



REWI

Renewable Energy Wildlife Institute

TECHNICAL REPORT

3rd Edition: Summary of Bird Fatality Monitoring Data Contained in AWWIC

Prepared By:

Eric Schaubert, Ph.D., REWI Director of Research & Programs

Ryan Butryn, M.Sc., REWI Information Science Lead

Shilo Felton, Ph.D., REWI Senior Scientist, Wind Program Lead

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REWI Technical Report:

3rd Edition: Summary of Bird Fatality Data Contained in AWWIC Land-based Wind Energy Monitoring Database

Renewable Energy Wildlife Institute
700 12th Street NW, Suite 700
Washington, DC 200065
www.rewi.org

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About the Renewable Energy Wildlife Research Institute

The [Renewable Energy Wildlife Institute](http://www.rewi.org) (REWI) is an independent 501(c)3 organization that develops and leverages scientific research around renewable energy interactions with wildlife, habitats, and ecosystems. Built on a partnership of renewable energy companies, conservation and science organizations, and public agencies, REWI develops innovative approaches and independent results that advance renewable energy expansion while meeting conservation goals.

About the American Wind Wildlife Information Center

The [American Wind Wildlife Information Center](http://www.rewi.org) (AWWIC) is a voluntary, cooperative initiative of wind energy companies and REWI to expand the availability and utility of data collected around wind turbines and better understand the patterns and drivers of impacts between wind energy and wildlife. This effort goes beyond mandatory permit reporting requirements to aggregate data across multiple projects and companies to better understand interaction drivers and minimize wildlife risk. AWWIC is designed to maintain the confidentiality of non-public data while making more data available to support research.

Find this document online once published at <https://rewi.org/resources/awwic-bird-technical-report-ed3/>

Acknowledgments

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Prepared By

Eric M. Schaubert, PhD, REWI Director of Research and Programs
Ryan Butryn, REWI Senior Information Science Manager
Shilo Felton, PhD, REWI Senior Scientist, Wind Program Lead

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Executive Summary

This report aims to provide the most up-to-date understanding of the patterns and variability in species composition, timing, and magnitude of bird collisions with land-based wind energy turbines to support research and insight. Findings are useful in checking assumptions and setting expectations about collision risks at wind energy facilities, as well as generating testable hypotheses.

Background

This report summarizes data from **331 post-construction mortality monitoring studies** conducted **over 21 years** and **across 254 land-based wind energy projects in the United States**.

- The AWWIC database contains fatality estimates and protocols used to develop those estimates, individual fatality incident records, and information about the wind energy project itself (such as turbine size, installed capacity, ecoregion).
- Most studies and search data represented in AWWIC are from the Prairie avifaunal biome, which contains 70% of installed wind energy capacity in the U.S.

Carcass detection insights

- **Approximately 60% of carcasses were found within 50 m and 80% were found within 80 m** when searches extended at least 100 m from the turbine. No difference observed in fall distance distribution between large and small birds.
- **Full plot searches provided much greater density weighted proportion (DWP) for both small and large birds** (median 0.89 and 0.88, respectively) than road-and-pad searches provided (median 0.14 and 0.10, respectively).
- **Large bird carcasses persisted on the landscape longer than small birds** (6.7 vs. 4 days on average) and were more likely to be found by surveyors than small bird carcasses (90% vs. 67%).

Insights regarding bird fatalities

- **Bird fatality incidents were rare, but widespread:** Nearly all (98%) studies report at least 1 bird fatality, yet 98.1% of turbine-searches found zero carcasses.
- **Estimated bird fatality rates differed greatly among studies:** Many had low fatality estimates and few had high values. Median fatality estimates were similar across avifaunal biomes (regions).
 - The median fatality estimate for all birds in the U.S. is 1.9 birds per MW per year and 3.9 birds per turbine per year. Only 13% of studies estimated fatalities >5 birds per MW per year.
- **Birds of conservation concern rarely occurred as fatality incidents, and no U.S. bird species with federal threatened or endangered status were recorded as fatalities.**
- **Bird species with “tipping point” status in 2025 State of the Birds (NABCI 2025) accounted for 1% of total fatality incidents (110) from 24 species.** Four of those species are categorized as “Red Watch List” and each accounted for 4 or fewer fatality incidents.
- **A small number of common U.S. bird species make up most fatality records.**
 - 44% (314) of the 719 bird species occurring in the U.S. (Partners in Flight 2024) have been recorded as collision fatalities found during scheduled turbine searches in AWWIC. A third (110) of the recorded species are represented in the database by only one or two incidents.
 - **Sixteen common bird species accounted for nearly half (47.5%) of the fatalities recorded in AWWIC.** These species are common, particularly in the Prairie avifaunal biome where most wind energy projects operate.
 - Small passerines accounted for 59% of all bird fatality incidents in AWWIC across all avifaunal biomes, with Horned Larks making up the greatest species percentage (13%).
 - Diurnal raptors accounted for 6.8% of total fatality records nationwide ranging regionally up to 8.5% in the Pacific biome, though small passerines remained the highest reported group for this biome.
- **Bird fatalities for passerines nationally and for all birds in most biomes peaked during spring and fall** (in alignment with peak migration periods). However, no seasonal pattern was apparent for raptors nationally or for all birds in the Northern Rockies and Pacific biomes.

Introduction

Wind energy generation has been a growing source of electricity in the U.S. since the 1980s, increasing by over 60-fold since 2000 to 161 GW of installed capacity (Hoen et al. 2018 updated May 2025). Wind energy can offset negative effects to birds from climate change and fossil fuels (Bateman et al. 2020), but the siting and operation of wind energy facilities also pose a risk to birds (Allison et al. 2019). Bird collisions with wind turbines have been reported at nearly all wind energy facilities and understanding the cumulative impacts to birds is important as wind energy capacity continues to expand (Smallwood 2013, Loss et al. 2013, Erickson et al. 2014, Jansen 2023). While wind energy is one way in which human activity impacts birds in North America, it is important to consider this impact in the context of other threats, including predation by outdoor domestic cats and collisions with buildings and automobiles, each of which causes hundreds to thousands of times more bird deaths than wind energy according to recent research (Loss et al. 2015).

The American Wind Wildlife Information Center (AWWIC) was established as a cooperative initiative of wind energy companies and the Renewable Energy Wildlife Institute (REWI, formerly American Wind Wildlife Institute, or AWWI) to expand the availability and utility of onshore wind-wildlife data to inform research and actionable insights that benefit future wind energy operations and wildlife conservation. For more than 25 years, wind energy companies have conducted post-construction mortality monitoring (PCMM) surveys to assess risk and impacts to wildlife from wind energy projects across the United States, and many have agreed to use AWWIC as a repository for the resulting data. The result is one of the largest and most detailed datasets of post-construction mortality studies from land-based wind energy facilities. Much of the data contained in AWWIC is publicly available, but other data has remained confidential and previously been unavailable for analysis. AWWIC is designed to maintain the confidentiality of non-public data while making more data available to support research intended to decrease impacts from wind energy to wildlife.

In 2019, REWI (then AWWI) released the first Bird Technical Report summarizing AWWIC data (AWWI 2019). With a goal of updating the report when at least 50 new studies are available, the 2nd edition released in 2020 (AWWI 2020a) with 82 new studies and this 3rd edition adds 56 new studies (Table 1). As new PCMM studies continue to be added, REWI will continue to update this report.

How to Use This Report

The goal of this report is to provide the most up-to-date understanding of the patterns and variability in species composition, timing, and magnitude of bird collisions with land-based wind energy turbines to support the development of hypotheses that can be tested with additional analysis. The findings reported here are useful in checking assumptions and setting expectations about collision risks at wind energy facilities in a particular region, such as what species might be at risk of collision and how fatality rates would likely vary across facilities. Industry representatives report that these statistics have been useful for discussing PCMM study results in context with agency personnel. AWWIC data has been analyzed to more rigorously confirm and characterize seasonal patterns in fatalities of birds and bats across regions of the United States (Lloyd et al. 2023). Previous editions of this report have been cited in at least 11 other peer-reviewed scientific publications.

Importantly, collisions at wind turbines are relatively well-studied compared with other, often much larger, sources of direct mortality. Human-caused factors that kill large numbers of birds include predation by feral and domestic cats, electrocution by and collision with power transmission lines, and collisions with buildings and vehicles (Loss et al. 2015). Therefore, the volume of data summarized here should not be equated with population level importance.

Regional Analysis Approach

We summarize bird fatality incidents and adjusted fatality estimates by avifaunal biome (e.g., Erickson et al. 2014). Avifaunal biomes represent aggregations of Bird Conservation Regions (BCRs; Rich et al. 2004, NABCI 2018) that encompass more similar bird fauna than other biomes. Information about existing wind installations in each region was obtained from the U.S. Wind Turbine Database (Hoen et al. 2018). State-level summaries of fatality data are provided in the Appendix for states with sufficient data to meet confidentiality criteria (at least 5 projects under at least 3 owners).

Caveats

When interpreting data summaries, it is important to note that these data are either publicly available or voluntarily shared with REWI by participating wind energy companies and do not represent a comprehensive or randomized monitoring dataset. Therefore, conclusions or extrapolations made from these data may change as additional data are added, and **we advise accounting for region and differences in study protocols before further analysis.**

As an example, we show in this report that raptor fatality rate estimates in AWWIC are highest for the Pacific avifaunal biome, which also happens to be the biome where AWWIC has the greatest coverage (projects with data in AWWIC total nearly half of installed capacity in the region). Failing to account for that regional variation would likely result in an overestimate of nationwide cumulative fatality for raptors

In addition, this report summarizes results of scheduled carcass searches, not carcasses found during incidental activities. This distinction is especially important for carcasses of eagles and other large birds that are readily spotted. Because of a national law protecting eagles specifically (the Bald and Golden Eagle Protection Act), companies report eagle fatalities to the U.S. Fish & Wildlife Service (USFWS) and many do not report these specific results in AWWIC. For these reasons, **AWWIC should not be used as a primary source for understanding eagle mortality in particular.**

Glossary of Frequently Used Phrases

- **Post-construction Mortality Monitoring (PCMM):** Standardized surveys to document and quantify carcasses of birds and bats found around operating wind turbines.
- **Project:** Wind turbines in the same general location with one owner that are put into operation as a group.
- **Study:** Set of surveys for bird or bat carcasses around wind turbines within a project, with accompanying bias trials, conducted over a specific time that result in a single, adjusted fatality estimate for birds.
- **Fatality Incident:** Bird carcass found and reported in PCMM data.
- **Curtailement:** Intentionally reducing power production of a wind turbine to reduce wildlife collision risk by stopping or greatly slowing rotation.
- **Density Weighted Proportion:** Metric to estimate what proportion of carcasses may have fallen within the searched area around a turbine, based on the area searched and the distribution of carcass fall distances.
- **Passerine:** Also called a perching bird or songbird, a bird classified in the taxonomic order Passeriformes. Among the diverse types of passerines are: sparrows, warblers, finches, thrushes, and flycatchers.
- **Small Passerine:** Includes all Passerine species except the largest (magpies, crows, and ravens)
- **Raptor:** Also called a bird of prey, one of several groups of carnivorous birds including hawks, eagles, owls, falcons, kites, and ospreys. In PCMM data, vultures are not considered raptors.

Description of the AWWIC Data

The AWWIC database contains data collected during PCMM studies at individual land-based wind energy projects (see Box 1). We define a study in AWWIC as the set of surveys for bird or bat carcasses and bias trials conducted at a single project (set of turbines in facility constructed as a group) over a specific time that result in a single, adjusted fatality estimate for birds. The results of a study are typically published in a single report, although variants exist. For example, results from multiple studies over multiple years at a wind facility can be published in a single report. PCMM results available in AWWIC typically lag 2-3 years behind the data being collected in the field.

Box 1: Post-construction Mortality Monitoring (PCMM)

Measuring Mortality

Monitoring studies are usually conducted by environmental consulting firms that employ a team of trained field biologists and statisticians to conduct carcass searches within established plots around turbines at pre-determined time intervals, analyze the results, and prepare a report for the client company. Because the number of carcasses observed is known to be an underestimate of the number of fatalities, all PCMM studies now estimate fatality rates by using bias trials (below) and correcting for imperfect detection and carcass disappearance (Huso et al. 2016), although the specific methods used are often tailored to the requirements and conditions at the individual projects. AWWIC captures the data common to PCMM studies to facilitate our ability to aggregate data from different studies and to conduct meta-analysis of post-construction fatality data from multiple wind energy projects.

Bias Trial Procedures

PCMM studies are conducted following established protocols (Strickland et al. 2011) to estimate and correct for known sources of bias. Factors such as imperfect carcass detection and removal of carcasses by scavengers make a raw count of fatalities an underestimate of the true number of fatalities. The two bias trials conducted for every study are searcher efficiency trials and carcass persistence trials. Searcher efficiency trials measure the ability of field biologists conducting searches to find carcasses that were independently placed in the search area. Searcher efficiency is typically expressed as a proportion of known, placed carcasses found during a study period or season. Carcass persistence trials estimate how long a carcass is available to be detected by the field biologist after the carcass falls into the search area. In most studies provided to AWWIC, carcass persistence is expressed as the mean number of days an emplaced carcass remained available before it disappeared due to decomposition or scavenger removal. In conducting bias trials, carcasses of target species may be used, but often surrogates, such as quail or pheasants are used which can influence carcass persistence estimates (Hallingstad et al. 2023).

Each wind energy project in the database is assigned a unique and randomly generated Project ID. A sequential Phase ID modifier is used for wind energy projects that have multiple phases, or groups of turbines of a similar capacity and manufacturer that are installed within the same period (e.g. PRJ1234-PH01). Often, fatality studies are conducted at each of the phases of a wind facility, which we will treat as representing distinct projects in this report. A detailed listing of data fields contained in AWWIC is provided in Appendix A. Each study provides data in three main categories: 1) project site description, 2) fatality estimates, 3) fatality incidents.

Project Site Description

These data provide information about a project's installed capacity (number of megawatts, MW), height and rotor swept dimensions of wind turbines, year of construction, and the geographic region where the project is located. Geographic regions include U.S. Fish and Wildlife Service Legacy Regions (referred to as "USFWS Regions" or "Regions"), EPA Level III Ecoregions, Bird Conservation Regions, and State.

Fatality Estimates

These data include estimates of fatalities for the period of the study and a description of the protocols used to develop those estimates. Protocol descriptions typically include the search area, search period, search interval, number of turbines searched, and results of searcher efficiency and carcass persistence trials.

Several different equations have been developed to estimate fatality rate given the number of carcasses observed and adjusting for various sources of detection error (Huso et al. 2016, Rabie et al. 2021). All estimator equations incorporate the results of bias trials (Box 1) conducted simultaneously with carcass searches. Primary differences among estimator equations are how the bias trial results are used and how missed carcasses are treated. Fatality estimates can also adjust raw counts for carcasses that fall outside the search area by calculating the density weighted proportion (DWP, Dalthorp et al. 2022) of the area searched. DWP accounts for the shape and size of the area searched as well as the distribution of carcass distances from turbines. Thus, different equations can generate different fatality estimates from the same raw data from a survey. Fatality estimates are most commonly expressed as the number of birds per installed MW capacity per year of operation, although studies may also report fatality estimates on a per turbine basis.

Fatality Incidents

A third category of AWWIC data contains information on individual carcasses, called fatality incidents, found during scheduled searches, incidental finds, and plot-clearing searches, though only data from scheduled searches are summarized in this report. Scheduled searches occur when plots are searched by trained observers, often along established transects, at a pre-determined search interval (i.e. number of days before repeating the search); bird carcasses are recorded as they are encountered. Some studies use trained dogs to conduct scheduled searches, but AWWIC does not contain dog search studies currently. Incidental finds are carcasses found outside of scheduled searches, and some studies record fatalities when plots are intensively surveyed to clear them of carcasses before the first search.

Fatality incidents from scheduled searches are the raw counts from which fatality rates are estimated accounting for bias trial results, although some studies also include incidental finds in estimated fatality rates. Additional data accompany each incident including date of carcass find, species name, carcass condition, and carcass distance to the nearest turbine (see Appendix A for a list of all data fields associated with fatality incident data).

Contributed Data

Owners of wind energy projects have worked extensively with REWI over years to establish a system that allows PCMM data to be shared with REWI at a level of detail that enables meaningful data analysis while maintaining the anonymity of the individual wind energy project. REWI works directly with the data contributors and consultants to review the data and correct errors that may result during data submission.

Public Data

In addition to the data from contributed studies, AWWIC contains PCMM data gleaned from publicly available reports and publications. Public reports have been obtained by locating references in previously published meta-analyses, searching online databases, and contacting data stewards at companies or municipalities. Data provided in publicly available studies typically do not contain values for all of the data fields provided in contributed studies. For example, not all public reports provide detailed data on individual fatality incidents. Public reports add significantly to the amount of data available for certain analyses, however. The results of some PCMM studies have been described in publications, but we have been unable to access the reports. Therefore, we recognize there is a gap between reports that we know exist and the reports in the AWWIC database.

3rd Edition Updates

Except for corrected all-bird fatality statistics indicated below, the findings presented in the 2nd Edition have generally been strengthened by the addition of new datasets available now.

Key updates in the 3rd edition of this Technical Report include:

- 56 new studies meeting inclusion criteria to inform data summaries (most in the Prairie avifaunal biome), giving a total of 331 studies.
- Seven additional species found in fatality searches (bringing total to 314 species); all seven new species were only observed once.
- Corrected calculation of all-bird fatality estimates in cases when only small and large birds estimates were provided (Figs. 13 and 14). This correction resulted in higher mean and median fatality estimates than in the 2nd Edition of this report. For instance, we now report nationwide median fatality estimates of 1.9 birds per MW per year (vs. 1.4 in 2nd Edition) and 3.9 birds per turbine per year (vs. 2.2 in 2nd Edition).
- Added a summary of density weighted proportion data (Table 4).
- Added a breakdown of estimated fatality rates by turbine size (Fig. 18).
- In addition to summaries aggregated by avifaunal biome, we now summarize fatality estimates for U.S. states with at least 5 projects from 3 owners (Appendix Table B3).

Table 1. Comparison of overall AWWIC database size between prior editions and this report. Not all studies meet criteria for inclusion in reports.

	1 st Edition (2019)		2 nd Edition (2020)		3 rd Edition (2025)	
	Total in AWWIC	Meeting Inclusion Criteria	Total in AWWIC	Meeting Inclusion Criteria	Total in AWWIC	Meeting Inclusion Criteria
Projects	146	130	227	196	272	254
Studies	227	193	336	275	406	331
Date range of studies	2002-2016		2002-2018		2002-2023	

Data Availability

This summary aggregates bird fatality data from 331 post-construction mortality monitoring (PCMM) studies conducted at 254 onshore wind energy projects in the coterminous U.S. that meet criteria for inclusion (Table 1, Table 2). Many projects receive more than one year of fatality monitoring. To maintain a basic level of standardization in our review of fatality estimates in AWWIC, we included studies in this report if they met the following criteria:

1. Turbines operated as they would during normal power production. This includes projects where curtailment (stopping or greatly slowing turbine rotation under specified conditions) is used as part of normal operations to minimize collision fatalities. In contrast, we did not include studies conducted while turbine operation was experimentally altered to test curtailment efficacy.
2. Reported fatality estimates adjusted raw carcass counts for searcher efficiency, carcass persistence, and incomplete space and time coverage – and all variables pass QA/QC filters
3. Bird carcass details were available to summarize species composition and validate fatality estimates.

Table 1. Number of studies contained in AWWIC excluded from this report based on the criteria they failed to meet in our review.

Reason for Exclusion	Number of Studies
1. Experimental turbine curtailment	40
2. Missing or erroneous study data	18
3. Missing carcass data	17
Total Exclusions	75

Studies are those made available by data contributors or acquired from publicly available reports. Total nameplate capacity of facilities included in this report is 33.4 gigawatts (GW), which represents 21% of total installed capacity in the continental US through Q1 2025 (Hoen et al. 2018 updated May 2025; Table 3). Data summaries contained in the following tables and figures result from 521,734 fatality searches at 9,436 distinct turbines and are aggregated by avifaunal biome (Fig. 1). For States with five or more projects with three or more owners, a summary of fatality estimates is available in Appendix B.

Most of the projects and PCMM studies contained in AWWIC were performed in the Prairie avifaunal biome, but that biome is underrepresented in AWWIC based on the production capacity of facilities studied versus facilities operating in that region (Table 3, Figs. 1 and 4). In contrast, AWWIC contains the fewest studies from the Pacific avifaunal biome, but those represent the highest fraction of installed capacity in any region.

AWWIC contains 22 consecutive years (2002-2023) of studies and 20 or more studies are available 2009 through 2015 (Fig. 3). Due to the lag in reporting and data availability, AWWIC contains fewer studies per year since 2015 which underrepresents annual wind energy buildout during that time.

Table 2. Number of wind energy projects and PCMM studies for the U.S. and avifaunal biome contained in AWWIC. Wind projects that have two or more phases (turbines made operational as a group) are treated as separate projects in this report. The table also provides the total nameplate capacity (in gigawatts [GW]) of turbines included across studies within each avifaunal biome and the total proportion of GW this represents across the entire biome, as of Q1 2025 (Hoen et al. 2018 updated May 2025).

Avifaunal Biome (Total GW Installed)	Projects	PCMM Studies	Nameplate capacity (GW) across turbines in PCMM studies	Percentage of total installed capacity represented by PCMM studies
Eastern (10.71)	29	50	2.85	26.6
Northern Forest (5.62)	19	24	1.3	23.1
Northern Rockies (14.56)	37	49	3.71	25.5
Pacific (2.2)	11	17	1.06	48.2
Prairie (112.3)	141	166	21.91	19.5
Southwest (15.45)	17	25	2.53	16.4
Total U.S. (161.5)	254	331	33.37	20.7

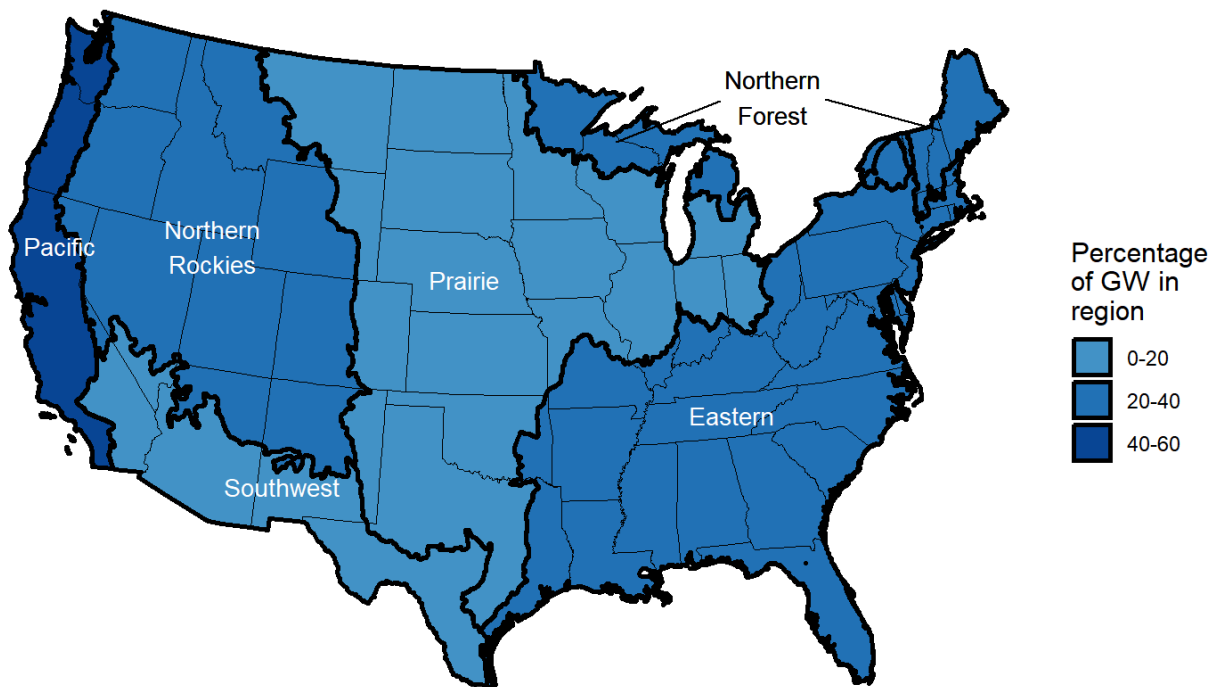


Figure 1. Percent of total 2025 installed wind capacity (gigawatts – GW) represented by post-construction fatality monitoring data contained in this report by avifaunal biomes. Only studies meeting criteria for inclusion are presented (N=331).

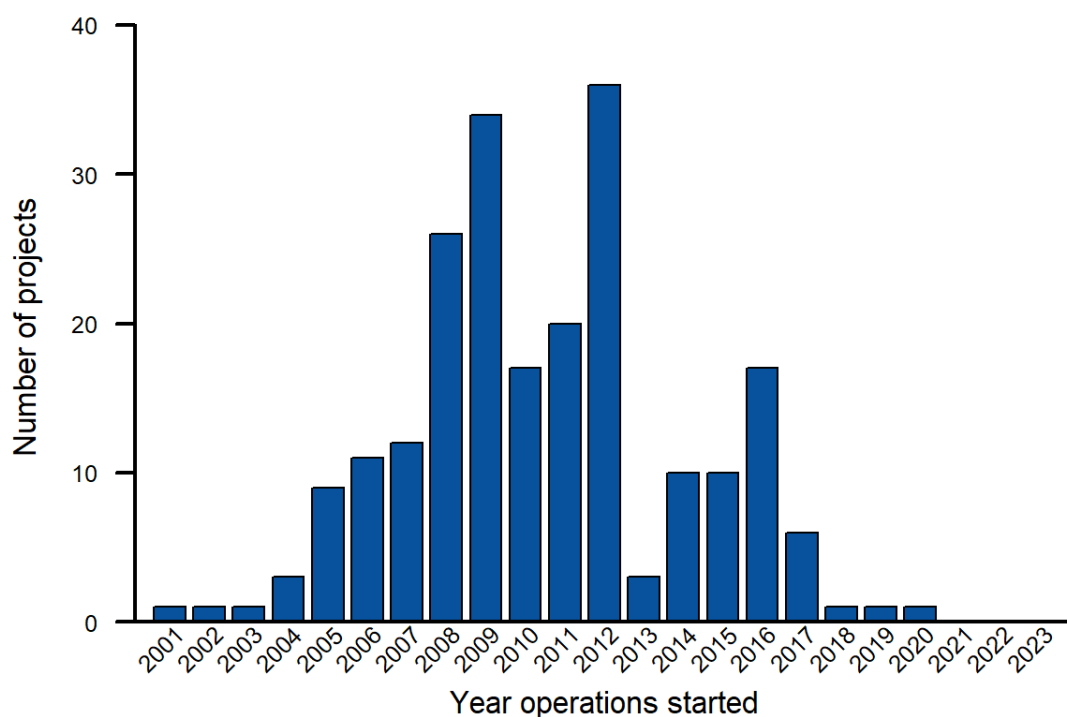


Figure 2. Wind energy projects meeting inclusion criteria for this report, (N=254) by year they became operational or repowered.

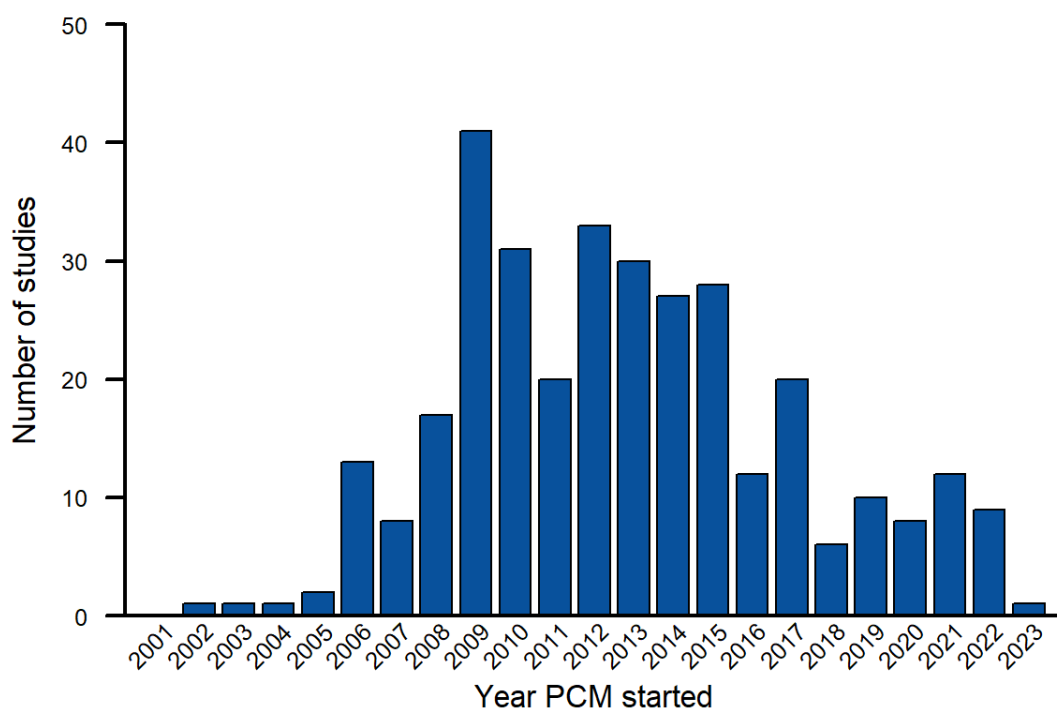


Figure 3. Fatality monitoring studies meeting inclusion criteria for this report (N=331) by year monitoring started.

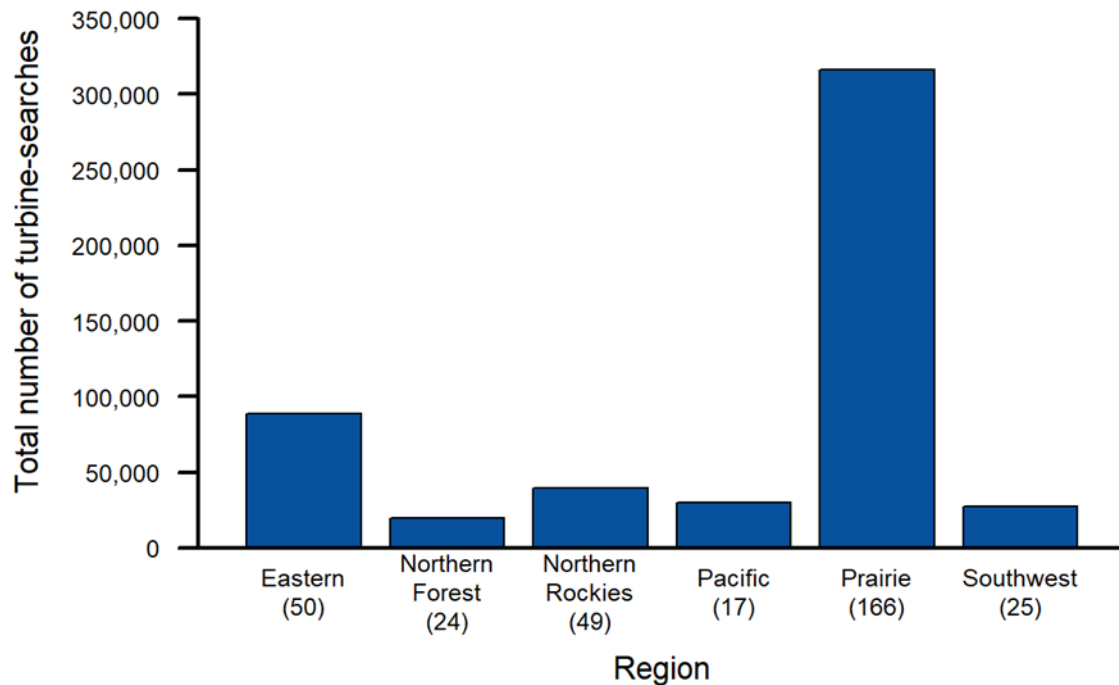


Figure 4. Total number of turbine-searches conducted during fatality monitoring studies by avifaunal biome (N=521,734). Each turbine-search is a scheduled visit by observers to a turbine. The number of studies reporting for each avifaunal biome is indicated in parentheses.

Study Attributes

PCMM studies vary in their search area(s), duration, and search interval. This section summarizes these parameters for the studies included in this report. Each of the figures and tables in this section may include data from a different number of studies because of variation in the consistency, quality, and requirements of reporting.

Search plots are either squares or circles centered around a turbine extending 33–215m from the base of each turbine. Plots are either full plots, a search of the roads and pads surrounding the turbines, or a combination of both types. In more recent studies, a measure that integrates area searched and carcass fall distribution called density weighted proportion (Dalthorp et al. 2022) has been reported for search plots. These values are used by the GenEst estimator to account for the likely proportion of carcasses that were within the searched area.

The frequency of turbine visits and the length of the study vary widely as biologists aim to ensure that peak activity periods are searched frequently enough to avoid carcasses being removed by local scavengers. Often, wind projects located in areas with snowfall are not monitored during winter months. It is common for carcass search intervals to be more frequent during periods of peak bird and bat collision likelihood within the study period, and in some cases, plot types may change as well. Therefore, complex study designs are approximated in some cases to allow our data summaries to capture general patterns.

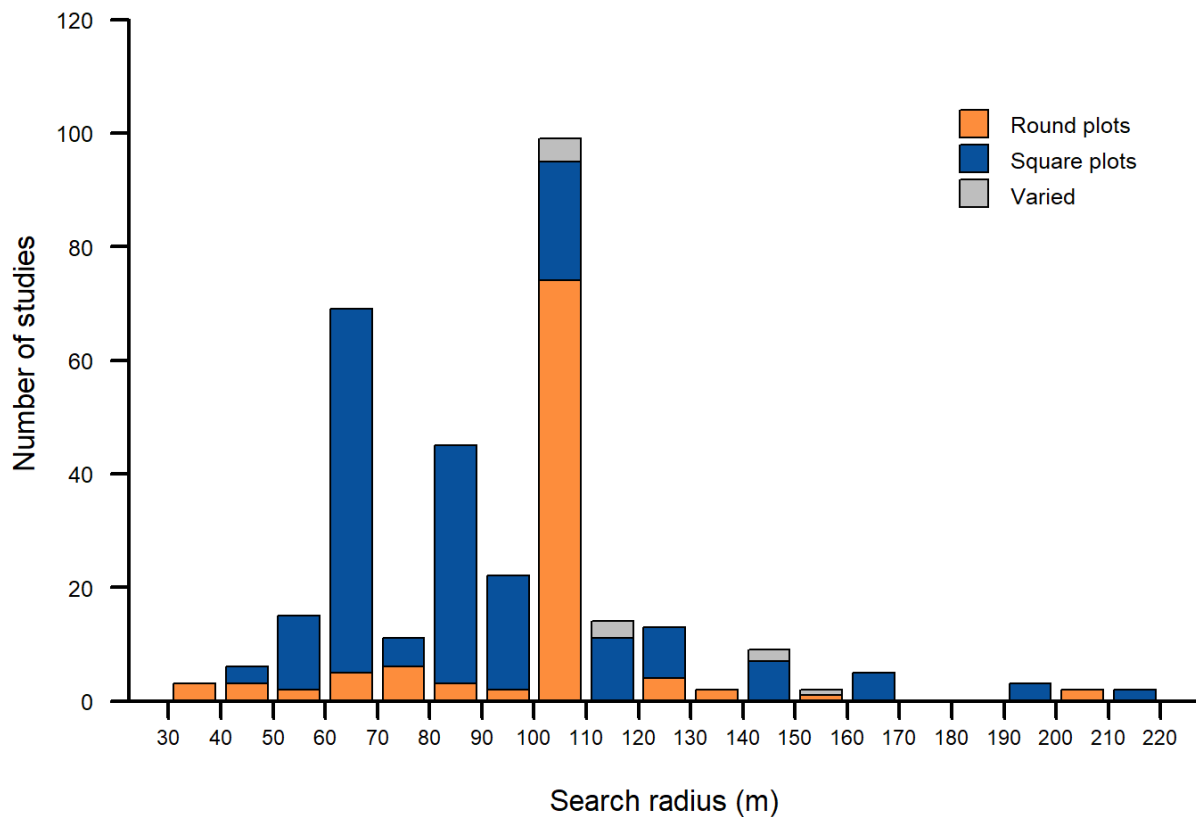


Figure 5. Frequency of plot size in meters around turbines searched during post-construction mortality monitoring (N=331 studies). Square plot radii are determined by the distance to the nearest plot boundary from the turbine. Varied plots indicate that search radius and plot shape was not consistent among turbines searched and an average search radius was used.

Table 3. Availability and summary of the Density Weighted Proportion (DWP) of carcasses falling within the searched area. DWP estimates are summarized separately for full plot searches using transects and “road & pad” searches of just the gravel road and pad near the turbine. Only studies that estimated DWP for small birds and large birds specifically were included.

	Full Plot		Road & Pad	
	Small Bird	Large Bird	Small Bird	Large Bird
Studies	23	22	29	26
Turbine	304	282	654	564
Range	0.21-1	0.21-1	0.03-0.65	0.02-0.83
Mean	0.89	0.88	0.14	0.1

Table 4. Frequency of survey duration of post-construction fatality monitoring studies by avifaunal biome.

Avifaunal biome	< 6 months	6 - 11 months	Full year	> 1 year
Eastern	7	36	7	0
Northern Forest	8	16	0	0
Northern Rockies	1	13	29	6
Pacific	0	3	10	4
Prairie	15	86	54	11
Southwest	0	3	21	1
Totals	31	157	121	22

Table 5. Frequency of search intervals for scheduled carcass searches by avifaunal biome. Reported for a subset of 324 studies. When studies used variable search intervals in different seasons, a mean interval value for the entire study duration was used.

Avifaunal biome	≤ 7 days	8 - 14 days	> 14 days
Eastern	45	2	2
Northern Forest	24	0	0
Northern Rockies	2	7	39
Pacific	8	4	5
Prairie	57	60	47
Southwest	6	15	1
Totals	142	88	94

Fatality Incidents

As further described in the introduction, we define a fatality incident as a carcass discovered within the search plot during a scheduled search of a turbine. Fatality incidents are the unadjusted raw data from which fatality estimates are derived. We summarize fatality incidents to evaluate the species composition of bird fatalities in different avifaunal biomes, to observe patterns in the timing of bird fatalities, and to examine the pattern of distances from the turbine that carcasses are found. Each figure and table in this section may be based on a different number of available studies because of variation in the consistency, quality, and requirements of reporting.

AWWIC studies meeting inclusion criteria for this report contain 10,097 bird fatality incidents discovered during scheduled searches. Fatality incidents include 314 identified bird species. The distribution of fatality incident data is strongly skewed, with zeroes (no carcasses found) dominating single turbine searches (98.1%) and study-week totals (70%; i.e., no carcass found at any turbine searched during a week in a given study). Multiple (>1) bird fatality incidents occurred rarely (0.11% of single turbine searches, 15% of study-week totals Fig. 6). The most carcasses found at a single turbine over the course of a study was 43, and 10 or more carcasses were found over the course of a study at 53 turbines (0.56% of all turbines searched). The maximum number of carcasses found at a single turbine during a single

search was 27 (all Savannah Sparrows). Ten or more carcasses were found during a single search at 3 turbines (0.03% of all turbines searched).).

Seasonal patterns of bird and bat fatalities apparent in AWWIC data were analyzed in greater detail and accounting for search effort by Lloyd et al. (2023). Specific dates for when incidents were found are available for 89.7% of incidents and thus can provide information on variation in seasonal timing of bird fatalities. Overall search effort across AWWIC studies was consistently high from April through November, and substantially lower December through March (Lloyd et al. 2023). Here, we present fatality timing for passerines and raptors separately to highlight the spring and fall fatality peaks in passerines and the more uniform distribution of raptor incidents throughout the year (Fig. 7). Seasonal peaks in bird fatalities vary in timing and duration among biomes with no discernable seasonality in Pacific and Northern Rockies biomes (Fig. 8).

A subset of 160 studies that searched 100m or more from each turbine and reported carcass distance from turbine (explicit and 10m distance bins) was used to summarize the fall distribution of carcasses. (Fig. 9). The available data indicate that approximately 60% of bird carcasses fall within 50m of the turbine (for contrast, 90% of bat carcasses fall within 50m of the turbine., AWWI [2020b]). Small birds and large bird carcasses have a similar fall distribution.

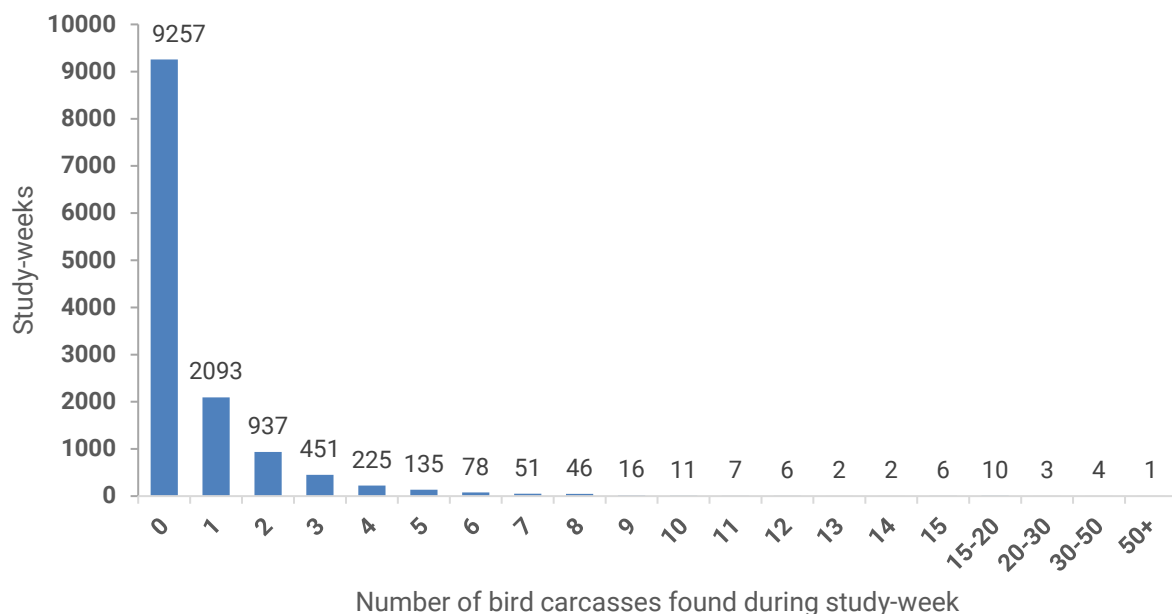


Figure 6. Distribution of bird carcass search results for studies with carcass discovery dates reported (N = 297). Bird carcass discoveries are summed for each week in each study (N = 13,341 “study-weeks”) to aggregate discoveries at all turbines searched during the study-week.

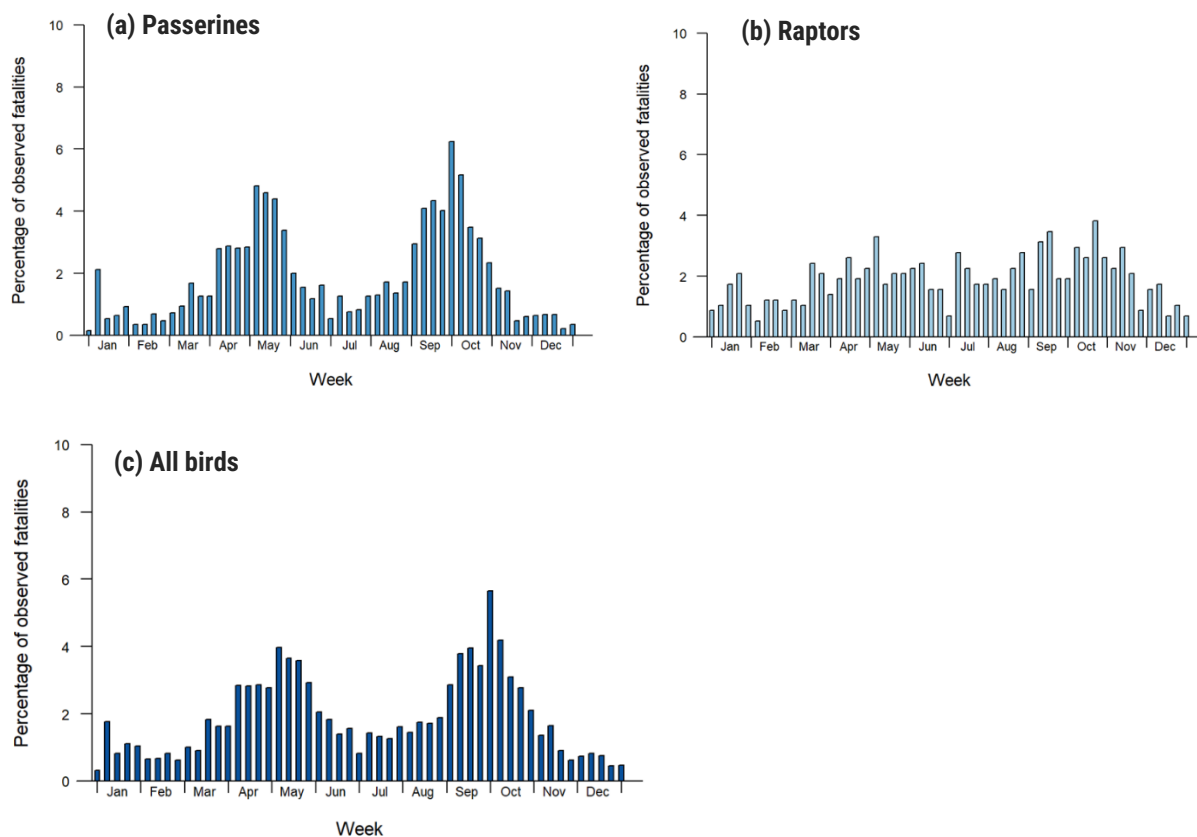


Figure 7. Distribution of bird fatality incidents aggregated by week of the year (7-day intervals) for all U.S. wind energy projects where date of carcass discovery is known for (a) passerines (N=5,717), (b) raptors (does not include vultures, N=1,061), and (c) all birds (N=9,060). Fatality incidents were recorded during scheduled carcass searches conducted at wind energy facilities and provided to AWWIC.

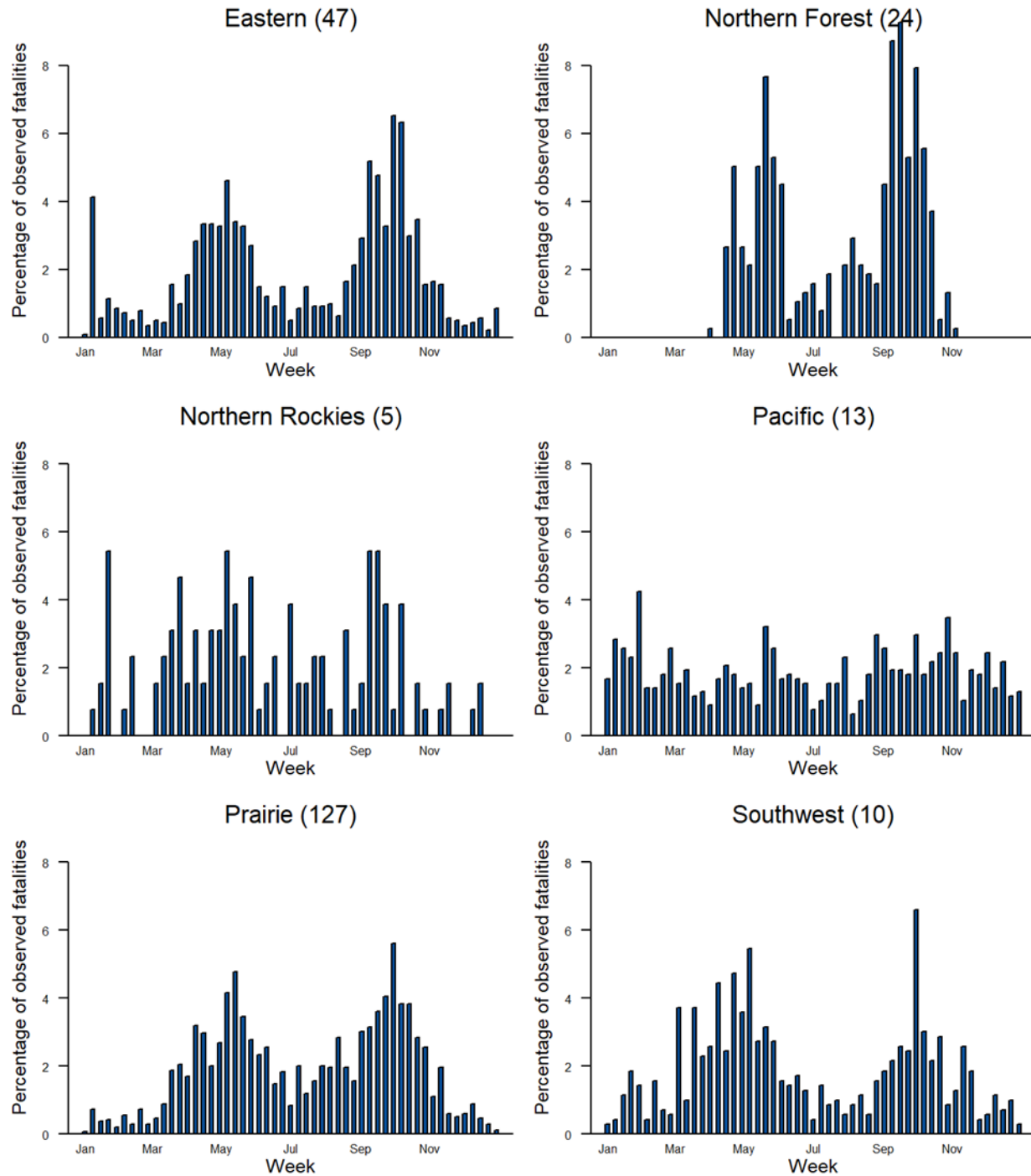


Figure 8. Distribution of all bird fatality incidents aggregated in weekly (seven-day) intervals for each avifaunal biome included in this analysis. Fatality incidents are recorded during scheduled searches of post-construction studies contained in AWWIC.

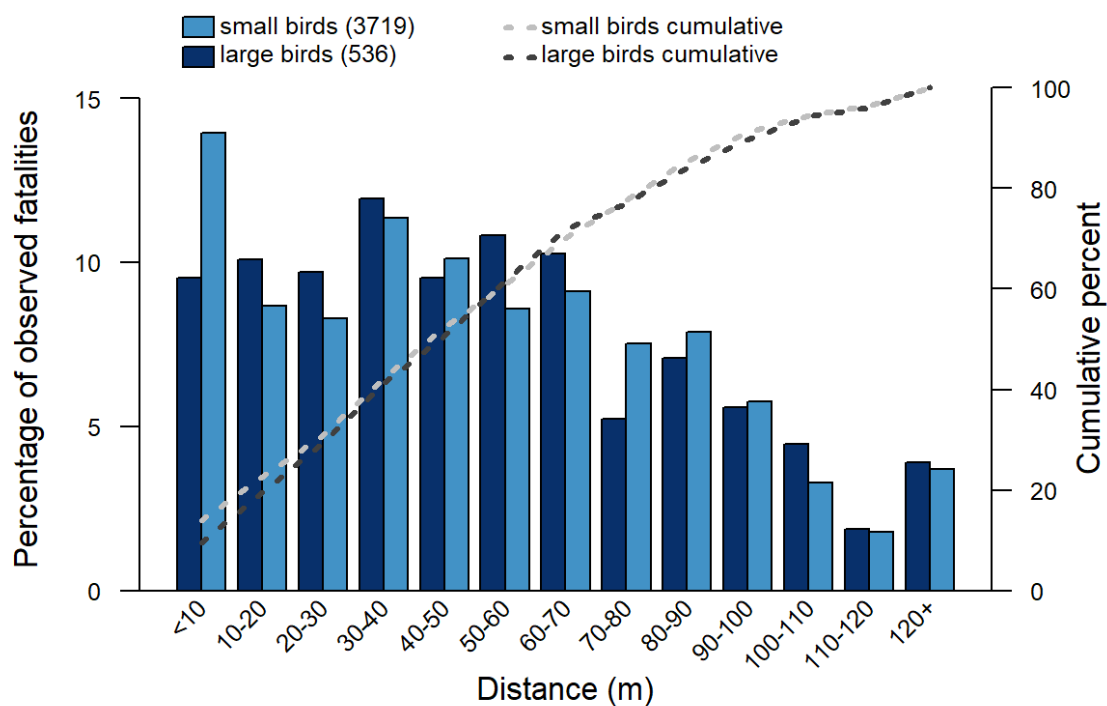


Figure 9. For 160 studies with search radius $\geq 100\text{m}$, distance from the turbine tower of small bird carcasses ($N=3,719$) and large bird carcasses ($N=536$) found during scheduled carcass searches. Small birds are defined as total length $\leq 30\text{cm}$. Dashed line shows cumulative percentage (right axis) of carcasses found as distance from the turbine increases.

Species Composition of Fatality Incidents

Bird fatality estimates are typically only calculated for groups of species (small birds, large birds, or raptors [excluding vultures]) and not for individual species. However, examining the unadjusted species composition is useful in assessing which species within a group and region may be at greater risk of turbine collisions. Incident data are aggregated here by species, species group, and avifaunal biome. Fatality incident data as reported are not adjusted for any variation among bird species in detectability or carcass persistence.

A small number of common species contribute the majority of fatality incidents in AWWIC. The 16 most reported of the 314 species constitute 47.4% of all fatality incidents (Table 7). Horned Larks are the single most frequently reported species, which reflects their overall abundance (ranked 9th most abundant bird species globally, Caldwell et al. 2021) and their particular abundance in the Prairie avifaunal biome (<https://science.ebird.org/en/status-and-trends/species/horlar/abundance-map>) where most U.S. wind energy capacity is concentrated. American Kestrel and Red-tailed Hawk are in the top ten most frequently reported bird fatalities and are the most frequently reported raptor fatalities. Turkey Vulture fatality frequency is similar to that of Red-tailed Hawks. One hundred and ten species (35%) are represented in the database by ≤ 3 fatality incidents and cumulatively account for 1.9% of all fatality incidents (Appendix C).

As with Erickson et al. (2014), we have aggregated the percentage of reported fatality incidents into 19 bird groups. These 19 bird groups correspond reasonably well to the major orders of North American birds potentially exposed to collisions at wind energy facilities. Of the groups, small passerines constitute the largest percentage of fatalities, followed by doves/pigeons, diurnal raptors, and upland game birds, in that order (Table 8). Percentages for each of these groups vary regionally, although small passerines are the most common in all avifaunal biomes. The representation of diurnal raptors is much higher in the Pacific biome, and representation of upland game birds was highest in the Northern Rockies and Southwest biomes.

Unidentified birds account for 13.7% of all incidents. Unidentified birds include all carcasses or feathers found that could not be identified to species. Many studies have sub-divided the unidentified bird category further (e.g., unidentified passerine, small bird, large raptor); we have combined all of these carcasses into the single category of unidentified bird to avoid reporting uncertain data in this report.

Additional factors to consider when interpreting species composition include:

- Differences in detectability and carcass persistence among species and species groups
- Differences among avifaunal biomes in bird communities and relative AWWIC data coverage
- Background mortality being assumed as turbine fatalities

Table 6. Number and percentage of bird fatality incidents from scheduled searches for species representing at least 1% of incidents. Frequency is the number of studies containing fatality incidents of each species. No incidents from studies investigating curtailment thresholds were included in this table. The aggregated species composition values should not be used as national numbers unless corrected for regional representation. See Appendix C1 for a full list of species and their conservation status; none of the species in this table have federal listing or watch list status.

Species	Number of incidents	Percentage of incidents	Frequency of studies
Horned Lark	1309	13	153
Mourning Dove	530	5.2	130
Golden-crowned Kinglet	396	3.9	105
Red-eyed Vireo	375	3.7	89
Western Meadowlark	334	3.3	68
Red-tailed Hawk	272	2.7	115
American Kestrel	235	2.3	65
Turkey Vulture	237	2.3	75
Killdeer	176	1.7	55
European Starling	162	1.6	82
Ruby-crowned Kinglet	164	1.6	84
Red-winged Blackbird	153	1.5	34
Rock Pigeon	128	1.3	66
Ring-necked Pheasant	118	1.2	49
Savannah Sparrow	107	1.1	40
Yellow-rumped Warbler	102	1	57
Other species (298)	3914	38.8	311
Unknown	1385	13.7	233
Total	10097	100	327

Table 7. Percent composition of unadjusted bird fatality incidents for bird groups by avifaunal biome from studies conducted at wind facilities in the U.S. and contained in AWWIC. Number of studies is in parentheses. Avifaunal biome totals are the total number of incidents recorded in each avifaunal biome. Dashes (–) indicate that no species from that bird group were reported in that biome.

Bird Group	Eastern (49)	Northern Forest (24)	Northern Rockies (49)	Pacific (17)	Prairie (165)	Southwest (23)	Total US (327)
Small passerines	60.3	89	63	50.6	59	48.1	59
Doves/pigeons	3.3	1.1	6.5	22.2	5.1	5.9	7.3
Diurnal raptors	5.5	0.7	4.8	8.5	5.4	17.4	6.8
Upland game birds	3	1.7	9.1	1.4	3.3	5.7	4
Vultures	2.5	0.4	0.1	1.6	4.5	0.9	2.5
Shorebirds	2.4	0.4	0.4	0.6	4.3	0.7	2.3
Waterfowl	1.5	0.7	3.4	1.4	2.2	0.7	1.9
Rails/coots	0.5	–	0.9	3.3	1.6	0.5	1.4
Cuckoos	2.8	0.7	–	–	1.4	1.5	1.2
Owls	0.3	–	1.7	2.9	0.6	0.9	1
Woodpeckers	0.5	2.6	1.2	0.6	0.6	0.8	0.8
Swifts/hummingbirds	0.7	0.2	0.3	0.6	0.6	1.5	0.6
Gulls/terns	0.3	–	0.9	0.1	0.5	1.7	0.6
Nightjars	2.1	–	–	1	<0.1	–	0.5
Large corvids	0.4	0.4	0.8	0.4	0.2	0.7	0.4
Loons/grebes	0.1	–	0.7	0.2	0.4	0.1	0.3
Waterbirds	0.7	0.2	0.1	0.4	0.3	0.2	0.3
Domestic	–	–	–	–	<0.1	0.2	<0.1
Kingfishers	–	0.2	–	–	<0.1	–	<0.1
Unidentified bird	13.3	1.7	6.2	4.2	10.1	12.5	9
Total	1591	536	1423	1404	3929	1076	9959

Bias Trials

Bias trials are conducted with bird carcasses or surrogates placed in search plots in a variety of visibility classes and seasons encompassing the study period. Separate trials are conducted for small birds and large birds in most studies. Each of the figures and tables in this section may have a different number of studies available because of variation in consistency, quality, or requirements of reporting. Descriptions of bias trial data types and collection are in the introduction section of this report.

Mean carcass persistence times reported for birds in AWWIC have a skewed distribution with a median of 6.1 days (median of 4 days for small birds and 6.7 days for large birds). The median searcher efficiency reported by studies in AWWIC is 80% for all birds (median of 69% for small birds and 90% for large birds).

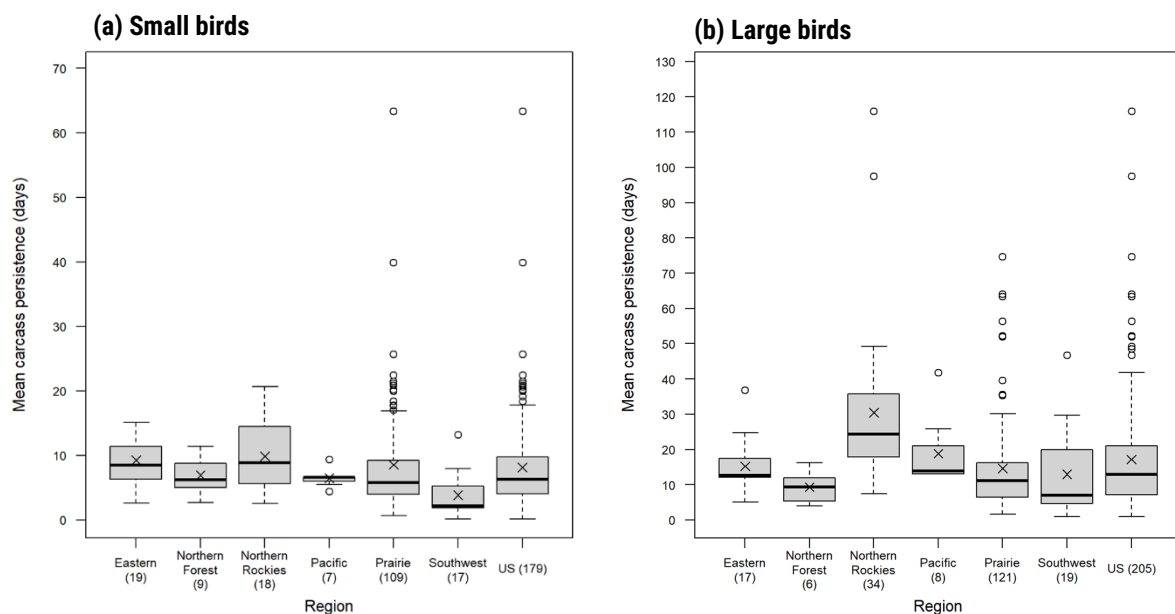


Figure 10. Estimated mean carcass persistence time by avifaunal biome for carcasses used in bias trials for adjusting raw carcass counts obtained during fatality monitoring. Number of studies available in each avifaunal biome is contained in parentheses. Boxplots show median and interquartile range; circles are defined as outliers and 'x' indicates mean value.

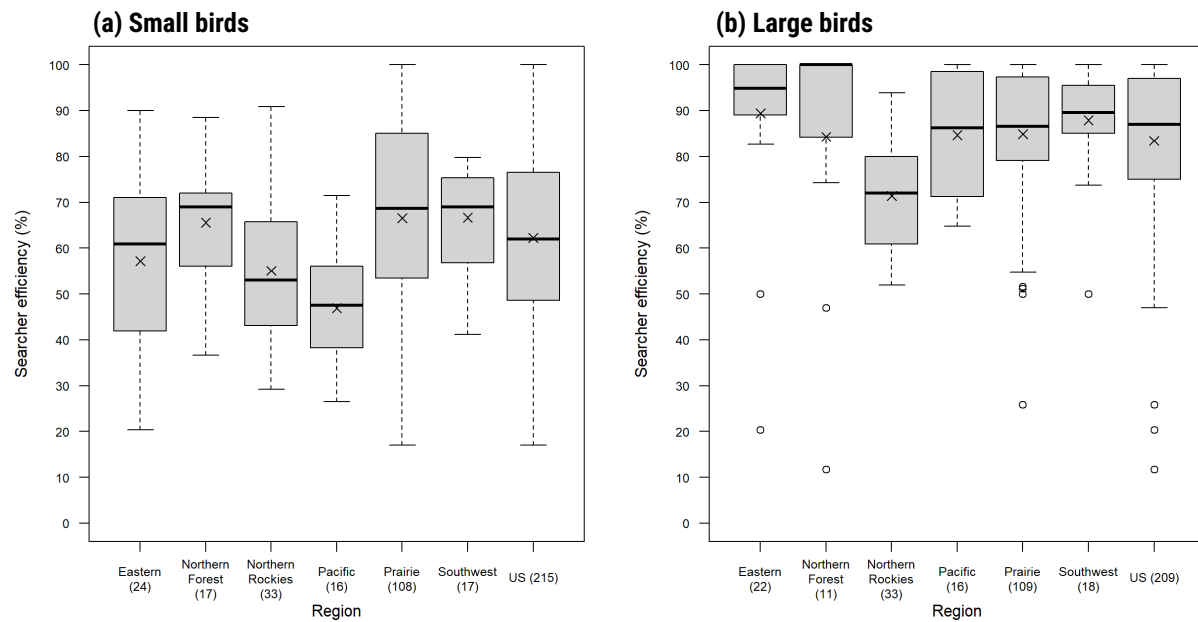


Figure 11. Estimated mean searcher efficiency by avifaunal biome for carcasses used in bias trials for adjusting raw carcass counts obtained during fatality monitoring. Number of studies available in each avifaunal biome is contained in parentheses. Boxplots show median and interquartile range; circles are defined as outliers and 'x' indicates mean value.

Fatality Estimates

Bird fatality estimates included in this report were calculated by the authors of each study by adjusting cumulative raw carcass counts for detection biases as described earlier and are “as reported.” No additional adjustments were made to account for differences in sampling period, plot size, or estimator used. If comparison of fatality estimates between avifaunal biomes is desired in future analyses, we recommend adjusting for these methodological differences whenever possible.

For studies that reported multiple adjusted fatality estimates, we used the following criteria adapted from Thompson et al. (2017). We chose the adjusted estimate that was based on:

1. Largest plot size
2. Longest survey duration
3. Greatest number of turbines sampled
4. Greatest number of total searches
5. If more than one estimator was used to calculate adjusted fatality estimates, the estimates were selected in the following sequence – GenEst → Huso → Shoenfeld → Others
6. All else being equal, we chose the highest adjusted estimate

Bird fatality estimates were plotted to observe their distribution and variability among biomes for all birds, small birds (< 30 cm total length), large birds (\geq 30 cm total length), and raptors. Not all studies provided estimates for these categories which leads to varying sample sizes for data summaries (Figs. 14-16). When only small bird and large bird estimates were available, we added them together to get an all bird estimate for the study. Estimates are presented as fatalities per MW per year (or study period) where MW is based on the rated power production capacity of the turbine, not the actual power produced.

After applying our selection criteria, this report contains 214 projects and 296 studies with estimates available to use. The pool of studies available for analysis of fatality rates and fatality incidents typically differ due to inconsistent availability of fatality incidents in public sources. The median fatality estimate for all studies is 1.9 birds per MW per year and 3.9 birds per turbine per year. We present summaries using per MW values, however Appendix B contains both per MW and per turbine values.

To summarize variability of bird fatality estimates by turbine size, studies were split into three categories of total turbine height (hub height + $\frac{1}{2}$ rotor diameter [Fig. 18]). Turbines with tower hub heights and rotor diameters of 80-90m are in the less than 125m category; 90-100m dimensions are in the 125-150m category; and the largest turbines with tower and rotor dimensions exceeding 100m are in the 150+ category. There was not a clear trend in the distribution of estimated fatality rates (birds per MW per year) among turbine size classes (Fig. 18), although the median was lowest for turbines <125m total height (1.62) versus 125-150m (2.50) and >125 m (1.99).

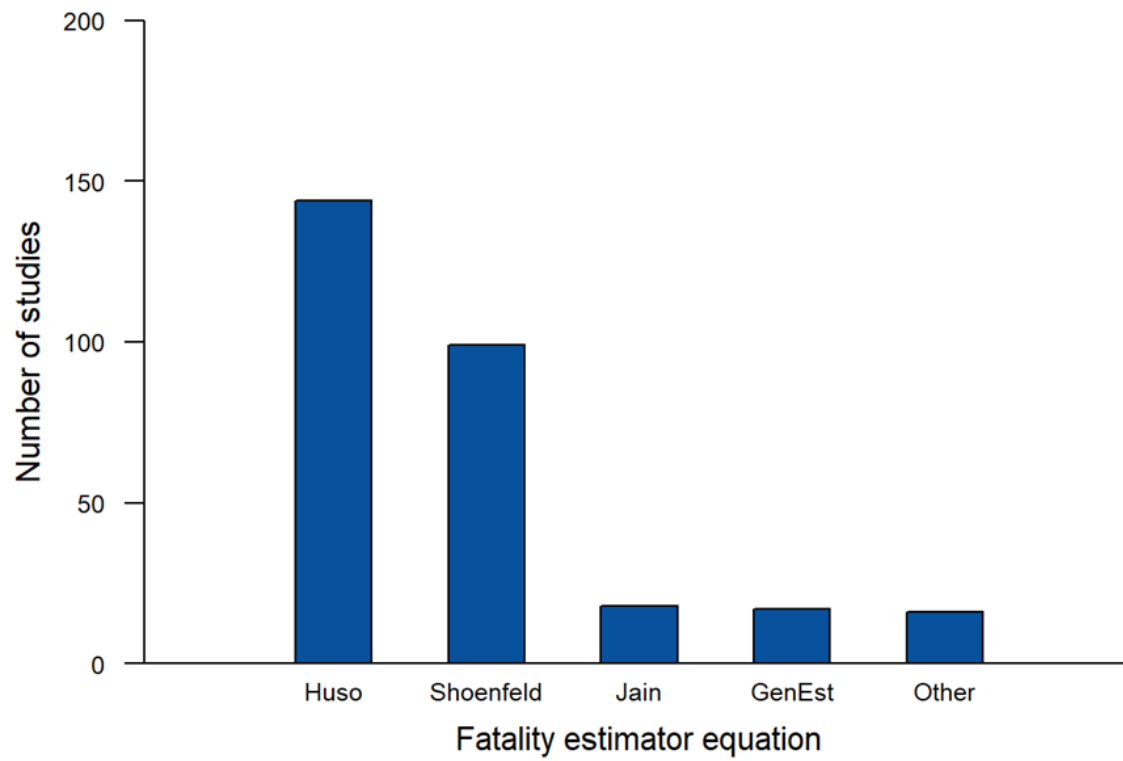


Figure 12. Frequency of fatality estimator equation used to calculate fatality estimates of post-construction studies contained in AWWIC (N=296).

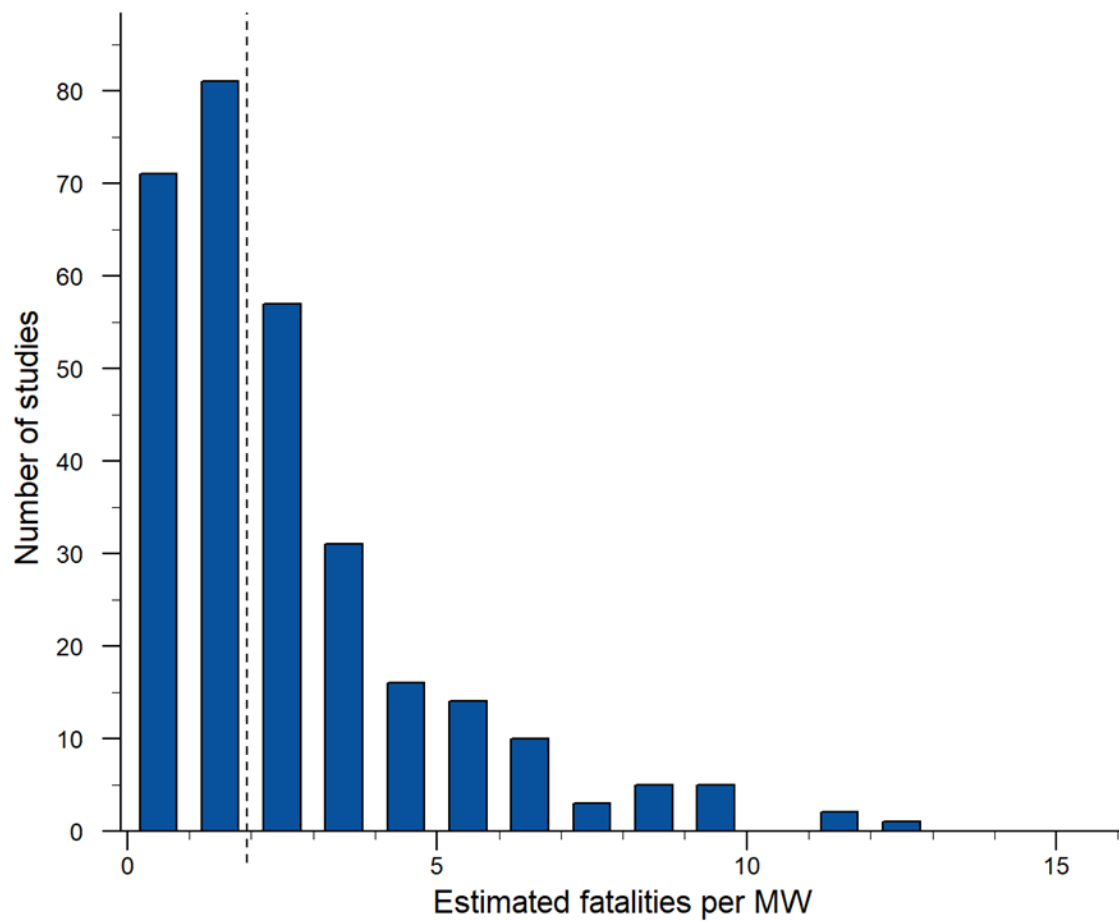


Figure 13. Estimated bird fatalities per installed MW per year from post-construction studies (N=296) contained in AWWIC. Estimates are presented as reported and not standardized for differences in study methodology. Vertical dashed line indicates median fatality rate.

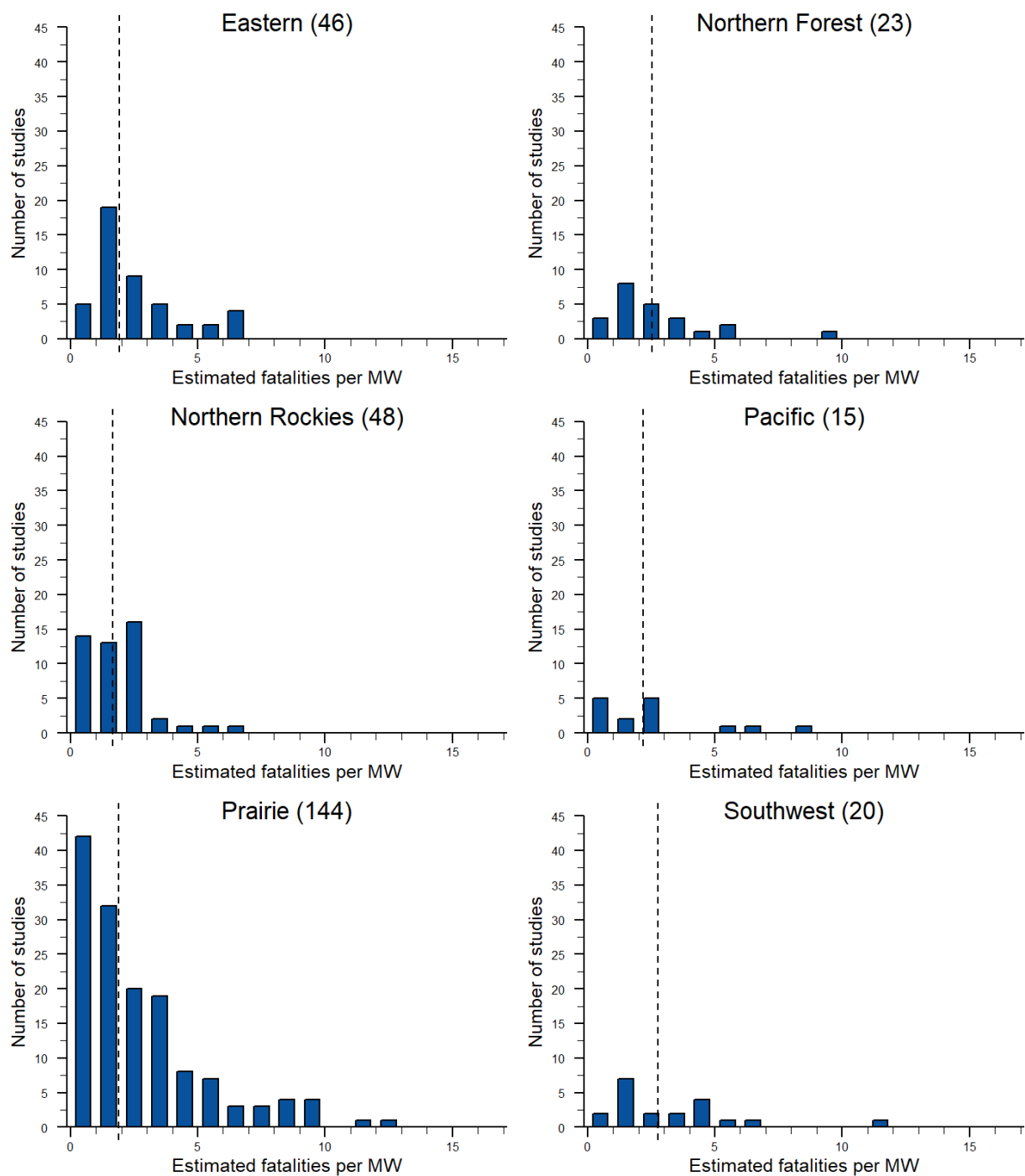


Figure 14. Estimated all bird fatalities per installed MW per year by avifaunal biome from post-construction studies contained in AWWIC. Estimates are presented as reported and not standardized for differences in study methodology. Number of studies available in each avifaunal biome is contained in parentheses. Vertical dashed line indicates median fatality rate. See Appendix B for tables of summary statistics.

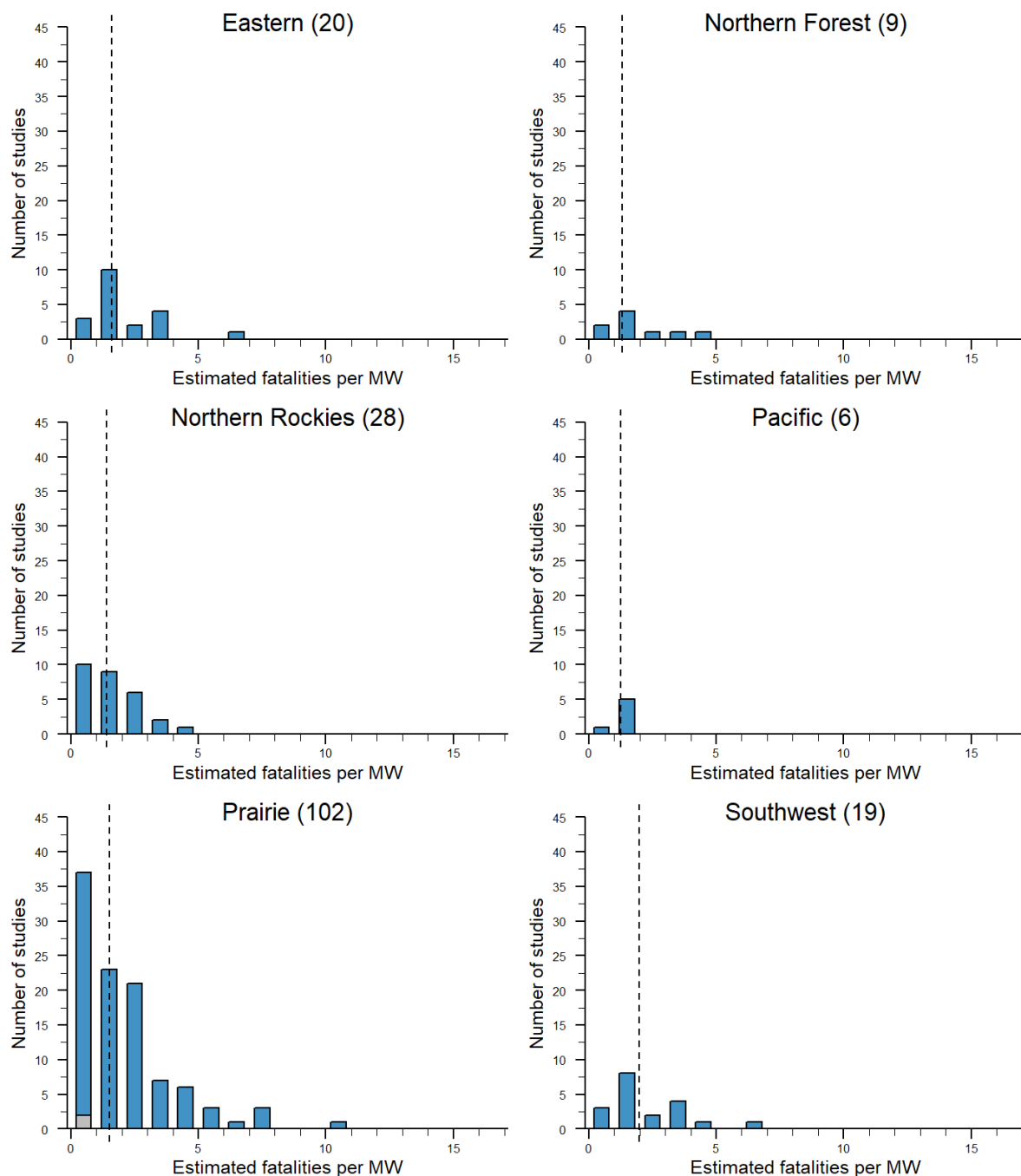


Figure 15. Estimated small bird fatalities per installed MW per year by avifaunal biome from post-construction studies contained in AWWIC. Estimates are presented as reported and not standardized for differences in study methodology. Number of studies available in each avifaunal biome is contained in parentheses. Vertical dashed line indicates median fatality rate. Gray bar indicates number of studies reporting zero fatalities. See Appendix B for tables of summary statistics.

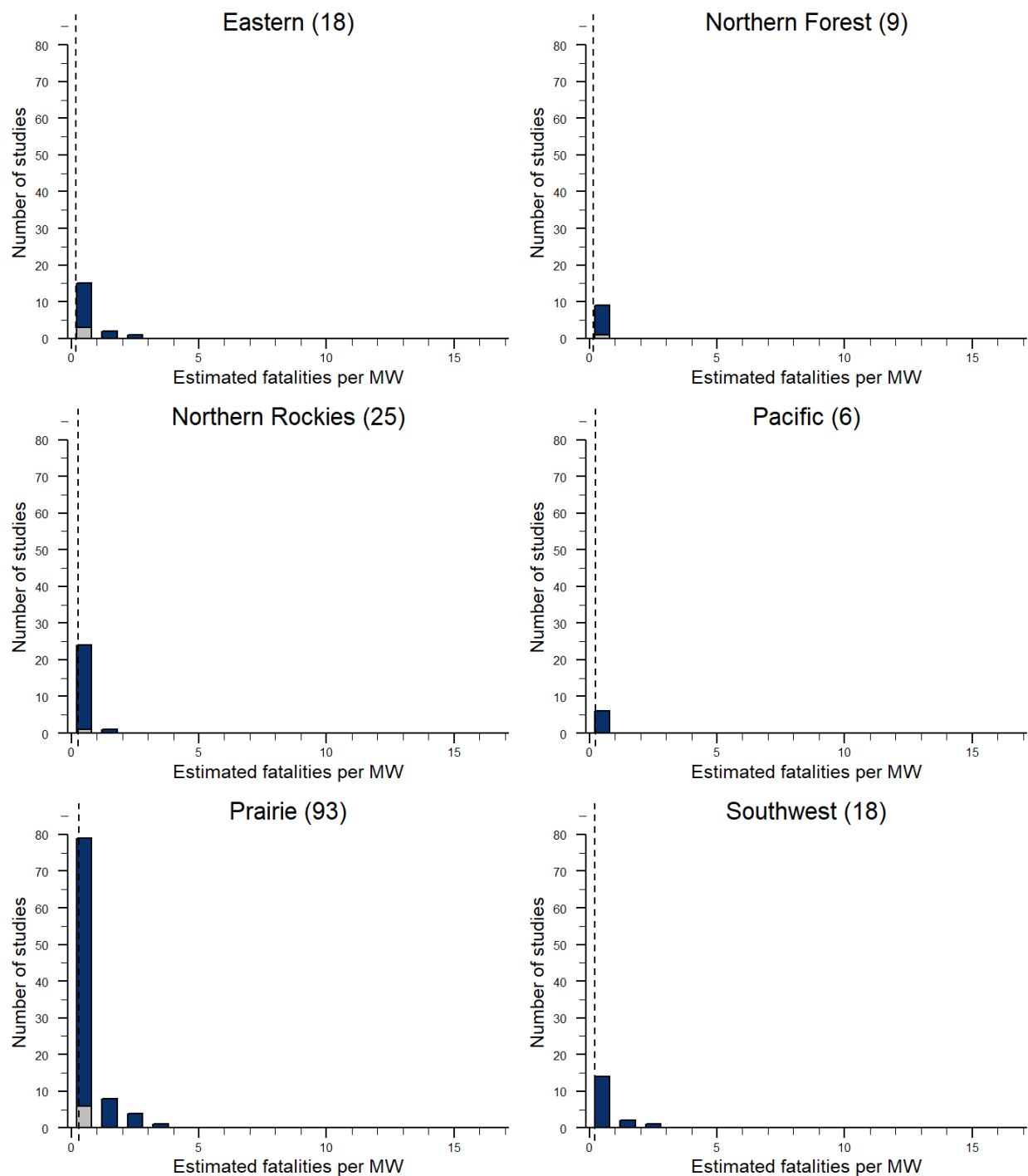


Figure 16. Estimated large bird fatalities per installed MW per year by avifaunal biome from post-construction studies contained in AWWIC. Estimates are presented as reported and not standardized for differences in study methodology. Number of studies available in each avifaunal biome is contained in parentheses. Vertical dashed line indicates median fatality rate. Gray bar indicates number of studies reporting zero fatalities. See Appendix B for tables of summary statistics.

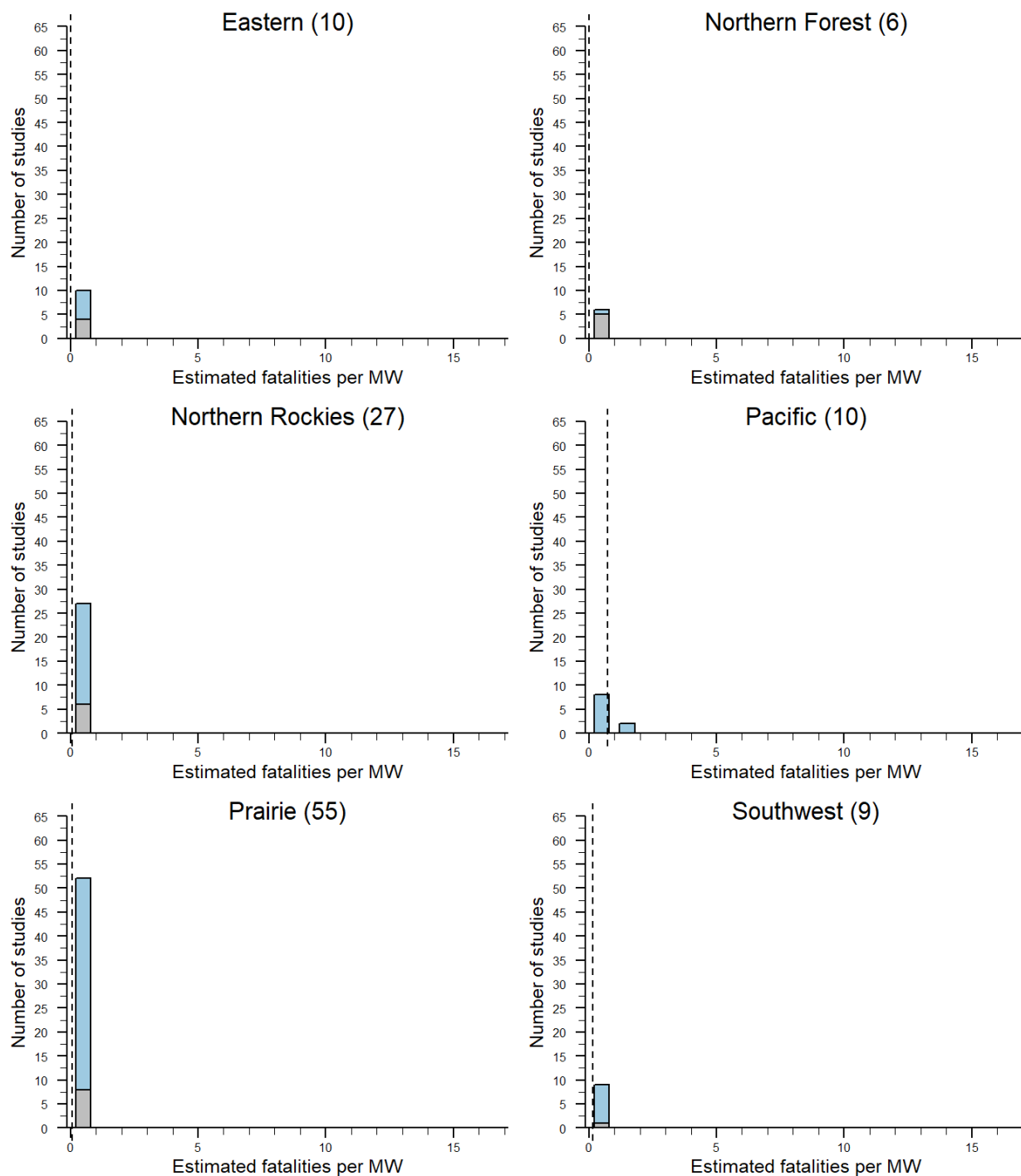


Figure 17. Estimated raptor fatalities per installed MW per year by avifaunal biome from post-construction studies contained in AWWIC. Estimates are presented as reported and not standardized for differences in study methodology. Number of studies available in each avifaunal biome is contained in parentheses. Vertical dashed line indicates median fatality rate. Gray bar indicates number of studies reporting zero fatalities. See Appendix B for tables of summary statistics.

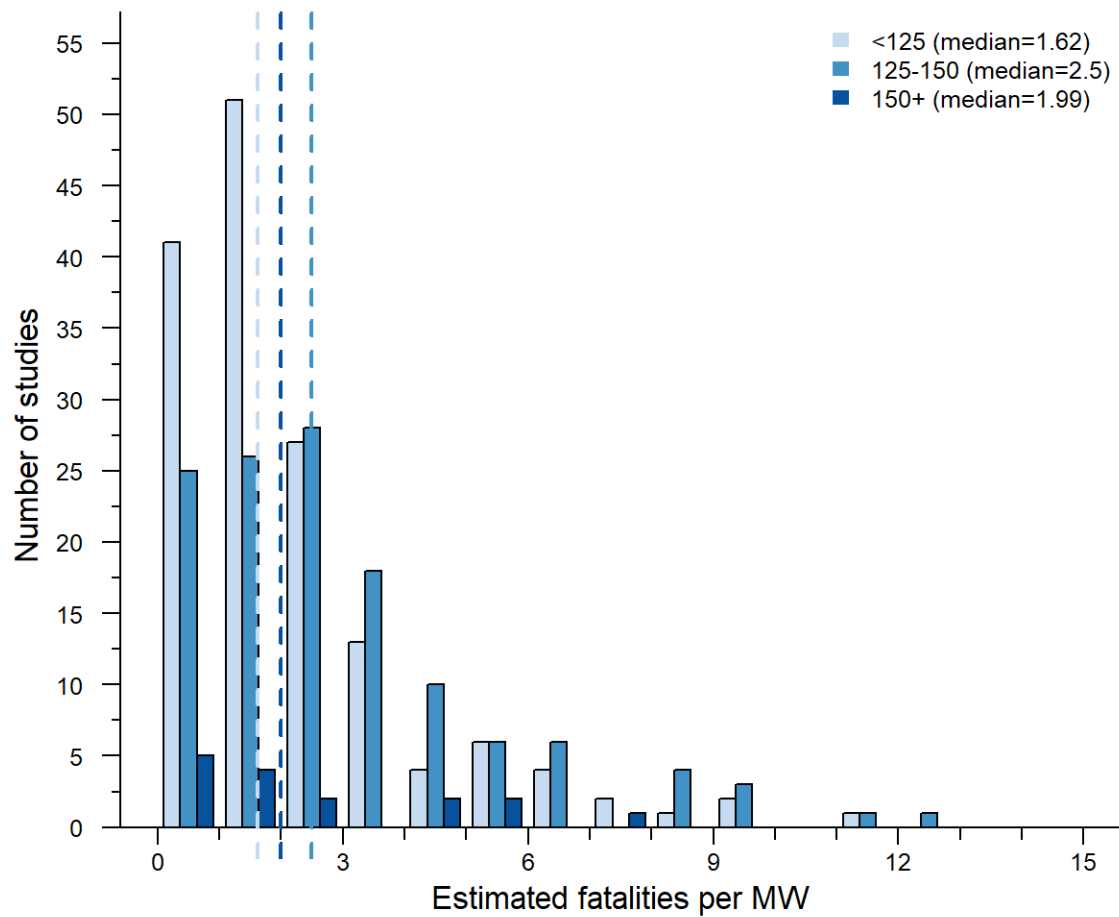


Figure 18. Estimated bird fatalities per installed MW from studies conducted at projects with an average total turbine height (height of tower + blade length) less than 125m (N=152), 125-150m (N=128), and greater than 150m (N=16). Estimates are presented as reported and not standardized for differences in study methodology. Number of studies available in each avifaunal biome is contained in parentheses. Vertical dashed line indicates median fatality rate for each turbine total height category.

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Appendix A. Data Fields Contained in AWWIC

Project Site Information	
	Site Size
	USFWS Region
	EPA Level III Ecoregion
	Bird Conservation Region
	Landscape Types (e.g. row crop, forested, grassland)
	Year Operations Started
	Turbine Details (e.g. make, model, size)
	# Turbines
Fatality Estimates	
Study Protocols	Study Start/End Date
	Turbine Search Schedule
	# Turbines Searched
	Plot Dimensions and Density Weighted Proportion (DWP) estimates
Fatality Estimates	Fatality Estimate Group (e.g. bird, bat, large bird)
	Estimator Used (e.g. GenEst, Shoenfeld, Huso)
	Estimated Fatalities per MW & per Turbine
	Fatality Estimate Confidence Intervals
Bias Trials	Searcher Efficiency Specimen Type
	SE: # placed, # available, # found, % found
	Carcass Removal Trial Specimen Type
	CR: # trials, # specimens placed, mean removal time, % remaining
Fatality Incidents	
	Species
	How Found (Scheduled Search, Cleanup Find, Incidental Find, Other)
	Action Taken (Collected, Released, Euthanized, Transported, None)
	Date Found
	Location Type (Turbine, Power Line, Met Tower, Other, N/A)
	Distance and Bearing from Turbine
	Nearest Turbine
	Find Type (Large Bird, Small Bird, Bat, Other)
	Sex
	Age (Adult, Juvenile, Unknown)
	Condition (Intact, Partial, Dismembered, Feather Spots, Other)
	Scavenged By (None, Carnivores, Corvids, Insects, Other, Unknown)
	Decomposition
	Est. Time Since Death
	Possible Cause (Turbine Collision, Non-turbine Collision, Unknown)

Appendix B. Fatality Estimate Summary Statistics

Table B1. Summary statistics of estimated bird fatalities per MW by avifaunal biome. Estimates are based on post-construction studies contained in AWWIC and are not standardized for differences in study methodology. Number of studies available in each region is contained in parentheses.

(a) All birds

Avifaunal Biome	Mean	25th percentile	Median	75th percentile
Eastern (46)	2.53	1.29	1.92	3.35
Northern Forest (23)	2.69	1.36	2.53	3.27
Northern Rockies (48)	1.86	0.92	1.67	2.54
Pacific (15)	2.72	0.8	2.17	2.94
Prairie (144)	2.78	0.85	1.9	3.71
Southwest (20)	3.38	1.59	2.78	4.69
US (296)	2.62	1.08	1.94	3.44

(b) Small birds

Avifaunal Biome	Mean	25th percentile	Median	75th percentile
Eastern (20)	2	1.09	1.59	2.85
Northern Forest (9)	1.89	1.01	1.31	2.63
Northern Rockies (28)	1.51	0.42	1.41	2.19
Pacific (6)	1.23	1.2	1.25	1.45
Prairie (102)	2.03	0.58	1.52	2.73
Southwest (19)	2.35	1.35	1.98	3.13
US (184)	1.95	0.82	1.52	2.62

(c) Large birds

Avifaunal Biome	Mean	25th percentile	Median	75th percentile
Eastern (18)	0.46	0.15	0.18	0.47
Northern Forest (9)	0.23	0.04	0.16	0.33
Northern Rockies (25)	0.31	0.11	0.27	0.42
Pacific (6)	0.28	0.2	0.23	0.29
Prairie (92)	0.55	0.14	0.3	0.74
Southwest (17)	0.5	0.18	0.22	0.52
US (167)	0.47	0.14	0.26	0.56

(d) Raptors (does not include vultures)

Avifaunal Biome	Mean	25th percentile	Median	75th percentile
Eastern (10)	0.05	0	0.01	0.05
Northern Forest (6)	0.04	0	0	0
Northern Rockies (27)	0.09	0.03	0.06	0.13
Pacific (10)	0.68	0.43	0.74	0.94
Prairie (52)	0.13	0.03	0.07	0.2
Southwest (9)	0.12	0.06	0.14	0.15
US (114)	0.16	0.01	0.07	0.21

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Table B2. Summary statistics of estimated bird fatalities per turbine by **avifaunal biome**. Estimates are based on post-construction studies contained in AWWIC and are not standardized for differences in study methodology. Number of studies available in each region is contained in parentheses.

(a) All birds

Avifaunal Biome	Mean	25th percentile	Median	75th percentile
Eastern (46)	4.92	2.29	3.71	6.69
Northern Forest (23)	4.54	2.11	4.03	6.24
Northern Rockies (48)	3.46	1.68	3.16	4.57
Pacific (15)	5.41	1.45	3.7	6.75
Prairie (144)	5.56	1.52	4.04	7.94
Southwest (20)	7.05	3.54	5.03	10.49
US (296)	5.13	2.03	3.92	6.82

(b) Small birds

Avifaunal biome	Mean	25th percentile	Median	75th percentile
Eastern (20)	4.04	2.06	2.5	5.39
Northern Forest (9)	3.22	1.51	2.52	4.21
Northern Rockies (28)	2.75	0.74	2.17	4.09
Pacific (6)	2.5	2.42	2.55	2.98
Prairie (102)	4.25	1.22	3.08	5.58
Southwest (19)	5.48	2.69	4.89	7.3
US (184)	4.02	1.52	2.9	5.47

(c) Large birds

Avifaunal biome	Mean	25th percentile	Median	75th percentile
Eastern (18)	0.92	0.25	0.32	1.05
Northern Forest (9)	0.37	0.12	0.25	0.65
Northern Rockies (25)	0.57	0.24	0.46	0.76
Pacific (6)	0.56	0.42	0.54	0.6
Prairie (92)	1.16	0.26	0.6	1.39
Southwest (17)	1.21	0.28	0.6	1.71
US (167)	0.99	0.25	0.5	1.16

(d) Raptors (does not include vultures)

Avifaunal biome	Mean	25th percentile	Median	75th percentile
Eastern (10)	0.1	0	0.02	0.08
Northern Forest (6)	0.07	0	0	0
Northern Rockies (27)	0.18	0.06	0.11	0.2
Pacific (10)	1.36	0.7	1.32	2.07
Prairie (52)	0.26	0.06	0.15	0.43
Southwest (8)	0.35	0.14	0.34	0.46
US (113)	0.32	0.03	0.14	0.45

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Table B3. Summary statistics of estimated bird fatalities per MW by State. Estimates are based on post-construction studies contained in AWWIC and are not standardized for differences in study methodology. Number of studies available in each avifaunal biome is contained in parentheses. Only states in which at least five studies from at least three different owners are included in the table. For states for which this is true for all bird counts, but not for small bird, large bird, or raptor counts, the summary statistics are replaced with “—”.

(a) All birds

State	Mean	25th percentile	Median	75th percentile
CA (29)	2.97	1.22	2.2	3.13
CO (8)	5.87	1.78	5.35	9.36
IA (32)	3.21	2.14	3.16	3.86
IL (6)	1.14	0.38	0.66	1.22
KS (9)	2.45	0.72	1.89	3.79
ME (10)	2.08	1.25	1.43	2.64
MI (6)	2.09	0.68	1.97	3.02
MN (9)	2.16	0.51	0.68	3.64
NE (5)	1.49	0.99	1.33	1.63
NY (26)	1.73	1.21	1.62	1.9
OK (12)	2.15	0.44	1.57	2.73
OR (23)	2.26	1.61	2.21	2.6
PA (11)	1.95	1.2	1.91	2.69
TX (32)	3.34	1.14	2.06	4.78
WA (11)	1.42	0.8	1.4	2.04

b) Small birds

State	Mean	25th percentile	Median	75th percentile
CA (19)	1.79	1.1	1.4	2.01
CO (1)	—	—	—	—
IA (30)	2.45	1.61	2.32	2.91
IL (3)	—	—	—	—
KS (5)	0.54	0.17	0.57	0.83
ME (1)	—	—	—	—
MI (5)	2.31	1	2.63	3.12
MN (5)	1.51	0.33	0.51	0.53
NE (3)	—	—	—	—
NY (14)	1.35	0.93	1.22	1.62

State	Mean	25th percentile	Median	75th percentile
OK (10)	1.41	0.33	1.04	2.03
OR (13)	2.03	1.54	2	2.48
PA (2)	—	—	—	—
TX (24)	2.94	1.09	1.9	3.77
WA (7)	1.13	0.49	1.02	1.64

(c) Large birds

State	Mean	25th percentile	Median	75th percentile
CA (18)	0.32	0.2	0.24	0.48
CO (0)	—	—	—	—
IA (29)	0.65	0.2	0.5	0.86
IL (0)	—	—	—	—
KS (5)	0.25	0.1	0.12	0.2
ME (0)	—	—	—	—
MI (5)	0.11	0.03	0.1	0.1
MN (5)	0.08	0	0.07	0.16
NE (2)	—	—	—	—
NY (14)	0.24	0.07	0.17	0.33
OK (9)	0.83	0.14	0.38	0.92
OR (13)	0.35	0.14	0.21	0.41
PA (0)	—	—	—	—
TX (22)	0.85	0.24	0.76	1.37
WA (5)	0.31	0.27	0.36	0.38

(d) Raptors (does not include vultures)

State	Mean	25th percentile	Median	75th percentile
CA (15)	0.49	0.18	0.42	0.84
CO (3)	—	—	—	—
IA (15)	0.06	0	0.04	0.07
IL (0)	—	—	—	—
KS (1)	—	—	—	—
ME (0)	—	—	—	—
MI (3)	—	—	—	—
MN (4)	—	—	—	—

State	Mean	25th percentile	Median	75th percentile
NE (1)	—	—	—	—
NY (1)	—	—	—	—
OK (1)	—	—	—	—
OR (18)	0.07	0.03	0.04	0.06
PA (4)	—	—	—	—
TX (14)	0.17	0.11	0.17	0.22
WA (5)	0.15	0.14	0.15	0.17

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Table B4. Summary statistics of estimated bird fatalities per turbine by State. Estimates are based on post-construction studies contained in AWWIC and are not standardized for differences in study methodology. Number of studies available in each avifaunal biome is contained in parentheses. Only states in which at least five studies from at least three different owners are included in the table. For states for which this is true for all bird counts, but not for small bird, large bird, or raptor counts, the summary statistics are replaced with “—”.

(a) All birds

State	Mean	25th percentile	Median	75th percentile
CA (29)	6.02	2.02	4.71	6.9
CO (8)	9.77	4.26	9.5	14.29
IA (32)	6.69	4.28	5.99	8.06
IL (6)	1.81	0.57	0.99	1.84
KS (9)	5.57	1.51	3.79	8.71
ME (10)	3.73	2.04	3.09	4.39
MI (6)	3.39	1.14	3.26	4.84
MN (9)	4.04	0.8	1.36	8.38
NE (5)	2.77	2.21	2.68	3
NY (26)	3.08	2.26	2.57	3.55
OK (12)	4.44	0.82	3.62	5.45
OR (23)	4	2.73	4.06	4.72
PA (11)	3.74	2.23	3.82	4.66
TX (32)	7.29	2.35	5.03	11.24
WA (11)	2.67	1.58	2.79	3.52

(b) Small birds

State	Mean	25th percentile	Median	75th percentile
CA (19)	4.28	2.45	3.1	4.78
CO (1)	—	—	—	—
IA (30)	5.11	3.38	4.34	6.07
IL (3)	—	—	—	—
KS (5)	1.24	0.43	1.2	1.67
ME (1)	—	—	—	—
MI (5)	3.72	1.7	4.21	5
MN (5)	2.92	0.66	0.8	0.92
NE (3)	—	—	—	—
NY (14)	2.24	1.39	2.24	2.44
OK (10)	3.02	0.6	2.41	4.38

State	Mean	25th percentile	Median	75th percentile
OR (13)	3.34	1.89	2.9	4.99
PA (2)	—	—	—	—
TX (24)	6.34	2.36	4.66	8.45
WA (7)	2.19	0.88	2.04	2.64

(c) Large birds

State	Mean	25th percentile	Median	75th percentile
CA (18)	0.8	0.42	0.6	1.15
CO (0)	—	—	—	—
IA (29)	1.39	0.39	1.1	1.68
IL (0)	—	—	—	—
KS (5)	0.55	0.25	0.25	0.5
ME (0)	—	—	—	—
MI (5)	0.2	0.05	0.16	0.2
MN (5)	0.16	0	0.14	0.26
NE (2)	—	—	—	—
NY (14)	0.38	0.14	0.28	0.5
OK (9)	1.73	0.25	0.86	2.11
OR (13)	0.56	0.28	0.35	0.67
PA (0)	—	—	—	—
TX (22)	1.83	0.53	1.69	2.67
WA (5)	0.61	0.48	0.76	0.76

(d) Raptors (does not include vultures)

State	Mean	25th percentile	Median	75th percentile
CA (14)	1.07	0.47	0.9	1.74
CO (3)	—	—	—	—
IA (15)	0.12	0.01	0.1	0.16
IL (0)	—	—	—	—
KS (1)	—	—	—	—
ME (0)	—	—	—	—
MI (3)	—	—	—	—
MN (4)	—	—	—	—
NE (1)	—	—	—	—
NY (1)	—	—	—	—

State	Mean	25th percentile	Median	75th percentile
OK (1)	—	—	—	—
OR (18)	0.13	0.06	0.09	0.12
PA (4)	—	—	—	—
TX (14)	0.37	0.22	0.4	0.49
WA (5)	0.29	0.23	0.25	0.34

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Appendix C. Full Species List

Table C1. Number and percentage of bird fatality incidents for all bird species reported from all available studies (N=327). New species in this edition are designated by an asterisk (*). Frequency of studies is the number of studies containing at least one fatality incident of the species. 2021 Federal Status indicates species that are listed as Birds of Conservation Concern (BCC), Endangered Species Act (ESA), or Watch List (WL) by the [U.S. Fish & Wildlife Service](#). Species with a dash (–) have no federal status. 2025 State of The Birds indicates continental status category assigned in [NABCI \(2025\)](#). Tipping Point bird species have lost more than 50% of their populations within the past 50 years. Incident numbers should not be used as national species composition values without further analysis accounting for variable effort.

Species	Bird Group	Number of incidents	Percentage of incidents	Frequency of studies	2021 Federal Status	2025 State Of The Birds
Horned Lark	Small Passerines	1309	13	153	–	Common Bird in Steep Decline
Mourning Dove	Doves/Pigeons	530	5.2	130	–	Low Concern
Golden-crowned Kinglet	Small Passerines	396	3.9	105	–	Common Bird in Steep Decline
Red-eyed Vireo	Small Passerines	375	3.7	89	–	Low Concern
Western Meadowlark	Small Passerines	334	3.3	68	–	Low Concern
Red-tailed Hawk	Diurnal Raptors	272	2.7	115	–	Low Concern
Turkey Vulture	Vultures	237	2.3	75	–	Low Concern
American Kestrel	Diurnal Raptors	235	2.3	65	–	Low Concern
Killdeer	Shorebirds	176	1.7	55	–	Low Concern
Ruby-crowned Kinglet	Small Passerines	164	1.6	84	–	Low Concern
European Starling	Small Passerines	162	1.6	82	–	Low Concern
Red-winged Blackbird	Small Passerines	153	1.5	34	–	Low Concern
Rock Pigeon	Doves/Pigeons	128	1.3	66	–	Low Concern
Ring-necked Pheasant	Upland Game Birds	118	1.2	49	–	Low Concern
Savannah Sparrow	Small Passerines	107	1.1	40	–	Common Bird in Steep Decline
Yellow-rumped Warbler	Small Passerines	102	1	57	–	Low Concern
Magnolia Warbler	Small Passerines	92	0.9	43	–	Low Concern
Gray Partridge	Upland Game Birds	83	0.8	26	–	Low Concern
American Coot	Rails/Coots	82	0.8	37	–	Low Concern
Yellow-billed Cuckoo	Cuckoos	77	0.8	34	–	Common Bird in Steep Decline
Northern Bobwhite	Upland Game Birds	71	0.7	22	–	Common Bird in Steep Decline
Swainson's Hawk	Diurnal Raptors	65	0.6	35	–	Low Concern

Species	Bird Group	Number of incidents	Percentage of incidents	Frequency of studies	2021 Federal Status	2025 State Of The Birds
Dark-eyed Junco	Small Passerines	64	0.6	43	–	Low Concern
Tree Swallow	Small Passerines	64	0.6	37	–	Low Concern
Wilson’s Warbler	Small Passerines	60	0.6	38	–	Low Concern
House Wren	Small Passerines	59	0.6	42	–	Low Concern
Yellow Warbler	Small Passerines	59	0.6	45	–	Low Concern
Mallard	Waterfowl	53	0.5	35	–	Low Concern
Barn Owl	Owls	49	0.5	28	–	Low Concern
House Sparrow	Small Passerines	49	0.5	35	–	Low Concern
Cliff Swallow	Small Passerines	48	0.5	30	–	Low Concern
Blackpoll Warbler	Small Passerines	45	0.4	16	–	Common Bird in Steep Decline
Chipping Sparrow	Small Passerines	44	0.4	40	–	Low Concern
Yellow-breasted Chat	Small Passerines	44	0.4	10	–	Low Concern
Northern Flicker	Woodpeckers	43	0.4	37	–	Low Concern
American Robin	Small Passerines	42	0.4	34	–	Low Concern
Common Yellowthroat	Small Passerines	42	0.4	33	–	Low Concern
Townsend’s Warbler	Small Passerines	42	0.4	22	–	Low Concern
Nashville Warbler	Small Passerines	41	0.4	24	–	Low Concern
Brewer’s Blackbird	Small Passerines	40	0.4	14	–	Low Concern
Vesper Sparrow	Small Passerines	40	0.4	30	–	Low Concern
Chukar	Upland Game Birds	38	0.4	15	–	Low Concern
Common Nighthawk	Nightjars	38	0.4	16	–	Common Bird in Steep Decline
Northern Parula	Small Passerines	38	0.4	24	–	Low Concern
American Redstart	Small Passerines	36	0.4	21	–	Low Concern
Grasshopper Sparrow	Small Passerines	36	0.4	17	–	Common Bird in Steep Decline
Wild Turkey	Upland Game Birds	36	0.4	18	–	Low Concern
Sedge Wren	Small Passerines	34	0.3	20	–	Low Concern
Black-and-white Warbler	Small Passerines	29	0.3	23	–	Low Concern
Black-throated Green Warbler	Small Passerines	29	0.3	18	–	Low Concern
Sora	Rails/Coots	29	0.3	24	–	Low Concern
Tennessee Warbler	Small Passerines	29	0.3	20	–	Low Concern

Species	Bird Group	Number of incidents	Percentage of incidents	Frequency of studies	2021 Federal Status	2025 State Of The Birds
White-crowned Sparrow	Small Passerines	29	0.3	22	–	Low Concern
Black-throated Blue Warbler	Small Passerines	28	0.3	20	–	Low Concern
Blue-headed Vireo	Small Passerines	28	0.3	20	–	Low Concern
Lark Bunting	Small Passerines	28	0.3	18	BCC	Common Bird in Steep Decline
Lincoln's Sparrow	Small Passerines	27	0.3	23	–	Low Concern
Brown-headed Cowbird	Small Passerines	26	0.3	23	–	Low Concern
Song Sparrow	Small Passerines	26	0.3	24	–	Low Concern
Brewer's Sparrow	Small Passerines	25	0.2	16	–	Low Concern
Cassin's Sparrow	Small Passerines	25	0.2	8	BCC	Low Concern
Cedar Waxwing	Small Passerines	25	0.2	13	–	Low Concern
Dickcissel	Small Passerines	25	0.2	18	BCC	Low Concern
Gray Catbird	Small Passerines	25	0.2	20	–	Low Concern
Barn Swallow	Small Passerines	24	0.2	19	–	Low Concern
Brown Creeper	Small Passerines	24	0.2	18	–	Low Concern
Golden Eagle	Diurnal Raptors	24	0.2	18	–	Low Concern
House Finch	Small Passerines	24	0.2	16	–	Low Concern
Orange-crowned Warbler	Small Passerines	24	0.2	18	–	Low Concern
Blue-winged Teal	Waterfowl	23	0.2	18	–	Low Concern
Ovenbird	Small Passerines	23	0.2	17	–	Low Concern
American Goldfinch	Small Passerines	22	0.2	20	–	Low Concern
Marsh Wren	Small Passerines	22	0.2	15	–	Low Concern
Swainson's Thrush	Small Passerines	22	0.2	14	–	Low Concern
Wood Thrush	Small Passerines	22	0.2	9	BCC	Yellow Watch List; Tipping Point
Greater Roadrunner	Cuckoos	21	0.2	11	–	Low Concern
Purple Martin	Small Passerines	21	0.2	16	–	Low Concern
Red-breasted Nuthatch	Small Passerines	21	0.2	14	–	Low Concern
Bobolink	Small Passerines	20	0.2	10	BCC	Orange Watch List; Tipping Point
Black-billed Cuckoo	Cuckoos	20	0.2	16	BCC	Common Bird in Steep Decline
Blackburnian Warbler	Small Passerines	20	0.2	15	–	Low Concern
Northern Harrier	Diurnal Raptors	20	0.2	15	BCC	Low Concern

Species	Bird Group	Number of incidents	Percentage of incidents	Frequency of studies	2021 Federal Status	2025 State Of The Birds
Short-eared Owl	Owls	20	0.2	13	BCC	Common Bird in Steep Decline
Swamp Sparrow	Small Passerines	20	0.2	14	–	Low Concern
Western Tanager	Small Passerines	20	0.2	17	–	Low Concern
Yellow-bellied Sapsucker	Woodpeckers	20	0.2	17	–	Low Concern
Black-throated Gray Warbler	Small Passerines	19	0.2	12	BCC	Low Concern
White-throated Swift	Swifts/Hummingbirds	19	0.2	12	–	Low Concern
American Pipit	Small Passerines	18	0.2	5	–	Common Bird in Steep Decline
Loggerhead Shrike	Small Passerines	18	0.2	12	–	Common Bird in Steep Decline
Ruby-throated Hummingbird	Swifts/Hummingbirds	18	0.2	15	–	Low Concern
Upland Sandpiper	Shorebirds	18	0.2	14	BCC	Low Concern
Warbling Vireo	Small Passerines	18	0.2	12	–	Low Concern
Yellow-bellied Flycatcher	Small Passerines	18	0.2	13	–	Low Concern
Common Grackle	Small Passerines	17	0.2	15	–	Common Bird in Steep Decline
Cooper's Hawk	Diurnal Raptors	17	0.2	14	–	Low Concern
Lapland Longspur	Small Passerines	17	0.2	12	–	Common Bird in Steep Decline
Virginia Rail	Rails/Coots	17	0.2	13	–	Low Concern
Clay-colored Sparrow	Small Passerines	16	0.2	10	–	Low Concern
Common Raven	Large Corvids	16	0.2	12	–	Low Concern
Ferruginous Hawk	Diurnal Raptors	16	0.2	12	BCC	Low Concern
Great Horned Owl	Owls	16	0.2	12	–	Low Concern
Indigo Bunting	Small Passerines	16	0.2	12	–	Low Concern
American Crow	Large Corvids	15	0.1	13	–	Low Concern
Lark Sparrow	Small Passerines	15	0.1	11	–	Low Concern
Pine Warbler	Small Passerines	15	0.1	10	–	Low Concern
Rock Wren	Small Passerines	15	0.1	9	–	Common Bird in Steep Decline
Ruffed Grouse	Upland Game Birds	15	0.1	10	–	Low Concern
Sharp-shinned Hawk	Diurnal Raptors	15	0.1	15	–	Low Concern
Spotted Towhee	Small Passerines	15	0.1	14	–	Low Concern
White-eyed Vireo	Small Passerines	15	0.1	11	–	Low Concern
Winter Wren	Small Passerines	15	0.1	13	–	Low Concern

Species	Bird Group	Number of incidents	Percentage of incidents	Frequency of studies	2021 Federal Status	2025 State Of The Birds
Canada Goose	Waterfowl	14	0.1	12	–	Low Concern
Common Poorwill	Nightjars	14	0.1	10	–	Low Concern
Hermit Thrush	Small Passerines	14	0.1	14	–	Low Concern
Western Scrub-Jay	Small Passerines	14	0.1	3	–	Low Concern
Field Sparrow	Small Passerines	14	0.1	10	BCC	Yellow Watch List; Tipping Point
Chimney Swift	Swifts/Hummingbirds	13	0.1	10	BCC	Orange Watch List; Tipping Point
Baltimore Oriole	Small Passerines	13	0.1	10	–	Low Concern
Black-headed Grosbeak	Small Passerines	13	0.1	8	–	Low Concern
Black Vulture	Vultures	13	0.1	5	–	Low Concern
Cape May Warbler	Small Passerines	13	0.1	5	BCC	Low Concern
Chestnut-sided Warbler	Small Passerines	13	0.1	9	–	Low Concern
Eared Grebe	Loons/Grebes	13	0.1	8	–	Low Concern
Laughing Gull	Gulls/Terns	13	0.1	3	–	Low Concern
Veery	Small Passerines	13	0.1	8	–	Low Concern
American Tree Sparrow	Small Passerines	12	0.1	8	–	Common Bird in Steep Decline
Bay-breasted Warbler	Small Passerines	12	0.1	8	BCC	Low Concern
Eastern Kingbird	Small Passerines	12	0.1	10	–	Low Concern
Long-billed Curlew	Shorebirds	11	0.1	6	BCC	Low Concern
Northern Mockingbird	Small Passerines	11	0.1	11	–	Low Concern
Rough-legged Hawk	Diurnal Raptors	11	0.1	9	–	Low Concern
Snow Goose	Waterfowl	11	0.1	3	–	Low Concern
Yellow-throated Vireo	Small Passerines	11	0.1	10	–	Low Concern
Blue-gray Gnatcatcher	Small Passerines	10	0.1	8	–	Low Concern
Blue Jay	Small Passerines	10	0.1	10	–	Low Concern
California Quail	Upland Game Birds	10	0.1	3	–	Low Concern
Eastern Meadowlark	Small Passerines	10	0.1	8	BCC	Common Bird in Steep Decline
Golden-crowned Sparrow	Small Passerines	10	0.1	5	–	Low Concern
Green-winged Teal	Waterfowl	10	0.1	7	–	Low Concern
Pacific-slope Flycatcher	Small Passerines	10	0.1	8	–	Low Concern
Ruddy Duck	Waterfowl	10	0.1	7	–	Low Concern

Species	Bird Group	Number of incidents	Percentage of incidents	Frequency of studies	2021 Federal Status	2025 State Of The Birds
Mountain Quail	Upland Game Birds	10	0.1	2	WL	Yellow Watch List
Eurasian Collared-Dove	Doves/Pigeons	9	0.1	9	–	Low Concern
Least Flycatcher	Small Passerines	9	0.1	6	–	Common Bird in Steep Decline
MacGillivray's Warbler	Small Passerines	9	0.1	8	–	Low Concern
Palm Warbler	Small Passerines	9	0.1	9	–	Low Concern
Philadelphia Vireo	Small Passerines	9	0.1	6	–	Low Concern
Western Grebe	Loons/Grebes	9	0.1	7	BCC	Low Concern
White-winged Dove	Doves/Pigeons	9	0.1	4	–	Low Concern
American White Pelican	Waterbirds	8	0.1	4	BCC	Low Concern
American Woodcock	Shorebirds	8	0.1	5	WL	Low Concern
Peregrine Falcon	Diurnal Raptors	8	0.1	7	–	Low Concern
Ring-billed Gull	Gulls/Terns	8	0.1	3	–	Low Concern
Black-throated Sparrow	Small Passerines	7	0.1	6	–	Low Concern
Bullock's Oriole	Small Passerines	7	0.1	6	BCC	Low Concern
Burrowing Owl	Owls	7	0.1	4	–	Low Concern
Fox Sparrow	Small Passerines	7	0.1	6	–	Low Concern
Great-tailed Grackle	Small Passerines	7	0.1	3	–	Low Concern
Lesser Scaup	Waterfowl	7	0.1	6	–	Low Concern
Northern Shoveler	Waterfowl	7	0.1	3	–	Low Concern
Northern Waterthrush	Small Passerines	7	0.1	7	–	Low Concern
Sage Thrasher	Small Passerines	7	0.1	7	BCC	Low Concern
White-throated Sparrow	Small Passerines	7	0.1	6	–	Low Concern
Northern Pintail	Waterfowl	7	0.1	7	–	Yellow Watch List; Tipping Point
Acadian Flycatcher	Small Passerines	6	0.1	6	–	Low Concern
Black-billed Magpie	Large Corvids	6	0.1	6	–	Low Concern
Canada Warbler	Small Passerines	6	0.1	5	BCC	Common Bird in Steep Decline
Downy Woodpecker	Woodpeckers	6	0.1	6	–	Low Concern
Gadwall	Waterfowl	6	0.1	5	–	Low Concern
Great Blue Heron	Waterbirds	6	0.1	6	–	Low Concern
Hairy Woodpecker	Woodpeckers	6	0.1	6	–	Low Concern

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Hammond's Flycatcher	Small Passerines	6	0.1	6	–	Low Concern
Hooded Warbler	Small Passerines	6	0.1	4	–	Low Concern
LeConte's Sparrow	Small Passerines	6	0.1	5	BCC	Low Concern
Long-eared Owl	Owls	6	0.1	6	BCC	Low Concern
N. Rough-winged Swallow	Small Passerines	6	0.1	5	–	Low Concern
Osprey	Diurnal Raptors	6	0.1	5	–	Low Concern
Pied-billed Grebe	Loons/Grebes	6	0.1	6	–	Low Concern
White-tailed Hawk	Diurnal Raptors	6	0.1	5	–	Low Concern
Bell's Vireo	Small Passerines	5	<0.1	4	–	Low Concern
Eastern Wood-Pewee	Small Passerines	5	<0.1	5	–	Low Concern
Mountain Bluebird	Small Passerines	5	<0.1	5	–	Low Concern
Orchard Oriole	Small Passerines	5	<0.1	5	BCC	Low Concern
Domestic Chicken	Domestic	5	<0.1	4	–	Low Concern
Scarlet Tanager	Small Passerines	5	<0.1	4	BCC	Low Concern
Varied Thrush	Small Passerines	5	<0.1	5	–	Low Concern
Broad-winged Hawk	Diurnal Raptors	4	<0.1	4	–	Low Concern
Cassin's Vireo	Small Passerines	4	<0.1	3	–	Low Concern
Dunlin	Shorebirds	4	<0.1	3	–	Common Bird in Steep Decline
Eastern Bluebird	Small Passerines	4	<0.1	4	–	Low Concern
Eastern Phoebe	Small Passerines	4	<0.1	4	–	Low Concern
Gambel's Quail	Upland Game Birds	4	<0.1	3	–	Low Concern
Gray-cheeked Thrush	Small Passerines	4	<0.1	2	–	Low Concern
Great Crested Flycatcher	Small Passerines	4	<0.1	2	–	Low Concern
Pine Siskin	Small Passerines	4	<0.1	4	–	Common Bird in Steep Decline
Prairie Falcon	Diurnal Raptors	4	<0.1	4	BCC	Low Concern
Ring-necked Duck	Waterfowl	4	<0.1	4	–	Low Concern
Scissor-tailed Flycatcher	Small Passerines	4	<0.1	4	–	Low Concern
Vaux's Swift	Swifts/Hummingbirds	4	<0.1	4	–	Low Concern
Western Kingbird	Small Passerines	4	<0.1	4	–	Low Concern
Yellow-headed Blackbird	Small Passerines	4	<0.1	4	BCC	Low Concern

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Greater Sage-Grouse	Upland Game Birds	4	<0.1	3	WL	Red Watch List; Tipping Point
Kentucky Warbler	Small Passerines	4	<0.1	3	BCC	Yellow Watch List
Eastern Towhee	Small Passerines	3	<0.1	3	–	Orange Watch List; Tipping Point
Semipalmated Sandpiper	Shorebirds	3	<0.1	3	–	Orange Watch List; Tipping Point
Ash-throated Flycatcher	Small Passerines	3	<0.1	3	–	Low Concern
Black-crowned Night-Heron	Waterbirds	3	<0.1	3	–	Low Concern
Cactus Wren	Small Passerines	3	<0.1	3	–	Common Bird in Steep Decline
Cattle Egret	Waterbirds	3	<0.1	3	–	Low Concern
Green-tailed Towhee	Small Passerines	3	<0.1	3	–	Low Concern
Green Heron	Waterbirds	3	<0.1	3	–	Common Bird in Steep Decline
Harris's Hawk	Diurnal Raptors	3	<0.1	1	BCC	Low Concern
Lesser Goldfinch	Small Passerines	3	<0.1	3	–	Low Concern
McCown's Longspur	Small Passerines	3	<0.1	2	BCC	Low Concern
Northern Cardinal	Small Passerines	3	<0.1	3	–	Low Concern
Red-naped Sapsucker	Woodpeckers	3	<0.1	3	–	Low Concern
Redhead	Waterfowl	3	<0.1	3	–	Low Concern
Rose-breasted Grosbeak	Small Passerines	3	<0.1	3	BCC	Low Concern
Black Rail (L. j. coturniculus)	Rails/Coots	3	<0.1	2	–	Red Watch List; Tipping Point
Snow Bunting	Small Passerines	3	<0.1	2	–	Common Bird in Steep Decline
Steller's Jay	Small Passerines	3	<0.1	1	–	Low Concern
Tricolored Blackbird	Small Passerines	3	<0.1	2	BCC	Red Watch List; Tipping Point
White-tailed Kite	Diurnal Raptors	3	<0.1	1	–	Common Bird in Steep Decline
Willow Flycatcher	Small Passerines	3	<0.1	3	–	Low Concern
Yellow-throated Warbler	Small Passerines	3	<0.1	3	–	Low Concern
Blue-winged Warbler	Small Passerines	3	<0.1	3	BCC	Yellow Watch List
Flammulated Owl	Owls	3	<0.1	3	BCC	Yellow Watch List
Bald Eagle	Diurnal Raptors	2	<0.1	2	–	Low Concern
Bank Swallow	Small Passerines	2	<0.1	2	–	Common Bird in Steep Decline
Belted Kingfisher	Kingfishers	2	<0.1	2	BCC	Low Concern
Bewick's Wren	Small Passerines	2	<0.1	2	–	Low Concern

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Black-bellied Whistling-Duck	Waterfowl	2	<0.1	2	–	Low Concern
Black-capped Chickadee	Small Passerines	2	<0.1	2	–	Low Concern
Brown Thrasher	Small Passerines	2	<0.1	2	–	Low Concern
Bushtit	Small Passerines	2	<0.1	1	–	Low Concern
California Gull	Gulls/Terns	2	<0.1	2	BCC	Low Concern
Carolina Wren	Small Passerines	2	<0.1	1	–	Low Concern
Chestnut-collared Longspur	Small Passerines	2	<0.1	2	BCC	Red Watch List; Tipping Point
Chuck-will's-widow	Nightjars	2	<0.1	2	BCC	Low Concern
Cinnamon Teal	Waterfowl	2	<0.1	2	WL	Common Bird in Steep Decline
Common Gallinule	Rails/Coots	2	<0.1	2	–	Low Concern
Common Ground-Dove	Doves/Pigeons	2	<0.1	1	–	Low Concern
Crested Caracara	Diurnal Raptors	2	<0.1	1	–	Low Concern
Double-crested Cormorant	Waterbirds	2	<0.1	2	–	Low Concern
Gilded Flicker	Woodpeckers	2	<0.1	1	BCC	Low Concern
Long-billed Thrasher	Small Passerines	2	<0.1	1	–	Low Concern
Merlin	Diurnal Raptors	2	<0.1	2	–	Low Concern
Purple Finch	Small Passerines	2	<0.1	2	–	Low Concern
Sage Sparrow	Small Passerines	2	<0.1	2	–	Low Concern
Sharp-tailed Grouse	Upland Game Birds	2	<0.1	2	–	Low Concern
Spotted Sandpiper	Shorebirds	2	<0.1	2	–	Common Bird in Steep Decline
Townsend's Solitaire	Small Passerines	2	<0.1	2	–	Low Concern
Western Bluebird	Small Passerines	2	<0.1	2	–	Low Concern
Western Wood-Pewee	Small Passerines	2	<0.1	2	–	Low Concern
Golden-winged Warbler	Small Passerines	2	<0.1	2	BCC	Yellow Watch List; Tipping Point
Prairie Warbler	Small Passerines	2	<0.1	2	BCC	Yellow Watch List; Tipping Point
Yellow Rail	Rails/Coots	2	<0.1	2	BCC	Yellow Watch List; Tipping Point
Evening Grosbeak	Small Passerines	1	<0.1	1	BCC	Orange Watch List; Tipping Point
Gray-crowned Rosy-Finch	Small Passerines	1	<0.1	1	–	Orange Watch List; Tipping Point
Great Black-backed Gull	Gulls/Terns	1	<0.1	1	–	Orange Watch List; Tipping Point
Greater Yellowlegs	Shorebirds	1	<0.1	1	–	Orange Watch List; Tipping Point

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Long-billed Dowitcher	Shorebirds	1	<0.1	1	–	Orange Watch List; Tipping Point
Short-billed Dowitcher	Shorebirds	1	<0.1	1	BCC	Orange Watch List; Tipping Point
Western Gull	Gulls/Terns	1	<0.1	1	BCC	Orange Watch List; Tipping Point
Allen’s Hummingbird	Swifts/Hummingbirds	1	<0.1	1	BCC	Low Concern
American Bittern	Waterbirds	1	<0.1	1	–	Low Concern
American Wigeon	Waterfowl	1	<0.1	1	–	Low Concern
Anna’s Hummingbird	Swifts/Hummingbirds	1	<0.1	1	–	Low Concern
Baird’s Sparrow*	Small Passerines	1	<0.1	1	BCC	Low Concern
Black-tailed Gnatcatcher	Small Passerines	1	<0.1	1	–	Low Concern
Brown-crested Flycatcher*	Small Passerines	1	<0.1	1	–	Low Concern
Buff-bellied Hummingbird	Swifts/Hummingbirds	1	<0.1	1	–	Low Concern
Canvasback	Waterfowl	1	<0.1	1	–	Low Concern
Calliope Hummingbird	Swifts/Hummingbirds	1	<0.1	1	BCC	Yellow Watch List
Chihuahuan Raven	Large Corvids	1	<0.1	1	BCC	Low Concern
Common Merganser	Waterfowl	1	<0.1	1	–	Low Concern
Connecticut Warbler	Small Passerines	1	<0.1	1	BCC	Low Concern
Costa’s Hummingbird	Swifts/Hummingbirds	1	<0.1	1	BCC	Low Concern
Couch’s Kingbird	Small Passerines	1	<0.1	1	–	Low Concern
Crissal Thrasher*	Small Passerines	1	<0.1	1	–	Low Concern
Dusky Flycatcher	Small Passerines	1	<0.1	1	–	Low Concern
Oak Titmouse	Small Passerines	1	<0.1	1	BCC	Yellow Watch List
European Goldfinch	Small Passerines	1	<0.1	1	–	Low Concern
Prothonotary Warbler	Small Passerines	1	<0.1	1	BCC	Yellow Watch List
Franklin’s Gull	Gulls/Terns	1	<0.1	1	BCC	Low Concern
Fulvous Whistling-Duck	Waterfowl	1	<0.1	1	–	Low Concern
Glaucous-winged Gull	Gulls/Terns	1	<0.1	1	–	Low Concern
Gray Flycatcher*	Small Passerines	1	<0.1	1	–	Low Concern
Great Egret	Waterbirds	1	<0.1	1	–	Low Concern
Greater White-fronted Goose	Waterfowl	1	<0.1	1	–	Low Concern
Groove-billed Ani	Cuckoos	1	<0.1	1	–	Low Concern

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Gull-billed Tern	Gulls/Terns	1	<0.1	1	BCC	Low Concern
Harris's Sparrow	Small Passerines	1	<0.1	1	–	Low Concern
Hermit Warbler	Small Passerines	1	<0.1	1	BCC	Low Concern
Herring Gull	Gulls/Terns	1	<0.1	1	–	Common Bird in Steep Decline
Lazuli Bunting	Small Passerines	1	<0.1	1	–	Low Concern
Least Bittern	Waterbirds	1	<0.1	1	–	Low Concern
Mourning Warbler	Small Passerines	1	<0.1	1	–	Low Concern
Northern Saw-whet Owl*	Owls	1	<0.1	1	BCC	Low Concern
Painted Bunting*	Small Passerines	1	<0.1	1	BCC	Low Concern
Cerulean Warbler	Small Passerines	1	<0.1	1	BCC	Yellow Watch List; Tipping Point
Red-bellied Woodpecker	Woodpeckers	1	<0.1	1	–	Low Concern
Red-shouldered Hawk	Diurnal Raptors	1	<0.1	1	–	Low Concern
Rusty Blackbird	Small Passerines	1	<0.1	1	BCC	Common Bird in Steep Decline
Scaled Quail	Upland Game Birds	1	<0.1	1	–	Common Bird in Steep Decline
Eastern Whip-poor-will	Nightjars	1	<0.1	1	BCC	Yellow Watch List; Tipping Point
Tufted Titmouse	Small Passerines	1	<0.1	1	–	Low Concern
Olive-sided Flycatcher	Small Passerines	1	<0.1	1	BCC	Yellow Watch List; Tipping Point
Western Screech-Owl*	Owls	1	<0.1	1	–	Low Concern
White-breasted Nuthatch	Small Passerines	1	<0.1	1	–	Low Concern
White-faced Ibis	Waterbirds	1	<0.1	1	–	Low Concern
Wilson's Phalarope	Shorebirds	1	<0.1	1	–	Low Concern
Wood Duck	Waterfowl	1	<0.1	1	–	Low Concern
Unknown		1385	13.7	233	–	
Total		10097	100	327	–	