically reduced their numbers, causing the species to be listed as federally endangered in Canada in 2014 and federally threatened in the United States in 2015. The disease was first detected in New York in 2006 and has since spread to 35 states and seven Canadian provinces, affecting nearly all of the species’ range. The most recent report of a northern long-eared bat fatality at a wind facility in North America was in 2015. We view the results in the following pages as the most current and comprehensive summary of fatalities for this species.

A number of wind companies have responded to the need to protect northern long-eared bats through the development of conservation plans. These programs take two main approaches to conserving northern long-eared bats: reducing the risk of collision with turbine blades through changes to operations, and mitigating unavoidable impacts from turbine operations. The first strategy, minimization, typically involves raising the nighttime wind speed at which turbine blades begin to rotate and produce energy. This is an effective strategy that reduces fatalities of bats, which tend to be most active at low wind speeds. The second strategy, mitigation, typically takes the form of an offsite conservation project, such as protecting important forest habitat or overwintering sites, intended to offset the impact of any incidental fatalities that do occur at these facilities.
Fatalities of northern long-eared bats by state or province, mapped against the species range. In the United States, each color represents a different US Fish and Wildlife Service region (some partial regions shown, see p 13). This represents all 56 public fatalities recorded throughout the United States and Canada since 2003.

In the United States, the first habitat conservation plan (HCP) for wind energy to include northern long-eared bats was finalized in 2015, the same year in which the species was first afforded federal protection under the Endangered Species Act. Since then, 13 other plans for this species have been finalized, while another is undergoing public review. The Iowa facilities are all covered under a single plan.
Fatalities of northern long-eared bats by year. This represents all 56 public fatalities recorded throughout the United States and Canada. White-nose syndrome, which has driven population declines in this and other bat species, was first detected in North America in 2006.

Fatalities of northern long-eared bats by month. This represents 53 fatalities recorded throughout the United States and Canada for which a date was reported.

DATABASE OVERVIEW

This report summarizes fatality rates at wind facilities throughout the United States and Canada. Standard inquiries like this are readily addressed with Renew in addition to many other relationships that can be explored.

The statistics below represent public reports entered into Renew through December 2020. These reports are either publicly available, or we have received owner permission to use them in composite results such as those presented here. The database has grown since our last report but the number of bat species has dropped slightly with the exclusion of Puerto Rico. Please see Agudelo et al. 2021 for a summary of Renew data from Latin America. Approximately one-half of the 47 bat species found in the United States and Canada have been documented as fatalities at wind facilities. This proportion is smaller for birds, with one-third of approximately 1,000 bird species recorded as fatalities.


<table>
<thead>
<tr>
<th>2019 report</th>
<th>2020 report</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>482</strong></td>
<td><strong>530</strong></td>
</tr>
<tr>
<td>studies from 1995 to 2018</td>
<td>studies from 1995 to 2020</td>
</tr>
<tr>
<td><strong>221</strong></td>
<td><strong>341</strong></td>
</tr>
<tr>
<td>facilities across 34 states</td>
<td>facilities across 38 states and 5 provinces</td>
</tr>
<tr>
<td><strong>27</strong></td>
<td><strong>24</strong></td>
</tr>
<tr>
<td>bat species</td>
<td>bat species</td>
</tr>
<tr>
<td><strong>336</strong></td>
<td><strong>349</strong></td>
</tr>
<tr>
<td>bird species</td>
<td>bird species</td>
</tr>
</tbody>
</table>
The Projects

Renew includes wind facilities with a wide range of project specifications. WEST is exploring how such specifications may influence fatality rates. Here, we summarize the facilities and studies in Renew by presenting turbine characteristics and the number of wildlife species recorded as fatalities.

<table>
<thead>
<tr>
<th>A typical project</th>
<th>The full range</th>
</tr>
</thead>
<tbody>
<tr>
<td>51 turbines</td>
<td>1–454 turbines</td>
</tr>
<tr>
<td>2 megawatts per turbine</td>
<td>0.2–3.3 megawatts per turbine</td>
</tr>
<tr>
<td>99 total megawatts</td>
<td>0.75–750 total megawatts</td>
</tr>
<tr>
<td>88 rotor diameter (meters)</td>
<td>27–125 rotor diameter (meters)</td>
</tr>
<tr>
<td>80 hub height (meters)</td>
<td>30–120 hub height (meters)</td>
</tr>
<tr>
<td>4 bat species</td>
<td>0–9 bat species</td>
</tr>
<tr>
<td>11 bird species</td>
<td>0–49 bird species</td>
</tr>
</tbody>
</table>

1 A typical project refers to the median of our dataset.
Over the years, the wind industry and wildlife agencies have worked together to find ways to avoid, minimize, and mitigate impacts to wildlife. For example, careful consideration is given to siting both facilities and individual turbines to avoid impacts to birds and bats. In the United States, guidelines on siting, monitoring, and mitigation are issued primarily by the US Fish and Wildlife Service (USFWS), whereas each provincial agency issues its own guidelines for wind and wildlife. Rarely does the Canadian federal government get involved in wind development or mitigation, unless projects are sited on federal lands (for example, First Nations’ land, Crown land).

When impacts to protected wildlife are deemed unavoidable, wind companies may mitigate through conservation easements, power pole retrofits, lead abatement programs, or other efforts. Curtailment strategies are regularly employed for bats, and acoustic and ultraviolet light deterrents are being developed to discourage bats from approaching turbines. These strategies may be formalized in agreements between wind operators and the USFWS in the form of a habitat conservation plan, eagle conservation plan, or bird and bat conservation strategy. In contrast, the approach in Canada is much more fluid, with some provinces requiring curtailment for bats (e.g., Ontario) while implementing ad hoc approaches to mitigation. In both countries, continued research and coordination between the wind industry and wildlife agencies are essential to understanding and minimizing impacts to wildlife at wind facilities. The further development of Renew, the American Wind Wildlife Information Center, and Canada’s Wind Energy Bird and Bat Monitoring Database is key to supporting these efforts.

In some places, post-construction monitoring is compulsory, while elsewhere it is the exception rather than the rule. Monitoring may be conducted to quantify ecological baselines, track fatalities of endangered and threatened species, or to provide data to inform adaptive management. Throughout North America, it is most often used to demonstrate adherence to agency guidelines, compliance with permits, or to confirm the efficacy of a particular risk reduction strategy such as curtailment or deterrents.
In the United States, the USFWS’s 2012 Land-based Wind Energy Guidelines are a voluntary system for evaluating and addressing the potential impacts of wind energy on wildlife of conservation concern. Many wind facilities conduct one to two years of post-construction fatality monitoring as a best practice. In Canada, provincial wildlife agencies require a minimum of two or three years of post-construction monitoring, and mitigation is normally done in consultation with the provincial agency.

<table>
<thead>
<tr>
<th>United States</th>
<th>Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>agencies</strong></td>
<td></td>
</tr>
<tr>
<td>US Fish &amp; Wildlife Service, state wildlife agencies</td>
<td>Provincial agencies (e.g., Alberta Environment &amp; Parks, Ontario Ministry of Natural Resources &amp; Forestry)</td>
</tr>
<tr>
<td><strong>laws</strong></td>
<td></td>
</tr>
<tr>
<td>Endangered Species Act, Bald and Golden Eagle Protection Act, Migratory Bird Treaty Act</td>
<td>Species at Risk Act, Migratory Birds Convention Act, provincial wildlife acts</td>
</tr>
<tr>
<td><strong>guidelines</strong></td>
<td></td>
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<tr>
<td>USFWS Land-based Wind Energy Guidelines</td>
<td>Provincial guidelines (e.g., Wildlife Directive for Alberta Wind Energy Projects, Ontario's Bats and Bat Habitats: Guidelines for Wind Power Projects)</td>
</tr>
<tr>
<td><strong>tools</strong></td>
<td></td>
</tr>
<tr>
<td>Habitat conservation plans, eagle conservation plans, bird and bat conservation strategies</td>
<td>Approaches negotiated on a project-by-project basis with the provincial wildlife agency</td>
</tr>
</tbody>
</table>
Generally, methods for monitoring fatalities are similar across projects, but may be adjusted to accommodate the unique characteristics of a facility or changing conditions at a site. To estimate fatality rates, a trained observer systematically searches predefined areas around turbines for carcasses. In some cases, especially in agricultural settings, an extended search area is cleared of vegetation to improve detection of carcasses.

Even experienced searchers will not find every bird or bat carcass during the monitoring period. It is standard practice to develop and apply adjustment factors to account for missed carcasses, those removed by scavengers, or those that fell outside search areas. “Bias trials” measure how effectively searchers detect carcasses (searcher efficiency) and the rates at which carcasses remain available to be found (carcass persistence). Additionally, researchers can estimate the proportion of carcasses in areas not searched (search area adjustment). These factors are combined to estimate an overall detection probability, which is used to adjust the raw counts of carcasses to produce an estimated fatality rate (individuals per megawatt or per turbine), along with a measure of confidence in that estimate.

The following are the typical inputs incorporated into a fatality estimate:

**Carcass surveys**
- Carcass count – number and species of individuals found
- Search schedule – frequency and date range of searches
- Search area – adjustment to account for carcasses located in areas not searched

**Bias trials**
- Searcher efficiency – the probability carcasses were found by searchers
- Carcass persistence – the probability carcasses remain available to be found during the search interval
A facility's location, project characteristics, and monitoring methodology should be considered when interpreting fatality estimates. With Renew, there are many opportunities to explore the relationships between these potential sources of variation and fatality rates in future analyses. Except where noted, these differences are not addressed in the comparison figures presented in this report. Salient caveats to combining estimates across studies are described below.

**Geographic Representation**

There are around 125 gigawatts of installed wind generation capacity in the United States and Canada. Although not all facilities have been monitored and not all post-construction monitoring reports are available to the public, we have information in the database for many of them. Renew represents roughly 33% of the total installed capacity in the United States and Canada, while the public portion of the database represents around 25% of installed capacity. The database covers more than half of the installed capacity for 11 states and two provinces.
Landscape Context
USFWS regions and Canadian provinces are administrative units often used when comparing fatality rates across broad spatial scales. However, biological comparisons amongst projects are most meaningful when habitats or species composition are similar across facilities. Our database catalogs land cover types for each project so habitat can be used in analyses at finer spatial scales.

Search Area Coverage
All post-construction monitoring studies are not implemented identically. Estimated fatality rates are influenced by study design features such as plot shape and size. Ideally, plots would be large enough to encompass carcasses landing at any distance from a searched turbine, but this is usually not the case. Researchers have developed distributions of the expected proportion of carcasses landing at different distances from turbines. We have estimated (but not corrected for) the impact of this caveat using these distributions across the range of plot sizes in our comparisons. The table below shows the probable percentage of carcasses missed for common turbine sizes (1.5 - 2.5 megawatts).

<table>
<thead>
<tr>
<th>Plot Radius in Meters</th>
<th>60</th>
<th>90</th>
<th>100</th>
<th>170</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bat</td>
<td>3-9</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Small Bird</td>
<td>10-16</td>
<td>0-1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Raptor</td>
<td>27</td>
<td>8</td>
<td>6</td>
<td>1</td>
</tr>
</tbody>
</table>

Fatality Estimator
The science of calculating a precise and unbiased fatality estimate from a post-construction monitoring study has evolved over the years. Shoenfeld and Huso estimates are the most commonly reported and are present in similar frequencies in Renew. This year we include Jain estimates as well. Estimates calculated with the Generalized Estimator (GenEst) are now included in Renew for the first time. Broader adoption of GenEst will improve the comparability of future fatality estimates. Ontario uses its own estimator, so we’ve included these and other estimators in reporting for Canada.

Further Reading
Typically, post-construction monitoring studies are designed to answer the following questions: What are the bird and bat fatality rates for the project? How do the fatality rates compare to those from existing projects in similar landscapes with similar species composition and use? Here, we achieve this comparison by examining fatality rates throughout the United States and Canada.

Most public data come from Canada and the USFWS Midwest and Northeast regions. The Southeast has little data because there are few wind facilities;
there are two public reports from a single facility for the approximately 240 megawatts of installed capacity in this region. There is one public report for the approximately 64 megawatts of installed capacity in the Alaska Region, but it does not include fatality estimates. We therefore do not summarize data from the Southeast or Alaska regions in the pages that follow. In contrast, the Southwest Region has many wind facilities, but few public monitoring reports. Of all the regions, the Pacific Southwest has the highest rate of public reporting at nearly 80% of installed capacity.

**Inclusion Criteria**

For comparability, we restricted estimates based on statistical approach, study duration and timing, and search interval. Modern analyses routinely measure two sources of bias: searcher efficiency and carcass persistence. The comparisons presented here are limited to estimates that were adjusted for these two factors. Risk to wildlife and the resulting fatalities at wind facilities differ seasonally and between species groups. Therefore, we also restricted our results to study periods that covered—at a minimum—peak risk for birds (April 15 to October 15) and bats
The comparison figures

Each bar graph depicts the estimated number of wildlife fatalities per megawatt per year from recent public studies. We present estimates for all bat species, all bird species, and diurnal raptors (excluding vultures). Fatality estimates for diurnal raptors are reported separately because of their special interest to developers and wildlife managers. For results combined across the United States and Canada, we present the 60 most recent public studies to convey the range of recent fatality estimates.

For each region, we present up to 30 of the most recent studies. Results from each facility are represented by a serial number and the year in which the study was conducted, such that there may be fewer than 30 facilities represented on any one graph. Facilities with more than one study are labeled with the same number. For example, 4-2014 and 4-2015 would represent a single facility within a given region for which we had access to fatality estimates from 2014 and 2015. Estimates of zero are also included with a facility number and year. For some studies, fatality estimates are available for some species groups but not others. This results in a different number of facilities and years displayed in each graph within a region.

The Historic Maximum

For each region, we also present the highest fatality rate that meets the criteria for inclusion in comparison figures, including the year and state in which it was recorded. These records may predate the 60 most recent results, in which case they will not be found in the comparison figure.

In most cases, the historic minimum fatality rate was zero, so we've not summarized this information region by region. In all cases, the minimum estimated fatality rate was less than or equal to 0.2 individuals per megawatt per year.
The Regions at a Glance

For each set of regional comparisons, we present an overview of the public data in the database. We provide the number of states or provinces for which we have reports out of the total number of states or provinces with wind facilities. We also report the number of facilities for which we have data out of the approximate number of wind facilities cataloged in the U.S. Wind Turbine Database and the Canadian Wind Turbine Database. The number of species reported as fatalities is compared to the potential number of species in each region. For bats, the number of species in each region came from an American Wind Wildlife Information Center report. For birds, the number of species in each region was approximated using Avibase.

The Top Five Species

The most commonly reported species are generated from raw count data and do not include individuals that were unable to be identified to species. Carcasses found incidentally (i.e., not found during regularly scheduled searches) are included in this dataset. Bias adjustment factors are rarely estimated for individual species, so the percentages reported here do not take species-specific detectability into account. We also include the combined total diurnal raptor composition as a percentage of all bird fatalities.
Of the 60 most recent public study results in the database between 2015 and 2018, fatality estimates ranged from 0–45 bats per megawatt per year. Projects in the Southwest and Midwest had some of the highest fatality estimates for bats; facilities in the Pacific Southwest and Northeast had some of the lowest. For one project, zero bats were found.

**Bat fatalities per megawatt**

- **Canada**: 7.8 (Ontario 2014)
- **Northeast**: 40.2 (West Virginia 2012)
- **Midwest**: 61.8 (Iowa 2015)
- **Pacific**: 9.3 (Idaho 2014)
- **Mountain-Prairie**: 8.2 (Kansas 2017)
- **Southwest**: 44.6 (Texas 2016)

**Historic maximum**

- **Pacific Southwest**: 3.8 (California 2011)
Of the 60 most recent public study results between 2015 and 2018, fatality estimates ranged from 0–8.7 birds per megawatt per year. These estimates represent all bird species, including raptors. Because of regulatory concerns specific to diurnal raptors, fatality estimates for this group are additionally reported in the following pages. Projects in the Midwest had some of the highest fatality estimates for birds, while those in the Pacific Southwest had some of the lowest. For one project, zero birds were found.
Of the 60 most recent public study results between 2011 and 2018, fatality estimates ranged from 0–0.40 diurnal raptors per megawatt per year. The highest single fatality rate was reported from a project in the Southwest, followed by facilities in the Pacific and Northeast regions. For 11 projects, zero diurnal raptors were found.
At a glance of Canada:

- 5 of 10 provinces
- 127 reports
- 65 of 268 facilities
- 9 of 18 bat species
- 149 of approximately 700 bird species

### Bats

- **Hoary bat (36%)**
  - Lasiurus cinereus
- **Silver-haired bat (25%)**
  - Lasiemycteris noctivagans
- **Eastern red bat (16%)**
  - Lasiurus borealis
- **Big brown bat (13%)**
  - Eptesicus fuscus
- **Little brown bat (10%)**
  - Myotis lucifugus

**Time Series Bar Chart:**

Bat fatalities/megawatt/year from 1st January 2015 to 22nd December 2016.
birds

golden-crowned kinglet (12%)
Regulus satrapa

horned lark (6%)
Eremophila alpestris

red-eyed vireo (6%)
Vireo olivaceus

tree swallow (6%)
Tachycineta bicolor

turkey vulture (5%)
Cathartes aura

raptors

Totaling less than 7% of all birds

red-tailed hawk
Buteo jamaicensis

Swainson’s hawk
Buteo swainsoni

Cooper’s hawk
Accipiter cooperii

rough-legged hawk
Buteo lagopus

bald eagle
Haliaeetus leucocephalus
NORTHEAST REGION

at a glance

8 of 12 states
95 reports
58 of 167 facilities
9 of 14 bat species
140 of approximately 400 bird species

bats

hoary bat (37%)
Lasius cinereus

eastern red bat (27%)
Lasius borealis

silver-haired bat (15%)
Lasionycteris noctivagans

little brown bat (8%)
Myotis lucifugus

tri-colored bat (8%)
Perimyotis subflavus
**birds**

*red-eyed vireo (20%)*  
*Vireo olivaceus*

*golden-crowned kinglet (7%)*  
*Regulus satrapa*

*magnolia warbler (6%)*  
*Setophaga magnolia*

*blackpoll warbler (3%)*  
*Setophaga striata*

*black-throated blue warbler (3%)*  
*Setophaga caerulescens*

---

**raptors**

Totaling less than 4% of all birds

*red-tailed hawk*  
*Buteo jamaicensis*

*sharp-shinned hawk*  
*Accipiter striatus*

*broad-winged hawk*  
*Buteo platypterus*

*American kestrel*  
*Aquila cooperi*

*osprey*  
*Pandion haliaetus*
**Midwest Region**

*At a glance*

- 8 of 8 states
- 96 reports
- 81 of 380 facilities
- 10 of 16 bat species
- 159 of more than 400 bird species

**Bats**

- **Eastern red bat (39%)**
  *Lasiurus borealis*
- **Hoary bat (27%)**
  *Lasiurus cinereus*
- **Silver-haired bat (20%)**
  *Lasionycteris noctivagans*
- **Big brown bat (8%)**
  *Eptesicus fuscus*
- **Little brown bat (3%)**
  *Myotis lucifugus*
birds

- horned lark (11%)  
  Eremophila alpestris
- killdeer (8%)  
  Charadrius vociferus
- golden-crowned kinglet (6%)  
  Regulus satrapa
- mourning dove (4%)  
  Zenaida macroura
- ruby-crowned kinglet (4%)  
  Regulus calendula

raptors

Totaling less than 6% of all birds

- red-tailed hawk  
  Buteo jamaicensis
- bald eagle  
  Haliaeetus leucocephalus
- American kestrel  
  Falco sparverius
- sharp-shinned hawk  
  Accipiter striatus
- Cooper's hawk  
  Accipiter cooperii
Pacific Southwest Region

at a glance

2 of 2 states
53 reports
38 of 107 facilities
10 of 25 bat species
148 of more than 500 bird species

bats

Mexican free-tailed bat (61%)
Tadarida brasiliensis

hoary bat (32%)
Lasiurus cinereus

silver-haired bat (4%)
Lasionycteris noctivagans

western red bat (1%)
Lasiurus blossevillii

big brown bat (<1%)
Eptesicus fuscus
birds

western meadowlark (9%)
*Sturnella neglecta*

mourning dove (6%)
*Zenaida macroura*

horned lark (5%)
*Eremophila alpestris*

red-winged blackbird (4%)
*Agelaius phoeniceus*

California quail (4%)
*Calipepla californica*

---

raptors

Totaling less than 20% of all birds

red-tailed hawk
*Buteo jamaicensis*

American kestrel
*Falco sparverius*

golden eagle
*Aquila chrysaetos*

northern harrier
*Circus hudsonius*

ferruginous hawk
*Buteo regalis*
PACIFIC REGION

**at a glance**

- 4 of 4 states
- **51** reports
- 40 of 74 facilities
- **7** of 17 bat species
- **126** of more than 500 bird species

**bats**

- **hoary bat (51%)**  
  *Lasiurus cinereus*
- **silver-haired bat (45%)**  
  *Lasionycteris noctivagans*
- **little brown bat (2%)**  
  *Myotis lucifugus*
- **big brown bat (<1%)**  
  *Eptesicus fuscus*
- **Hawaiian hoary bat (<1%)**  
  *Lasiurus cinereus semotus*

**top 5 species**

![Bat fatalities chart]
**birds**

*horned lark (31%)*
*Eremophila alpestris*

*gray partridge (7%)*
*Perdix perdix*

*golden-crowned kinglet (5%)*
*Regulus satrapa*

*ring-necked pheasant (5%)*
*Phasianus colchicus*

*mourning dove (3%)*
*Zenaida macroura*

**raptors**

*Totaling less than 9% of all birds*

*red-tailed hawk*
*Buteo jamaicensis*

*American kestrel*
*Falco sparverius*

*Swainson’s hawk*
*Buteo swainsoni*

*golden eagle*
*Aquila chrysaetos*

*rough-legged hawk*
*Buteo lagopus*
at a glance

8 of 8 states
39 reports
34 of 188 facilities
10 of 26 bat species
130 of approximately 450 bird species

bats

hoary bat (53%)  
Lasiurus cinereus

silver-haired bat (17%)  
Lasionycteris noctivagans

eastern red bat (15%)  
Lasiurus borealis

Mexican free-tailed bat (7%)  
Tadarida brasilienis

little brown bat (4%)  
Myotis lucifugus
**birds**

- horned lark (24%)  
  *Eremophila alpestris*
- ring-necked pheasant (6%)  
  *Regulus satrapa*
- mallard (4%)  
  *Anas platyrhynchos*
- mourning dove (3%)  
  *Zenaida macroura*
- western meadowlark (3%)  
  *Sturnella neglecta*

**raptors**

Top 5 species:

- golden eagle  
  *Aquila chrysaetos*
- red-tailed hawk  
  *Buteo jamaicensis*
- American kestrel  
  *Falco sparverius*
- bald eagle  
  *Haliaeetus leucocephalus*
- Swainson’s hawk  
  *Buteo swainsoni*
**SOUTHWEST REGION**

**at a glance**

- **4 of 4 states**
- **19 reports**
- **20 of 228 facilities**
- **16 of 43 bat species**
- **79 of approximately 550 bird species**

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**bats**

- **Mexican free-tailed bat (41%)**
  *Tadarida brasiliensis*
- **northern yellow bat (29%)**
  *Lasiurus intermedius*
- **hoary bat (10%)**
  *Lasiurus cinereus*
- **evening bat (10%)**
  *Nycticeius humeralis*
- **southern yellow bat (7%)**
  *Lasiurus ega*
**birds**

- **mourning dove (23%)**  
  *Zenaida macroura*
- **horned lark (18%)**  
  *Eremophila alpestris*
- **turkey vulture (7%)**  
  *Cathartes aura*
- **northern bobwhite (4%)**  
  *Colinus virginianus*
- **common nighthawk (3%)**  
  *Chordeiles minor*

**raptors**

- **Swainson’s hawk**  
  *Buteo swainsoni*
- **American kestrel**  
  *Falco sparverius*
- **red-tailed hawk**  
  *Buteo jamaicensis*
- **white-tailed hawk**  
  *Geranoaetus albicaudatus*
- **golden eagle**  
  *Aquila chrysaetos*
The following is a complete list of every public post-construction monitoring report housed in Renew. This year’s report is limited to studies conducted in the United States and Canada, but we have also archived information from other countries. References for northern long-eared bat fatalities are shown in bold.

2020


2019


2018


2017


2016


2015


Fagen Engineering, LLC. 2015. 2014 Avian and Bat Monitoring Annual Report: Big Blue Wind Farm, Blue Earth, Minnesota. Prepared for Big Blue Wind Farm. Prepared by Fagen Engineering, LLC.


2014


Fagen Engineering, LLC. 2014. 2013 Avian and Bat Monitoring Annual Report: Big Blue Wind Farm, Blue Earth, Minnesota. Prepared for Big Blue Wind Farm, Prepared by Fagen Engineering, LLC. May 2014.


2013


2012


2011


2010


2009


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55


2008


2007


2006


2005


2004


2003


2002


2000


1996
