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TRANSPORTATION
FEDERAL AVIATION
ADMINISTRATION

Wildlife Strikes to Civil Aircraft in the United States 1990 - 2024

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OF AGRICULTURE
WILDLIFE SERVICES

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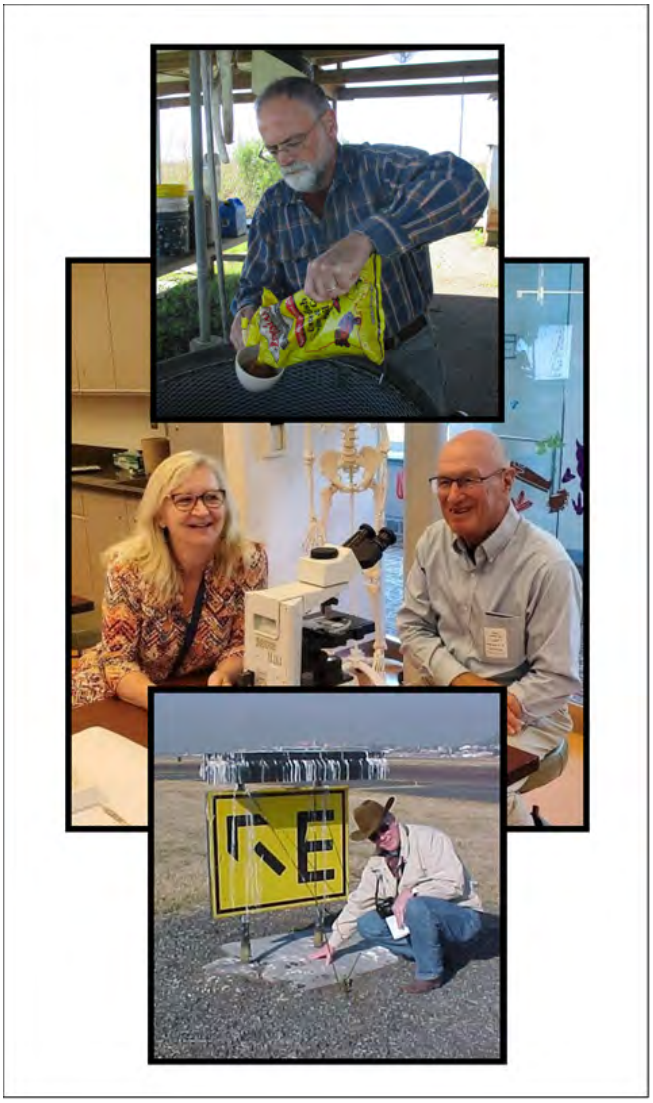

Dedication

The genesis for this report started with a far-reaching collaboration in 1994 between the FAA and USDA, Wildlife Services. **Gene LeBoeuf** (FAA, retired, top image) and **Richard Dolbeer** (USDA, Wildlife Services, middle image, right side) formed a lasting partnership that soon included the Smithsonian's Feather ID Lab (**Carla Dove** middle image, left side). Prior to the first comprehensive strike report being finished in November 1995, **Edward Cleary** (FAA, deceased, bottom center image) had accepted the FAA Staff Biologist position and was a co-author in 1995 with Richard and Database Manager Sandra Wright. Because of their vision for realizing the benefits from such an important database we dedicate this report, and all strike reports, for their groundbreaking efforts. The database remains foundational to wildlife/aviation mitigation, our regulatory guidance and best management practices. It has benefitted the world's aviation beyond measure.

The Federal Aviation Administration produced this report in cooperation with the U. S. Department of Agriculture, Wildlife Services, under an interagency agreement (692M15-19-T-00017). The purpose of this agreement is to 1) document wildlife strikes to civil aviation through management of the FAA National Wildlife Strike Database and 2) research, evaluate, and communicate the effectiveness of various habitat management and wildlife control techniques for minimizing wildlife strikes with aircraft at and away from airports. These activities provide a scientific basis for FAA policies, regulatory decisions, and recommendations regarding airport safety and wildlife.

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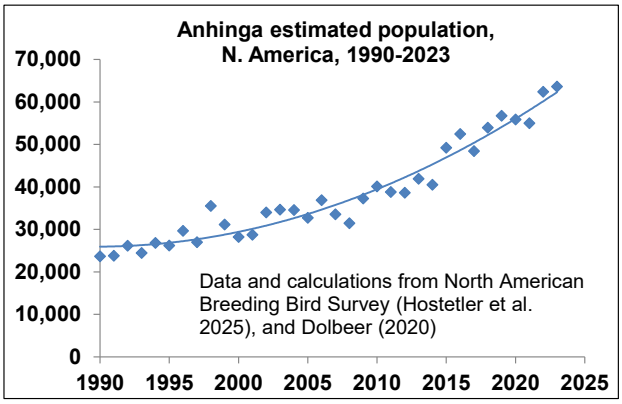
“When you can measure what you are speaking about, and express it in numbers, you know something about it.” Lord Kelvin (1824-1907)

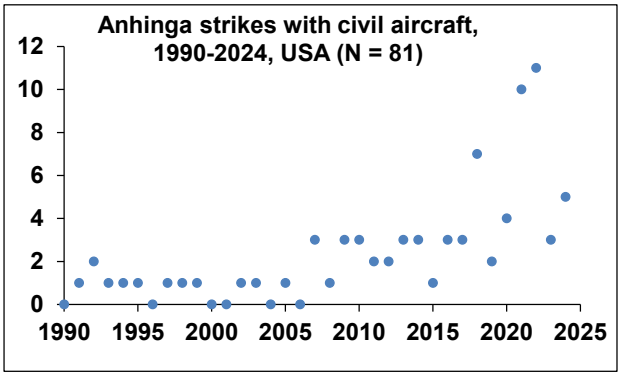
COVER PAGE

A Cessna 525 struck a flock of anhinga at 3,000 feet AGL and 200 knots on a 10-mile approach to a Texas airport, August 2024. Nose and empennage were damaged. The aircraft was out of service for 10 days and repair costs totaled $50,000. The bird remains (snarge) were identified by the Smithsonian Feather Lab. From 1990-2024, 81 anhinga were reported struck by civil aircraft, including 5 in 2024. Photo, Pilot.

The population of anhinga in the USA has more than doubled from about 25,000 to 65,000 since 1990. An average of 7 strikes involving anhinga and civil aircraft were reported per year, 2020-2024. The mean height above ground level for anhinga strikes was 1,419 feet. About 60 percent of the strikes involved more than 1 bird seen or struck. Their flocking and soaring behavior makes managing anhinga around airports a challenging endeavor.

The National Wildlife Strike Database provides the scientific foundation for policies and management programs to mitigate the risk of strikes by anhinga and other wildlife in ways compliant with the Migratory Bird Treaty Act and other environmental laws at all levels of government.





ACKNOWLEDGMENTS

The National Wildlife Strike Database (NWSD) office acknowledges the many people who took the time and effort to report the 319,047 wildlife strikes summarized in this report-pilots, mechanics, control tower and airport operations personnel, airline flight safety officers, airport wildlife biologists, and many others. We recognize **Mahalah Schank** (USDA) for her diligence in entering and editing data and editing this report. Special recognition is given to **Sandra Wright**, who managed the NWSD from its inception in 1995 until her retirement in 2015. She set a high standard for data quality and consistency so that analyses such as presented in this report could be accomplished. Sandra also edited this report. We also acknowledge **Gene LeBoeuf** (FAA, retired) and **Edward Cleary** (FAA, deceased) for their leadership in initiating and developing the NWSD. Finally, we acknowledge the suggestions and critiques made by various people over the years that have enhanced the usefulness and accuracy of the NWSD and annual reports such as presented here.

Sponsorship and funds for the ongoing maintenance and analysis of the NWSD are provided by the FAA, Office of Airport Safety and Standards, Washington, DC, and the Airport Technology Research and Development Branch, FAA William J. Hughes Technical Center, Atlantic City, NJ.

EXECUTIVE SUMMARY - PART 1: WILDLIFE STRIKES TO CIVIL AIRCRAFT IN THE UNITED STATES, 1990-2024

Although birds are critical ecologic, economic, and esthetic components of the environment deserving rigorous international protection, they can at times conflict with human activities such as aviation. Aircraft collisions with birds and other wildlife (wildlife strikes) have become a growing concern for aviation safety. Factors that contribute to this threat are increasing populations of large birds and increased air traffic by quieter, turbofan-powered aircraft. Globally, wildlife strikes with civil and military aircraft combined have killed more than 643 people and destroyed over 360 aircraft from 1990-2024. Specific to the USA, wildlife strikes with civil and military aircraft have killed 82 people and destroyed 126 aircraft from 1990-2024.

This report presents an analysis of data from the National Wildlife Strike Database (NWSD) for the 35-year period, 1990 through 2024. A sample of 13 significant wildlife strikes to civil aircraft in the USA during 2024 is also included as Appendix A. Appendix B explains how to report strikes and the role of the Smithsonian Institution Feather Lab in identifying bird and other wildlife species that are struck. Appendix C lists the scientific names and mean body masses for the 810 wildlife species mentioned in the report.

In 2024, 22,372 strikes were reported, an increase of 14 percent compared to the 19,628 strikes reported in 2023. This increase in reports was higher than the respective 4 percent and 3 percent increases in aircraft movements at Part 139 airports (certificated for passenger service) and general aviation airports in 2024 compared to 2023. For the 35-year period (1990-2024), 319,047 strikes were reported of which 313,716 (98.3 percent) occurred in the USA.

Both Part 139-certificated airports and general aviation airports have recorded significant increases in reported strikes per 100,000 movements from 2000-2024. However, the number of damaging strikes per 100,000 movements below 1,500 feet above ground level has remained stable at Part 139-certificated airports from 2000- 2024 whereas there has been a significant increase in the damaging strike rate at general aviation airports and at Part-139 airports for flights on approach or climb at >1,500 feet AGL.

In 2024, 74 percent and <1 percent of the 22,372 strike reports were filed using the electronic and paper versions, respectively, of FAA Form 5200-7, Bird/Other Wildlife Strike Report. More than one type of report was filed for the same strike event in 16 percent of the strikes (many of these had at least one FAA Form 5200-7E report filed). Nine percent of reports were submitted via the Air Traffic Organization Mandatory Occurrence Reporting system.

The 809 USA airports with strikes reported in 2024 were comprised of 433 Part 139-certificated airports and 376 general aviation airports. From 1990-2024, strikes have been reported from 2,360 different USA airports. Commercial transport and general aviation aircraft were involved in 85 and 15 percent of reported strikes, respectively, in 2024.

From 1990 to 2024, 54 percent of bird strikes occurred between July and October; 38 percent of deer strikes occurred in September-November. Terrestrial mammals are more likely to be struck at night (62 percent) whereas birds are struck more often during the day (62 percent). Birds, terrestrial mammals, and bats are all more likely to be struck during the arrival phase of flight (62, 63, and 84 percent of strikes, respectively) compared to departure (34, 32 and 12 percent, respectively).

For commercial transport and fixed-wing general aviation aircraft, about 71 and 54 percent of bird strikes occurred at or below 500 feet AGL from 1990 to 2024. Above 500 feet AGL, the number of strikes declined by 34 percent for each 1,000-foot gain in height for commercial transport aircraft. Strikes occurring above 500 feet were more likely to cause damage than strikes at or below 500 feet. The record height for a reported bird strike was 32,000 feet AGL (Wilson's warbler, identified by Smithsonian FIL).

From 1990 to 2024, 656 species of birds, 57 species of terrestrial mammals, 52 species of bats, and 45 species of reptiles were identified as struck by aircraft (810 species total). Waterfowl, raptors, and gulls are the species groups of birds with the most damaging strikes; artiodactyls (mainly deer) and carnivores (mainly coyotes) are the terrestrial mammals with the most damaging strikes. Although the percentage of wildlife strikes with reported damage has averaged 7 percent for the 35-year period, this number has declined from a peak of 18 percent in 1995 to 4 percent in 2024.

A negative effect-on-flight was reported in 5 percent and 15 percent of the bird and terrestrial mammal strike reports, respectively, 1990-2024. Precautionary/emergency landing after striking wildlife was the most reported negative effect (9,375 incidents), including 383 incidents in which the pilot either jettisoned fuel (67 incidents, mean of 13,910 gallons), made an overweight landing (155 incidents), or burned fuel in circling pattern (161 incidents). Aborted take-off was the second most reported negative effect (3,199 incidents). These negative incidents included 623 aborted take-offs at $\geq$100 knots. As has the trend for the percentage of strikes causing damage, the percentage of strikes with a reported negative effect-on-flight has declined from a high of 11 percent in 1995-1996 to 4 percent in 2024. For commercial transport aircraft, the number of high-speed ($\geq$100 knots) aborted take-offs declined from a high of 25 in 2000 to 4 in 2020 but increased to 12 in 2024.

For the 33 species of birds most frequently identified as struck by civil aircraft, 2024, there was a strong correlation (R^2 = 0.89) between mean body mass and the likelihood of a strike causing damage to aircraft. For every 100-gram increase in body mass, there was a 1.02 percent increase in the likelihood of damage. Thus, body mass is a good predictor of relative hazard level among bird species.

Eighty-eight strikes resulted in a destroyed aircraft from 1990-2024 (2 in 2024); 48 (58 percent) of these occurred at general aviation airports. The annual cost of wildlife strikes to the USA civil aviation industry in 2024 was projected to be 74,268 hours of aircraft downtime and $473 million in direct and other monetary losses. These projections may

be at the high end of actual costs because of the skewed nature of reported cost data. More thorough reporting of strike events and associated costs combined with additional economic analyses are needed to refine the actual costs of wildlife strikes to the aviation industry.

Management actions to mitigate the risk have been implemented at many airports since the 1990s; these efforts are likely responsible for the general stabilization or decline in reported strikes with damage and a negative effect-on-flight at Part 139-certificated airports below 1,500 feet AGL from 2000-2024 despite continued increases in populations of many large bird species. However, much work remains to be done to reduce wildlife strikes, especially during the climb and approach phases of flight outside the airport boundaries. Management actions at airports should be prioritized based on the hazard level of species observed in the aircraft operating area.

To address strikes outside the airport boundaries, municipalities and the aviation community must first widen their view of wildlife management to minimize hazardous wildlife attractants within 5 miles of airports. Second, the aviation community needs to broaden the view of wildlife strike risks from a ground-based wildlife management problem to an airspace management problem that also encompasses Air Traffic Control, flight crews, and aircraft manufacturers. Long-term goals include the integration of avian radar and bird migration forecasting into airspace management and the development of aircraft lighting systems to enhance detection and avoidance by birds. Finally, there continues to be a need for increased and more detailed strike reporting. When reports are filed, it is important that relevant information be provided whenever possible regarding species identification, number of wildlife struck, time and height of strike, phase of flight, and damage to aircraft components. A problem that is not well defined cannot be properly managed.

EXECUTIVE SUMMARY- PART 2: FAA ACTIVITIES FOR MITIGATING WILDLIFE STRIKES

In 2024, the FAA continued a multifaceted approach for mitigating wildlife strikes both nationally and globally. This included continuing a robust research program, making improvements to the NWSD and outreach, working with the International Civil Aviation Organization (ICAO) on multiple projects, as well as providing Airport Improvement Program (AIP) funding to airports to conduct Wildlife Hazard Assessments (Assessments) and develop Wildlife Hazard Management Plans (Plans).

Significant wildlife / aircraft strikes such as the Boeing 737-800 that ingested Baikal teals on final approach to Muan International Airport (South Korea) continue to demonstrate to the world the severity of aircraft collisions with birds and other wildlife. Comprehensive evaluations have ensured optimal guidance, compliance and risk reduction moving forward. The FAA, in conjunction with the USDA and Smithsonian Institution, has worked

to improve strike reporting options, turnaround time from report submission to public availability, data processing and analysis, as well as data access via this report and our web sites. The reduced turnaround time has provided immediate benefits to airports, airlines, engine and airframe manufacturers and biologists alike.

In the sixteen-year span since the emergency forced landing of US Airways Flight 1549 Airbus into the Hudson River on January 15, 2009, over $400 million of Airport Improvement Program (AIP) funds have been allocated for wildlife-related projects such as Assessments, Plans and airport perimeter fencing. All Part 139 certificated airports have successfully completed Assessments followed by Plans. Many of those airports have already updated their original Assessments with new ones while others have chosen to implement Continual Monitoring programs as detailed in Advisory Circular 150/ 5200-38 - *Protocol for the Conduct and Review of Wildlife Hazard Site Visits, Wildlife Hazard Assessments, and Wildlife Hazard Management Plans* (published August 20, 2018).

The FAA dedicated over $30 million in research funds since Flight 1549's emergency forced landing into the Hudson River in 2009. These research funds help us better understand the capabilities of advanced detection and monitoring systems such as avian radars, Foreign Object Debris (FOD) radars and infrared / electro-optical scanning systems. Other research initiatives included aircraft-mounted lighting systems to enhance bird detection and avoidance, wildlife control techniques, habitat management, Canada goose movement analyses, capture and relocation efficacy of raptors, DNA and molecular identifications, and the evaluation of unmanned aerial systems (UAS) for hazing, detection and monitoring hazardous wildlife.

In October 2022, the FAA released a new Wildlife Hazards video. This updated outreach endeavor is part of the FAA Airport Safety Information Video Series. It discusses how successful wildlife strike reporting, and the National Wildlife Strike Database (jointly administered by USDA and FAA) is reducing the impact of wildlife strikes on both commercial and general aviation.

Continuing international efforts in 2024 included: 1) leading ICAO's ADOP.015.05 Job Card to rewrite the ICAO Birdstrike Information System (IBIS) manual (Doc 9332) as Rapporteur of the Wildlife Hazard Management Expert Group (WHMEG); 2) assisting ICAO on an initiative to support access to IBIS data; 3) assisting the ICAO APAC region with finalizing its regional wildlife hazard management manual; 4) presentations for international forums and; 5) providing assistance to foreign regulators and aerodromes on an as-needed basis.

The Sandy Wright / Richard Dolbeer Excellence in Strike Reporting award was initiated in 2014 to recognize those airports that have exhibited a noteworthy strike-reporting program. For their commitment to the identification and documentation of wildlife / aircraft strike information, the FAA proudly recognizes the strike reporting programs at **Orlando International Airport (MCO)** and **Mankato Regional Airport (MKT)** as the winners of the 2024 Sandy Wright / Richard Dolbeer Excellence in Strike Reporting award.

Eighty-two percent of strikes occur at or below 1,500 feet Above Ground Level (AGL). This altitude falls within the 5-mile separation distance recommended for wildlife attractants, meaning that on-ground wildlife mitigation activities out to 5 miles can have a

positive effect on risk reduction for the majority of all wildlife strikes. This again shows why managing wildlife attractants off airport properties out to 5-miles is critical.

The FAA offers two key essentials to aid the aviation community with reporting and monitoring strikes. First, the NWSD can receive wildlife strike reports that are completed through an organization's internal reporting system. This synchronized reporting uses an application programming interface (API) to safely and securely allow different software systems to communicate and exchange data. Secondly, the NWSD can automatically send an email notification when a wildlife strike report is received. This can be set based on airfield code, engine make/model involved, aircraft operator, and a few other select parameters. This feature allows key aviation stakeholders to know about a wildlife strike as soon as possible.

Strikes occur every day, but when compared to the total number of flights in the system they are rare. Although it is impossible to eliminate all strikes at all times between aircraft and animals, comprehensive assessment, planning and management techniques have successfully mitigated damaging strikes on or near airports. Combined with systematic evaluation and adaptation of techniques, safety can be increased one less strike at a time.

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PART 1: WILDLIFE STRIKES TO CIVIL AIRCRAFT IN THE UNITED STATES, 1990-2024

INTRODUCTION

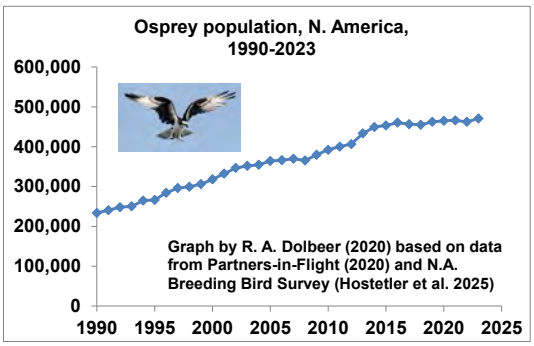
By the end of 2024, the NWSD contained strike records involving civil aircraft and 656 species of birds, 57 species of terrestrial mammals, 52 species of bats, and 45 species of reptiles for a total of 810 wildlife species since 1990. Each species has unique characteristics regarding body mass, physical density, social behavior, habitat use, feeding habits, movement patterns, and response to approaching aircraft. In addition to these factors, about 90 percent of the bird strikes involve species federally protected by the Migratory Bird Treaty Act (MBTA, Dolbeer 2021). Most of the remaining 10 percent of bird species and the various mammal and reptile species have legal protection at the state and local level. This diversity of species, the overlying legal protections, and broad public concern for wildlife require that airports and engine and aircraft manufacturers consider a broad range of elements when mitigating the risk of bird and other wildlife strikes.

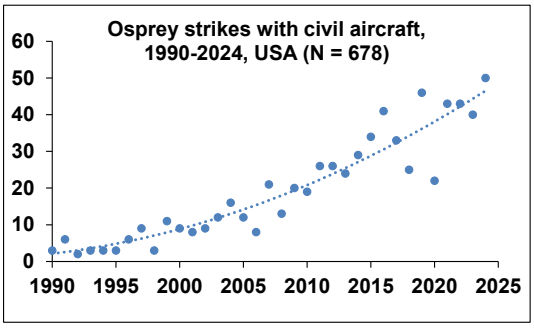
An Airbus 321 on approach to an east coast airport at 400 feet AGL in April 2024 ingested a large bird in the #1 engine. Passengers reported flames “shooting out” of engine. The aircraft landed safely but was out of service for 5 days and engine had to be replaced. Repair costs were $8 million. Bird remains from engine sent to Smithsonian Feather Lab were identified as osprey (1.6 kg). Photo courtesy of airport.

Although birds and other wildlife are critical ecologic, economic, and esthetic components of the environment deserving rigorous protection (Sekercioglu et al. 2016), they at times conflict with human activities such as agriculture (Linz et al. 2017), health (Ringenberg et al. 2024), and aviation. Aircraft collisions with birds and other wildlife have become an increasing concern for aviation safety in recent years (Bogaisky 2019, Koerner 2020, Ghayad 2022).

The reasons for the increasing concern are complex. A major factor is that due to the MBTA, other environmental initiatives, and land-use changes, populations of most large bird species in North America have increased markedly in the last 3 decades and adapted to urban environments, including airports (Rutledge et al. 2015, Ma et al. 2024). Dolbeer (2020) examined the estimated population trends and numbers for the 36 species of birds in North America with mean body masses ≥1.1 kg and at least 20 reported strikes with civil aircraft, 1990-2018 (certification standards for aircraft engines and airframe components require testing with bird masses from 1.1 kg to 3.6 kg depending on component and aircraft type [Croft 2011, 14 CFR Part 33-77]). Of these 36 larger species, 26 indicated population increases of greater than 10

percent, 5 were unchanged, and 5 showed declines of greater than 10 percent. The net gain in numbers for the 36 species was an estimated 35 million birds (62% increase). Notably, all 9 species with body mass ≥3.6 kg indicated population increases.





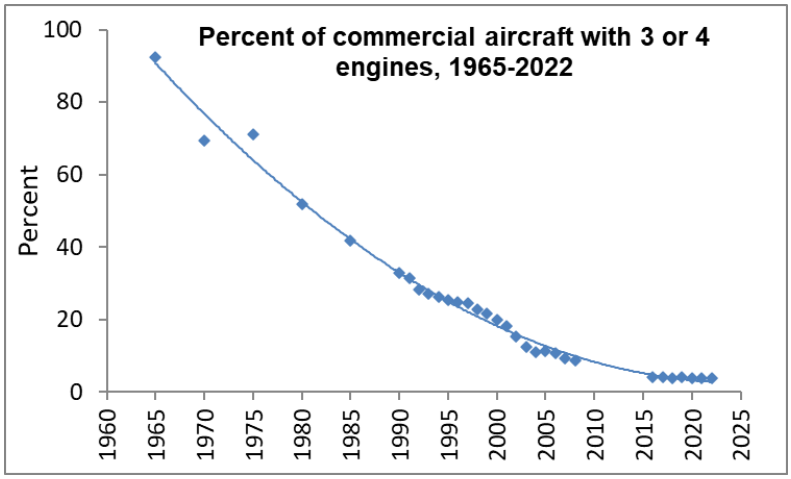
A record 50 osprey strikes were reported in 2024.

As specific examples, the osprey population has increased about 2-fold from 220,000 in 1990 to 460,000 in 2023. During the same time, the black vulture population has increased 5-fold to over 5 million (Zimmerman et al. 2019, Dolbeer 2020, Hostetler et al. 2025).

In addition, populations of various large terrestrial mammal species that encroach on airfields such as deer and coyotes have also increased. For example, the white-tailed deer population in the USA increased from about 15 million in 1984 to 30 million by 2021 (Hanberry 2021). Furthermore, most of these large bird and mammal species have adapted to living in urban environments, including airports (e.g., Rutledge et al. 2015, Hanberry 2021).

A second factor relates to aircraft and engine design. Commercial air carriers have replaced their older three or four-engine aircraft fleets with more efficient and quieter, two-engine aircraft. In 1965, about 94 percent of the 1,037 turbine-powered transport aircraft in the USA had three or four engines compared to 3 percent of the 8,162 aircraft in 2022 (U.S. Department of Transportation 2025, Forecast International 2025). With the steady advances in technology over the past several decades, today's two-engine aircraft are more powerful and reliable than yesterday's three and four-engine aircraft. However, in the event of multiple-engine ingestions, aircraft with two engines may have vulnerabilities not shared by their three or four engine-equipped counterparts (Langston 2019). In addition, bird strikes to critical aircraft sensors connected to flight control systems (e.g., Angle of Attack Vanes) can be problematic (National Transportation Safety Board 2023).

Four incidents in the past 15 years have highlighted these vulnerabilities. On 15 January 2009, US Airways Flight 1549 (Airbus 320) with 155 persons aboard made a forced landing in the Hudson River after ingesting Canada geese into both engines at 2900 feet above ground level after departure from LaGuardia Airport, New York (Marra et al. 2009, National Transportation Safety Board 2010). On 15 August 2019, Ural Airlines Flight 178 (Airbus 321) with 234 persons aboard made a forced landing in a corn field 3 miles from Zhukovsky International Airport, Moscow, Russia after ingesting herring gulls into both engines during take-off (Aviation Safety Network 2025*a*). Incredibly, none of the 389



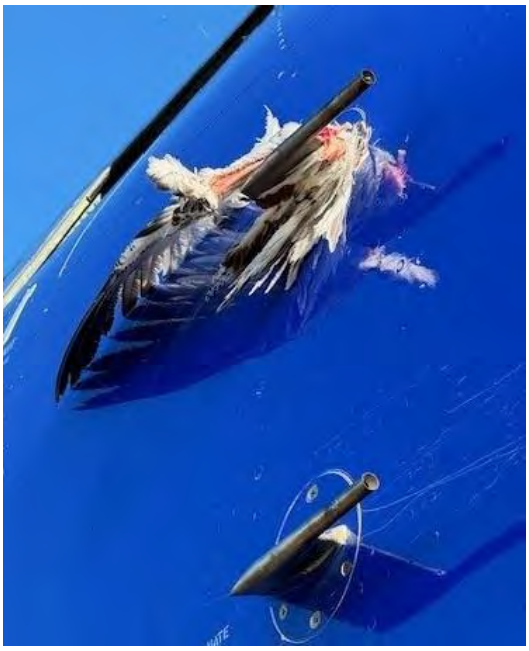
people were killed in these "Miracle on the Hudson" and "Miracle in the Corn Field" bird-strike events even though both aircraft were damaged beyond repair.

However, on 10 March 2019, a Boeing 737 Max 8 crashed shortly after take-off from Addis Ababa Bole International Airport, Ethiopia, killing all 157 people aboard. The U.S. National Transportation Safety Board concluded that the "erroneous Angle of Attack sensor output [which forced the aircraft into a steep dive] was caused by the separation of the Angle of Attack sensor vane due to impact with a foreign object, which was most likely a bird" (National Transportation Safety Board 2023). On 29 December 2024, a Boeing 737-800 on approach to Muan International Airport, South Korea, ingested ducks (Baikal teal) into both engines. The resulting crash killed 179 of 181 passengers and crew (Aviation Safety Network 2025*b*).

A third complicating factor is that birds are less able to detect and avoid modern jet aircraft with quieter turbofan engines (Chapter 3, International Civil Aviation Organization 1993) compared to older aircraft with noisier (Chapter 2) engines (Burger 1983, Kelly et al. 1999). This is analogous to the demonstrated greater "strike rate" for pedestrians and bicyclists (increases of 35 percent and 57 percent, respectively) with electric vehicles compared to vehicles with noisier internal combustion engines (Wu et al. 2011, Edwards et al. 2024). In October 2017, the FAA adopted a rule requiring new transport aircraft to have noise levels further reduced by at least 7 decibels compared to the current fleet (Federal Register 2017).

As a result of these factors, experts within the Federal Aviation Administration (FAA), U.S. Department of Agriculture (USDA), and U.S. military expect the risk of bird and other wildlife strikes to be a continuing challenge. Mitigating these risks can be difficult because of the diversity of wildlife species involved, their mobility and adaptability, legal requirements of the MBTA and other environmental laws, and overall public interest in the protection of wildlife. But these challenges must be met. Globally, wildlife strikes have killed more than 643 people and destroyed over 340 civil and military aircraft from 1990-2024 in addition to causing economic losses in the billions of dollars (Allan and Orosz 2001; Richardson and West 2000; Thorpe 2012; Avisure 2025). Specific to the USA, wildlife strikes with civil and military aircraft have killed at least 82 people and destroyed 126 aircraft from 1990-2024 (Avisure 2025).

The FAA has initiated several programs to address this important safety issue. A foundation of these programs is the collection and analysis of data from wildlife strikes.



A B-737 800 struck a bird at 110 knots during take-off run at a west coast airport, February 2024. Pilot made a precautionary landing back at airport where bird remain were found in a pitot tube. Remains sent to Smithsonian were identified as white-headed gull complex. Photo, Airport.

The FAA began collecting bird and bat strike data in 1965 (expanded to include terrestrial mammals and reptiles in 1990). However, except for cursory examinations of strike reports to determine general trends, the data were never organized and submitted to rigorous analysis until the 1990s. In 1995, the FAA, through an interagency agreement with the USDA, Wildlife Services (USDA/WS), initiated a project to obtain more objective estimates of the magnitude and nature of the wildlife strike problem for civil aviation. Specialists from the USDA/WS: (1) research all strike reports (FAA Form 5200-7, *Bird/Other Wildlife Strike Report*) received by the FAA since 1990 to ensure consistent, high-quality data; (2) process all edited strike reports into the FAA National Wildlife Strike Database; (3) supplement FAA-reported strikes with additional, non-duplicated strike reports from other sources; and (4) assist the FAA with the production of annual and special reports summarizing the results of analyses of the data from the National Wildlife Strike Database. Such analyses are critical to determining the economic cost of wildlife strikes, the magnitude of safety issues, and most important, the nature of the problems (e.g., wildlife species involved, types of damage, height and phase of flight during which strikes occur, seasonal patterns, and long-term trends in strikes). The information obtained from these analyses provides the foundation for FAA national policies and guidance and for refinements in the development and implementation of integrated research and management efforts to reduce wildlife strikes. Data on the number of strikes causing damage to aircraft or other adverse effects (e.g., aborted take-off) also provide a benchmark for individual airports to evaluate and improve their Wildlife Hazard Management Plans in the context of a Safety Management System (Dolbeer and Begier 2012).

The first annual report on wildlife strikes to civil aircraft in the USA was completed in November 1995 (Dolbeer et al. 1995). This is the 31st report in the series and covers the 35-year period, 1990-2024. The current annual report is accessible as a PDF file at: http://www.faa.gov/airports/airport_safety/wildlife/.

To supplement the statistical summary of data presented in tables and graphs, a sample of 13 significant wildlife strikes to civil aircraft in the USA during 2024 is presented in Appendix A. These recent strike examples demonstrate the widespread and diverse

nature of the problem. A more extensive list of significant strike events, 1990-2024, is available at http://www.faa.gov/airports/airport_safety/wildlife/.

Appendix B explains how to report strikes and the role of the Smithsonian Institution Feather Lab in identifying bird and other wildlife species that are struck.

Appendix C lists the common and scientific names for the 810 species of wildlife mentioned in the report, as well as mean and (when available) maximum body masses.

RESULTS

NUMBER OF REPORTED STRIKES AND STRIKES WITH DAMAGE

In 2024, 22,372 strikes were reported which was an increase of 14 percent compared to the 19,628 strikes reported in 2023 (Table 1, Figure 1). In 2024, 98.9 percent of the 22,372 strikes occurred in the USA[1]; birds were involved in 94.4 percent of these strikes, bats in 3.7 percent, terrestrial mammals in 1.6 percent, and reptiles in 0.3 percent (Table 2). For the 35-year period (1990-2024), 319,047 strikes were reported of which 313,716 (98.3 percent) occurred in the USA (Table 1).

A large bird caromed off the radome and entered the #1 engine of a B-737-800 at 1200 feet AGL during climb from a Florida airport, March 2024. The flight crew declared an emergency and returned safely to airport. Inspection revealed at least 5 damaged fan blades. Aircraft was out of service for 3 days. Smithsonian identified bird remains as wood stork. Photo, airline.

The 14 percent increase in reported strikes in 2024 compared to 2023 can be partially explained by the 4 percent and 3 percent increase in aircraft movements at Part 139-certificated[2] airports and general aviation airports, respectively, compared to 2023 (Tables 3, 4).

The number of reported strikes per 100,000 movements at Part 139-certificated airports has increased 3.3-fold from 12.70 in 2000 to 41.29 in 2024 (Table 3, Figure 2). However, the number of damaging strikes per 100,000 movements has changed by only 4 percent, from 1.40 in 2000 to 1.46 in 2024.

[1] The database contains strikes involving U.S.- or foreign-registered aircraft in the USA and U.S.-registered aircraft in foreign countries.
[2] The U.S. Code of Federal Regulations (14 CFR Part 139) requires the FAA to issue operating certificates to airports that serve scheduled and unscheduled air carrier aircraft with more than 9 seats or that the FAA Administrator requires to have a certificate. Part 139-certificated airports experiencing hazardous wildlife conditions as defined in Part 139.337 must conduct Wildlife Hazard Assessments and develop Wildlife Hazard Management Plans (Federal Aviation Administration 2025*b*).

The number of reported strikes per 100,000 movements at general aviation airports increased 3.8-fold, from 0.79 in 2000 to 3.02 in 2024 (Table 4, Figure 2). In contrast to Part 139-certificated airports, the damaging strike rate increased 77 percent, from 0.26 in 2000 to 0.46 in 2024.

The slight increase in the damaging strike rate at Part 139-certificated airports since 2000 can be attributed to the significant increase in damage strikes at >1,500 feet AGL during climb and approach (Figure 3). The damage strike rate in the airport environment (strikes occurring on departure or arrival at ≤1,500 feet above ground level [AGL]) has shown no increase (Figure 3). This stabilization in damaging strikes for transport aircraft in the airport environment has occurred despite an increase in populations of hazardous wildlife species (Dolbeer 2020) and as noted above, a major increase in reported strikes. These data demonstrate progress in wildlife hazard management programs at Part 139-certificated airports (Dolbeer 2011). The data also demonstrate the lack of progress in mitigating the risk of strikes outside the airport environment and the purview of wildlife hazard management plans (aircraft on approach or departure at >1,500 feet AGL).

A Citationjet on approach to airport in Arkansas in Sept. 2024 struck a group of migrating broad-winged hawks at 5,800 feet AGL. Multiple birds were struck with damage to windshield, nose, and fuselage. Repair costs = $80,000; aircraft out of service = 60 hours. Photo, Pilot.

As with Part 139-certificated airports, general aviation airports have not seen a significant increase in the damaging strike rate in the airport environment (at ≤1,500 feet AGL) but there has been an increase at >1,500 feet AGL, 2000-2024 (Figure 3).

The significant increase in the number of reported strikes per 100,000 movements at both Part 139-certificated airports and general aviation airports from 2000 to 2024, concurrent with the stabilization in damaging strikes at <1,500 feet AGL, indicate that the aviation industry is doing a better job of documenting all wildlife that are struck. Many of these strikes involve small species that rarely cause damage to civil aircraft. This premise is supported by the fact that the mean mass of birds reported as struck has declined 64 percent from 0.76 kg to 0.27 kg, 2000-2024 (Figure 4).

METHODS OF REPORTING STRIKES

In 2024, 74 percent and <1 percent of the 22,372 strike reports were filed using the electronic and paper versions, respectively, of FAA Form 5200-7, *Bird/Other Wildlife Strike Report* (Table 5*)*. Sixteen percent of reports came from multiple sources (i.e., more than one type of report was filed for same strike; many of these had at least one 5200-7E

report filed). Strike reports submitted to the FAA via the Air Traffic Organization (ATO) Mandatory Occurrence Reporting system comprised 9 percent of reports. Under FAA Order JO 7210.632, (effective 30 Jan 2012), ATO personnel are required to report all bird strikes of which they become aware.

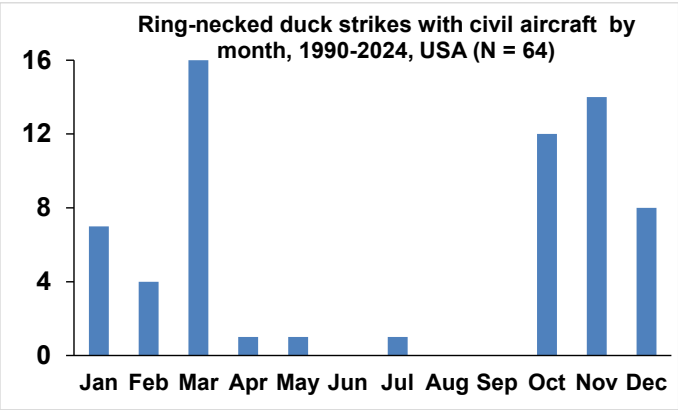
SOURCE OF REPORTS

In 2024, airport operations personnel filed 63 percent of the strike reports (including "Carcass Found" reports), followed by pilots (18 percent), Air Traffic Control personnel (10 percent), air transport operations personnel (3 percent), and other (5 percent, Table 6). In 2024, about 87 percent of the reported strikes involved commercial transport aircraft; the remainder involved business, private, and government aircraft (Table 7).

In 2024, strikes were reported at 809 USA airports, an increase of 4 percent compared to the 781 airports in 2023 (Table 8, Figure 5). Of the 809 airports with strikes reported in 2024, 433 were Part 139-certificated airports and 376 were general aviation airports.

From 1990-2024, 272,551 strikes have been reported from 2,360 USA airports (Table 8). In addition, 5,331 strikes involving USA-registered civil aircraft were reported at 343 foreign airports in 113 countries, 1990 - 2024. In 2024, 257 strikes were reported at 96 foreign airports in 56 countries.

TIMING OF OCCURRENCE AND PHASE OF FLIGHT OF STRIKES



Ring-necked ducks nest primarily in Canada and migrate through the USA in fall and spring. About 80 percent of reported strikes occur at night. Mean height AGL for strikes was 1,903 feet.

From 1990-2024, most bird strikes (54 percent) occurred between July and October (Figure 6) which is when birds are migrating, and populations are at their annual peak in North America following the nesting season. Sixty-two percent of bird strikes occurred during the day and 30 percent at night (Table 9). Almost twice as many strikes (62 percent of total) occurred during the arrival (descent, approach, or landing roll) phase of flight compared to 34 percent during departure (take-off run and climb, Table 10).

Most terrestrial mammal strikes occurred between July and November; with 38 percent of deer strikes concentrated in September-November and 38 percent of coyote strikes in August-October (Figure 7). Most terrestrial mammal strikes (62 percent) occurred at night (Table 9). As with birds, about twice as many strikes (63 percent of total) occurred during the arrival (final approach or landing roll) phase of flight compared to 32 percent during departure (take-off run and initial climb, Table 10).

For bats, 87 percent of strikes occurred at dawn, dusk, or night (Table 9). The difference in numbers of strikes during arrival compared to departure phase of flight was even greater for bats compared to birds and terrestrial mammals. Eighty-four percent of reported bat strikes occurred during arrival compared to only 12 percent during departure (Table 10).

HEIGHT ABOVE GROUND LEVEL (AGL) OF STRIKES

Bird strikes with transport aircraft- From 1990 - 2024, about 43 percent of bird strikes with transport aircraft occurred when the aircraft was at 0 feet AGL, 71 percent occurred at 500 feet or less AGL, and 92 percent occurred at or below 3,500 feet AGL (Table 11). About 1 percent of bird strikes occurred above 9,500 feet AGL. Above 500 feet AGL, the number of reported strikes declined consistently by 34 percent for each 1,000-foot gain in height (Figure 8). The record height for a reported bird strike involving a transport aircraft in USA was 32,000 feet AGL (Wilson's warbler).

An Ayres Thrush hit a flock of mallards at 30 feet AGL and 140 knots during aerial applications to agricultural fields in S. Dakota, June 2024. The engine lost all power. The pilot made emergency landing, and aircraft flipped over after wheels sank in mud. The pilot had minor injuries. Cost, $900,000. Photo, Pilot.

Strikes occurring above 500 feet AGL had a greater probability of causing damage to the aircraft compared to strikes at 500 feet or less. Although only 29 percent of the reported strikes were above 500 feet AGL, these strikes represented 46 percent of the damaging strikes (Table 11, Figure 9).

Bird strikes with general aviation (GA) fixed wing aircraft- From 1990 - 2024, about 41 percent of the bird strikes with GA aircraft occurred when the aircraft was at 0 feet AGL, 75 percent occurred at 500 feet or less AGL, and 96 percent occurred at or below 3,500 feet AGL (Table 12). Less than 1 percent of bird strikes occurred above 7,500 feet AGL. The record height for a reported bird strike involving a GA aircraft in USA was 27,500 feet AGL.

Strikes occurring above 500 feet AGL had an even greater probability of causing damage to GA aircraft compared to strikes at 500 feet or less than was shown above for commercial transport aircraft. Although only 25 percent of the reported strikes were above 500 feet AGL, these strikes represented 50 percent of the damaging strikes (Table 12, Figure 9).

Terrestrial mammal strikes- As expected, terrestrial mammal strikes predominately occurred at 0 feet AGL; however, 11 percent of the reported strikes occurred when the

aircraft was in the air immediately after lift-off or before touchdown (e.g., aircraft struck a deer with landing gear, Table 10).

AIRCRAFT COMPONENTS DAMAGED

The aircraft components most commonly reported as struck by birds from 1990 - 2024 were the nose/radome, windshield, wing/rotor, fuselage, and engine (Table 13). Aircraft engines and wing/rotor were the components most frequently reported as being damaged by bird strikes (each 25 percent of all damaged components). There were 26,327 strike events in which a total of 27,486 engines were reported as struck (25,201 events with one engine struck, 1,100 with two engines struck, 19 with three engines struck, and 7 with four engines struck). In 5,522 damaging bird-strike events involving engines, a total of 5,707 engines was damaged (5,340 events with one engine damaged, 180 with two engines damaged, 1 with three engines damaged, and 1 with four engines damaged).

A Desault-2000 on approach to a midwestern airport in April 2024 struck a flock of ring-billed gulls at 20 feet AGL and 112 knots. The birds damaged the wing and struck the pitot tube (above). From 1990-2024, 928 pitot tubes have been reported as struck (48 in 2024). Ring-bills are the most frequently struck gull species for civil aircraft in USA. Photo, Airport.

Aircraft components most commonly reported as struck by terrestrial mammals were the landing gear, “other”, propeller, and wing/rotor. Aircraft components most commonly reported as damaged were the landing gear, wing/rotor, propeller, and “other” (Table 13).

“Other” components reported as struck (all wildlife species combined) include critical sensors such as pitot tubes (928), antenna (communication, radar, global position; 310), angle of attack vanes (214), and temperature gauges (TAT, RAT, OAT, SAT; 182).

REPORTED DAMAGE

For the 305,813 strike reports involving birds from 1990-2024, 19,467 (6 percent) indicated damage to the aircraft (Table 14). When classified by level of damage, 8,054 (3 percent) indicated the aircraft suffered minor damage; 7,508 (2 percent) indicated the aircraft suffered an uncertain level of damage; 3,852 (1 percent) reported substantial damage; and 53 reports (less than 1 percent) indicated the aircraft was destroyed because of the bird strike (Table 14).

A BE-200 on final approach to an airport in Colorado hit at least 2 Canada geese, March 2024. The pilot did a go-around and landed safely. Airport personnel removed 2 geese from the runway. Prompt removal of carcasses is critical as they attract vultures and other scavengers. In 2024, 81 strikes involving Canada geese were reported; 33 (41 percent) caused damage (Table 20). Photo, Airport.

For the 6,391 terrestrial mammal strikes reported, 1,383 (22 percent) indicated damage to the aircraft. When classified by level of damage; 619 (10 percent) indicated the aircraft suffered minor damage; 478 (7 percent) indicated the aircraft suffered substantial damage; 251 (4 percent) reported an uncertain level of damage; and 35 (1 percent) indicated the aircraft was destroyed because of the strike (Table 14). Not surprisingly, a much higher percentage of terrestrial mammal strikes (22 percent) resulted in aircraft damage than did bird strikes (6 percent). Deer (1,442 strikes, of which 1,190 caused damage; Table 18) were involved in 23 percent of the strikes and 83 percent of the damaging strikes involving terrestrial mammals. Coyotes caused 5 percent of damaging strikes by terrestrial mammals.

Although the percentage of wildlife strikes (all species) with reported damage has averaged 7 percent for the 35-year period (Table 14), this number has declined from a peak of 18 percent in 1995 to 4 percent in 2024 (Figure 10).

Reported Negative Effect-on-Flight

A negative effect-on-flight was reported in 5 percent and 15 percent of the bird and terrestrial mammal strike reports, respectively, (Table 15). Precautionary/ emergency landing after striking wildlife was the most reported negative effect (9,194 incidents, 3 percent of strike reports). These precautionary landings included 383 incidents in which the pilot jettisoned fuel (67) or burned fuel in a circling pattern (161) to lighten aircraft weight or in which an overweight landing was made (155, Table 16, Figure 11). In the 67 reported incidents in which fuel was jettisoned, an average of 94,590 pounds (13,910 gallons) of fuel was jettisoned per incident (range 44 - 39,706 gallons). Aborted take-off after striking wildlife was the second most reported negative effect (3,199 incidents, 1 percent of strike reports, Table 15). These negative incidents included 623 aborted take-offs in which the pilot initiated the abort at an aircraft speed of 100 knots

(115 miles per hour) or greater (Table 17). For commercial transport aircraft, the number of high-speed aborted take-offs declined from a high of 25 in 2000 to 4 in 2020 but increased to 12 in 2024 (Figure 12). For general aviation aircraft, the number of high-speed aborted take-offs has averaged about 4 per year (0 in 2024).

There were 60 Cabin Air Quality Events (CAQE, 1 in 2024) documented in which smoke entered the cockpit or cabin after a bird strike event (Table 15, Varley 2024).

As has the trend for the percent of strikes causing damage, the percentage of wildlife strikes (all species) with a reported negative effect-on-flight has declined from a high of 11 percent in 1996 to 4 percent in 2024 (Figure 10). However, there was a record number (16) of bird-strike related fuel burns reported in 2024 (Figure 11).

WILDLIFE SPECIES INVOLVED IN STRIKES

Carla Dove examines feathers from a strike involving barn swallows. The number of bird strike cases involving civil aircraft processed by the Smithsonian Feather Identification Lab in 2024 was 6,742 with 7,290 separate identifications (some cases involved remains from multiple impact points). Photo, J., Kegley, Smithsonian.

Table 18 shows the number of reported strikes, strikes causing damage, strikes having a negative effect-on-flight, strikes involving >1 animal, the reported aircraft down time, and the reported costs by the 810 identified wildlife species, 1990-2024. This information can be useful in comparing the relative hazard level of bird and other wildlife species encountered during Wildlife Hazard Assessments at airports and in the development of priorities for Wildlife Hazard Management Plans (Dolbeer et al. 2000, Dolbeer and Wright 2009, DeVault et al., 2011).

Birds- Of the 305,813 reported bird strikes, 152,606 (50 percent) identified the bird to species and an additional 26,587 strikes (9 percent) identified the bird at least to species group (e.g., gull, hawk, duck). Species identification has improved from less than 30 percent in the 1990s to 60 percent in 2024 (Figure 13). In all, 656 species of birds have been identified as struck by aircraft, and 337 of these species were reported as causing damage, 1990-2024. In 2024, a record 410 bird species were identified as struck by civil aircraft (Figure 13).

Doves/pigeons (13 percent), raptors (12 percent), shorebirds (9 percent), gulls (9 percent), and waterfowl (4 percent) were the most frequently struck bird groups (Table 19). However, raptors and waterfowl comprised 47 percent of the damage strikes in which the bird type was identified, 1990-2024. Doves/pigeons and gulls were responsible for the greatest number of bird strikes (3,437 and 2,732, respectively) that involved multiple birds.

Table 20 lists the 33 species of birds identified most frequently as struck by civil aircraft for 1990-2024 and for 2024 only. Mourning doves, killdeer, barn swallows, American kestrels, and horned larks were the 5 most frequently identified species struck by civil aircraft overall from 1990-2024 and in 2024 only. Canada geese, the 15th most frequently identified species struck overall from 1990-2024, declined to the 26th most frequently struck species in 2024 although the overall population in North America has increased over 2-fold, 1990-2018 (Dolbeer 2020). This decline is likely related to the integrated management programs implemented in the past decade at many airports to dissuade feeding and nesting by Canada geese (Dolbeer et al. 2014, Rutledge et al. 2015).

For the 33 species of birds most frequently identified as struck by civil aircraft, 2024, there was a strong correlation (R^2 = 0.89) between mean body mass and the likelihood of a strike causing damage to aircraft (Figure 14). For every 100-gram increase in body mass, there was a 1.04 percent increase in the likelihood of damage. Thus, body mass is a good predictor of relative hazard level among bird species, as noted previously by Dolbeer et al. (2000) and DeVault et al (2011).

Identifying the gender of a struck bird is sometimes important in evaluating airworthiness standards for aircraft components. Female bald eagles have body masses about 30% greater than males. Photo, R. Dolbeer, 2024.

Terrestrial mammals, bats, and reptiles- The most frequently struck terrestrial mammals were Carnivores (40 percent) and Artiodactyls (24 percent; Tables 18, 19). Coyotes and skunks were the most frequently struck Carnivores, and deer were the most frequently struck Artiodactyl. Artiodactyls were responsible for 90 percent of mammal strikes that resulted in damage and 66 percent of mammal strikes that involved multiple animals. In all, 57, 52, and 45 identified species of terrestrial mammals, bats, and reptiles, respectively, were reported struck; 24, 8, and 2 identified species of these respective wildlife taxa caused damage to aircraft (Table 18).

Human Fatalities and Injuries Due to Wildlife Strikes

For 1990-2024, reports were received of 25 wildlife strikes that resulted in 52 human fatalities (Table 21). Ten of these strikes, resulting in 13 fatalities, involved unidentified species of birds. American white pelicans and red-tailed hawks (8 fatalities each); bald eagles (4); snow geese, turkey vultures, and cackling geese (3 each); Canada geese, green-winged teal, and rock pigeon (2 each); and white-tailed deer, brown pelicans, gulls, and black vultures (1 each) were responsible for the other 39 fatalities. Reports were received of 292 strikes that resulted in 373 human injuries (Table 21). Waterfowl (ducks and geese;

67 strikes, 78 injuries), vultures (40 strikes, 49 injuries), and deer (26 strikes, 37 injuries) caused 164 (54 percent) of the 292 injuries in which the species or species group was identified.

Aircraft Destroyed Due to Wildlife Strikes

A MH-60 enroute at night in Florida at 400 feet AGL and 120 knots hit a bird which detached part of a rear vertical fin. The rotorcraft made a precautionary landing. Repair costs = $12,500; downtime = 24 hours. October 2024. In 2024, 387 strikes with rotorcraft were reported. Photo, USCG.

For 1990 - 2024, reports were received of 88 aircraft destroyed or damaged beyond repair due to wildlife strikes (range of 0 to 6 per year, Tables 14, 22, Figure 15). Two aircraft were lost to a wildlife strike in 2024. Small (≤2,250 kg maximum take-off mass) general aviation aircraft comprised 59 (67 percent) of the lost aircraft. Terrestrial mammals (primarily white-tailed deer) were responsible for 35 (40 percent) of the incidents. Raptors and waterfowl (23 incidents) were responsible for 68 percent of the 34 incidents involving birds in which the species or species group was identified.

Fifty-one (58 percent) of the 88 wildlife strikes resulting in a destroyed aircraft occurred at USA general aviation airports, 25 (28%) occurred “en route”, 7 occurred at USA airports certificated for passenger service under 14 CFR Part 139, 3 occurred in miscellaneous situations, and 2 occurred at foreign airports. (Table 22). General aviation airports, often located in rural areas with inadequate fencing to exclude large mammals, face unique challenges in mitigating wildlife risks to aviation (DeVault et al. 2008; Dolbeer et al. 2008).

Economic Losses Due to Wildlife Strikes

Of the 38,262 reports from 1990 - 2024 indicating the strike had an adverse effect on the aircraft and/or flight, 15,035 provided an estimate of the aircraft downtime (1,205,053 hours, mean = 80.1 hours/incident, Tables 18, 23, 24). Regarding monetary losses, 5,261 reports provided an estimate of direct aircraft repair costs ($1.06 billion, mean = $201,511/incident), and 5,159 reports gave an estimate of other monetary losses ($155.6 million, mean = $30,166/incident)[3]. Other monetary losses include such expenses as lost revenue, the cost of putting passengers in hotels, re-scheduling aircraft, and flight cancellations.

[3] Costs from years prior to 2024 are inflation-adjusted to 2024 U.S. dollars.

Strike reporting for commercial transport aircraft at Part 139 airports was an estimated 91 percent in 2009-2013; reporting of strikes with damage was estimated at 93 percent (Dolbeer 2015). Strike reporting for aircraft at general aviation airports is lower (Dolbeer et al. 2008). In addition to the underreporting of strikes, only 39 percent of the 38,262 reports from 1990-2024 indicating an adverse effect provided estimates of aircraft downtime. For the 20,898 reports indicating damage, 25 percent provided estimates of repair (direct) costs, and 25 percent provided estimates of other (indirect) costs (these respective percentages were 18 and 36 for 2024 only, Tables 23, 24). Furthermore, some reports providing cost estimates were filed before aircraft damage and downtime had been fully assessed. Lastly, these reported costs do not capture the costs in time and money for aircraft inspections following non-damaging strikes and costs associated with runway closures to inspect for wildlife carcasses after reported strikes. As a result, the information on the number of strikes and associated costs compiled (summarized by species of wildlife struck in Table 18) is believed to underestimate the economic magnitude of the problem.

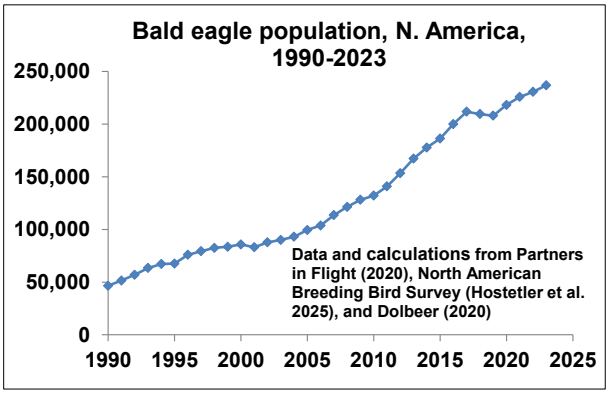
A ring-necked duck penetrated the chin bubble of a Eurocopter BK-117 on a medical mission in Massachusetts at midnight at 1,500 feet AGL and 110 knots, October 2024. The pilot, with duck remains at his feet, made an emergency landing at nearest airport. In 2024, there were 248 strikes with medical transport aircraft. Photo, Pilot.

Assuming (1) all 38,262 reported wildlife strikes that had an adverse effect on the aircraft and/or flight engendered similar amounts of downtime and/or monetary losses and (2) that these reports are all of the damaging strikes that occurred, wildlife strikes annually cost the USA civil aviation industry, on average, 99,462 hours of aircraft downtime and $248 million in monetary losses ($205 million in direct costs and $43 million in other costs), 1990-2024 (Table 24). For 2024 only, the estimates are 74,268 hours of downtime and $473 million in direct and indirect costs.

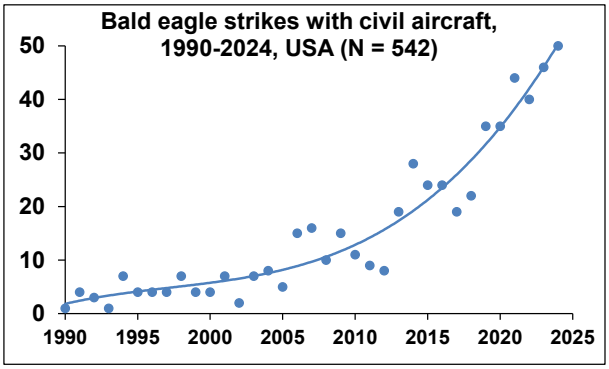
In contrast to these estimates, a recent analysis by Altringer et al. (2021) using a machine learning approach with cost data from the National Wildlife Strike Database, estimated that wildlife strikes cost the US civil aviation industry a minimum average of $54.3 million in losses annually over the 1990-2018 period. A follow-up analysis by Altringer et al. (2022) estimated that damaging wildlife strike events generate additional “spillover” costs

of around $25 million (2020 US$) each year for transport aviation related to delays in subsequent flights. Altringer (2025), using the procedures in Altringer et al. (2022) and the strike data for 2024, estimated that minimum spillover costs for transport aviation for the year 2024 were $46.3 million.

Estimating the economic costs of wildlife strike is complex because of the many variables involved and the skewed nature of reported strikes and costs. More thorough reporting of strike events and associated costs combined with additional analyses such as by Altringer et al. (2021, 2022) are needed to refine the actual costs of wildlife strikes to the aviation industry.



The bald eagle population in North America increased 5-fold to 250,000, 1990-2023.



A record 50 bald eagle strikes with civil aircraft were reported in 2024, USA.

Conclusions

The analysis of 35 years of strike data reveals the magnitude and nature of wildlife strikes with civil aircraft in the USA, and documents that progress is being made in mitigating the risk. Although wildlife strikes continue to pose an economic and safety risk for civil aviation in the USA, management actions to mitigate these risks have been implemented at many airports, especially beginning in 2000 when the FAA manual, Wildlife Hazard Management at Airports, was initially available to airports nationwide (Cleary and Dolbeer 2005). These efforts are likely responsible for the stabilization in reported strikes with damage and negative effects-on-flight from 2000-2024 for commercial transport aircraft (Table 1, Figures 2, 3, 4, 9, 10) in the airport environment (<1,500 feet AGL) despite continued increases in populations of many large bird species. For example, an economic analysis of 24 joint-use airports revealed the combined benefit-cost ratio of wildlife hazard mitigation programs was 7:1 for civil and military aviation Altringer et al. (2024). Other examples of the work done to mitigate the risk of strikes at airports are documented in, Human Wildlife Conflicts Journal 2009, Human-Wildlife Interactions Journal 2011, Dolbeer 2011, DeVault et al. 2013, Dolbeer et al. 2014, Rutledge et al. 2015, and Washburn 2019. As another measure of the increase in wildlife management activities, USDA Wildlife Services biologists assisted 807 civil and military airports nationwide in 2024 to mitigate wildlife risks to aviation compared to only 42 airports in 1991 and 193 in 1998 (Begier et al., 2025). However, much work remains to be done to reduce wildlife strikes.

To address the problem in the airport environment, airport managers first need to assess the wildlife hazards on their airports with the help of qualified airport wildlife biologists (FAA Advisory Circular 150/5200-36B, Qualifications for Wildlife Biologist Conducting Wildlife Hazard Assessments and Training Curriculums for Airport Personnel Involved in Controlling Wildlife Hazards on Airports). They then must take appropriate actions, under the guidance of these biologists, to minimize risks posed by wildlife. Management actions should be prioritized based on the hazard level of species (Table 18, Figure 14) observed in the aircraft operating area. The manual *Wildlife Hazard Management at Airports* (Cleary and Dolbeer 2005), available online in English, Spanish, and French at http://wildlife.faa.gov, provides guidance for conducting wildlife hazard assessments and in developing and implementing wildlife hazard management plans. The International Civil Aviation Organization (2020) also provides guidance on wildlife hazard management at airports.

This taxidermic mount of a coyote on a swinging platform is part of an integrated harassment program to keep geese and other birds off the airport at Minneapolis - St. Paul International Airport. Photo, R. Dolbeer, USDA, 2024.

Management efforts to reduce the risks of bird strikes have primarily focused on airports since most civil aircraft strikes occur (during take-off and landing at ≤500 feet AGL (see Tables 11, 12). However, the successful mitigation efforts at Part 139-certificated airports that have stabilized damaging strikes for commercial transport aviation in recent years have done little to reduce strikes outside the airport environment such as occurred with US Airways Flight 1549 in 2009 (Figure 3, and Dolbeer 2011, Dolbeer and Begier 2025).

To mitigate the risk for strikes beyond the airport fence, municipalities and the aviation community must first widen their view of wildlife management to consider habitats and land uses within 5 miles (or sometimes greater distances) of airports (Pfeiffer et al. 2018). For example, wetlands, dredge-spoil containment areas, municipal solid waste landfills, and wildlife refuges typically attract hazardous wildlife. Such land uses, as discussed in FAA Advisory Circular 150/5200-33C, *Hazardous Wildlife Attractants on or Near Airports*, are often incompatible with aviation safety and should either be prohibited near airports or designed and operated in a manner that minimize the attraction of hazardous wildlife (e.g., Washburn et al. 2010, Beffre and Washburn 2020).

American white pelicans soar in large flocks during migration, posing an off-airport threat to aircraft during climb and approach. Mitigation of strikes in these situations will require integration of avian radar and bird migration forecasting into airspace management for civil aviation. Photo, R. Dolbeer, Lake Erie, Ohio, March 2024.

Second, the aviation community needs to broaden the view of wildlife strike risks from a ground-based wildlife management problem solely dealt with by airports to an airspace management problem that also encompasses Air Traffic Control, flight crews, and aircraft manufacturers (McKee et al. 2016, Metz et al. 2021, Dolbeer and Begier 2025). Long-term goals include the integration of avian radar and bird migration forecasting into airspace management for civil aviation (Nohara et al. 2011, Gerringer et al. 2016, Shamoun-Baranes et al., 2019, Nilsson et al. 2021). The further development of aircraft lighting systems to enhance detection and avoidance by birds (Bernhardt et al. 2010, Blackwell et al. 2012, DeVault et al. 2015, Dolbeer and Barnes 2017, Foss et al. 2017, Fedy 2018, Dwyer et al. 2019, Lunn et al. 2023) is also needed as part of an integrated program.

Finally, there continues to be a need for increased and more detailed strike reporting, especially for general aviation aircraft. When reports are filed, relevant information should be provided whenever possible regarding species identification, number of wildlife struck, time and height of strike, phase of flight, and damage to aircraft components (Dolbeer 2015, see Appendix B: Reporting a Strike and Identifying Species of Wildlife Struck). A problem that is not well defined cannot be properly managed.

PART 2: FAA ACTIVITIES FOR MITIGATING WILDLIFE STRIKES

In 2024, the FAA continued a multifaceted approach for mitigating wildlife strikes both nationally and globally. This included continuing a robust research program, making improvements to the NWSD and outreach, working with the International Civil Aviation Organization (ICAO) and its Asia Pacific (APAC) region as well as providing Airport Improvement Program (AIP) funding to airports to conduct Wildlife Hazard Assessments (Assessments) and develop Wildlife Hazard Management Plans (Plans).

Landmark events such as the emergency forced landing of US Airways Flight 1549 Airbus 320 into the Hudson River on January 15, 2009, have demonstrated to the world the severity of aircraft collisions with birds and other wildlife. More recently, the catastrophic Jeju Air Flight 2216 bird strike at Muan International Airport, South Korea on 29 December 2024 resulted in the loss of 179 lives and stands as the single-worst wildlife-related aviation accident. Hull losses of this magnitude result in action. Accident Investigators, Civil Aviation Authorities (CAA), airports, airlines, air traffic organizations and biologists all evaluate and modify and develop improved comprehensive guidance, compliance standards and risk reduction techniques (e.g., detection, monitoring, communication, mitigation) moving forward. Since the first Advisory Circular 150 / 5200-1 *Bird Hazards to Aviation*, published March 1, 1965, these types of evaluations have allowed the Federal Aviation Administration (FAA) wildlife program to systematically improve its oversight to reduce risks within the safest aerospace system in the world. The results from reviews conducted post-1549 have continued to enhance regulations and provide beneficial layers of expansion throughout other key FAA wildlife-related areas (e.g., Data collection and analysis, Partnerships, Research, and Outreach).

FAA Guidance

In the sixteen-year span 2009 - 2024, over $400 million of AIP funds have been allocated for wildlife-related projects such as Assessments, Plans and airport perimeter fencing. All Part 139 certificated airports have successfully completed Assessments followed by Plans. Many of those airports have already updated their original Assessments with new ones while others have chosen to implement Continual Monitoring programs as detailed in Advisory Circular 150/ 5200- 38 (AC-38) - *Protocol for the Conduct and Review of Wildlife Hazard Site Visits, Wildlife Hazard Assessments, and Wildlife Hazard Management Plans* (published August 20, 2018). AC 150/5200-38 defines the minimum acceptable standards for the conduct and preparation of Site Visits, Assessments and Plans. AC 150/5200-38 also clarifies the NEPA process for projects included in an airport's Plan and provides protocol for the approval (or partial approval) of Plans with regard to NEPA and other environmental laws. The AC gives Airports and Biologists checklists for Assessments and Plans and provides Airport Certification Safety Inspectors guidelines/ templates to review those documents.

As a reminder, the latest version of AC 150/5200-36B *Qualifications for Wildlife Biologist Conducting Wildlife Hazard Assessments and Training Curriculums for Airport Personnel Involved in Controlling Wildlife Hazards on Airports* (2019) provides for an alternative field

experience option of Continual Monitoring to aid Qualified Airport Wildlife Biologist (QAWB) candidates in an era where all certificated airports have finished their initial Assessments and Plans.

The FAA wildlife program assisted with the update of AC No: 150/5200-28G Notice to Air Missions (NOTAMs) for Airport Operators (5/25/2022). The updated guidance stated that "*Birds and other wildlife activity NOTAMs should focus on chronic or persistent problems that are relatively short-lived or seasonal in nature*." NOTAMs of this type are effective at providing timely alerts for seasonal movements including migration (e.g., birds, caribou), nesting (e.g., bald and golden eagles, heron rookeries) and breeding (e.g., deer in the fall and alligators in spring to early summer) or other movement activities contrary to or beyond the scope of published airport data in the Chart Supplement or 5010 Airport Master Records.

CertAlert 23-08 *Considerations for Use of Unmanned Aircraft in Support of Airport Wildlife Dispersal* was published October 3, 2023, and highlighted a letter recently distributed regarding the use of unmanned aircraft systems (UAS) in dispersing wildlife at an airport. The letter contains information about permitting requirements under the Airborne Hunting Act1 (AHA) in conjunction with an airport wildlife hazard plan.

FAA has specific requirements and guidance for UAS operations, registration, certifications, as well as waivers and airspace authorizations. Before UAS operations occur for wildlife dispersal on airports, airport sponsor and UAS operator coordination should occur, and any necessary approvals should be received, including FAA airspace authorization. To ensure compliance with federal regulations for wildlife dispersal, the appropriate regional U.S. Fish and Wildlife permitting office(s) should be contacted prior to any dispersal activities with an unmanned aircraft system.

The FAA Airports booth at the EAA AirVenture Oshkosh 2024 was a success with (left to right) Azra Hussain (Program Manager in the Chicago ADO) and Amy Anderson (Wildlife Biologist at FAA HQ in Washington D.C.). Not pictured Dale Williams (ACSI, FAA HQ, Washington, DC).

FAA Outreach and Information

The FAA wildlife program uses a multifaceted outreach effort involving partnerships and cooperators to ensure useful, timely information is disseminated to the widest possible audience. Outreach efforts continued to benefit in 2024 from the release of the FAA's new Wildlife Hazards video in October 2022 as part of the FAA Airport Safety Information Video Series. It discusses how wildlife strike reporting, and the National Wildlife Strike Database (jointly administered by USDA and FAA) are reducing the impact of wildlife issues on both commercial and general aviation.

A wide range of information sharing in 2024 included presentations for the 2024 Bird Strike Committee USA (BSC USA) Conference in Minneapolis, St. Paul, MN, the 11th

Annual Hawaii DOT & USDA Wildlife Hazard Workshop, the U.S. Department of Commerce Sabit Program Airport Development for Eurasia and the State Block Grant meetings held in Washington, DC, the National Consultant Workshop in Fort Worth, TX, the Australian Aviation Wildlife Hazard Group (AAWHG)biennial conference in Melbourne, Victoria, Australia, the CARSAMPAF / WBA international conference in Guadalajara, México, and multiple ICAO forums and meetings (e.g., ICAO's EASPG Regional Working Group on Aerodrome Operations Fourth Meeting [RWGAO/4] Dublin, Ireland, ICAO / FAA Wildlife Hazard Management Workshop in Nairobi, Kenya, ICAO-ADOP-5-Aerodrome Design and Operations Panel in Montreal, Quebec, Canada and the Sixth Meeting of the Asia/Pacific Wildlife Hazard Management Working Group [AP–WHM/WG/6] held in Bangkok, Thailand.

The ICAO WHMEG utilizing a combination of in-person / virtual meeting formats to allow the international team to effectively focus on its ADOP.015.05 Job Card tasks through 12± UTC time zones.

The FAA continued to work closely with ICAO on multiple initiatives. ICAO requested that FAA Chair these collaborative projects as defined on the ADOP.015.03 Job Card as Rapporteur of the Wildlife Hazard Management Expert Group (WHMEG). The first initiative to update the ICAO Birdstrike Information System (IBIS) manual (Doc 9332) was submitted to ICAO Q4 2023 while the second proposal to allow / enhance international data access and data sharing is scheduled for submission Q4 2024. The justification behind both tasks was simple: enhance global aviation safety by improving member State reporting of wildlife / aircraft strike incidents and the submission of that data into IBIS as well as identifying and / or improving pathways to that data. The next phase for the ADOP.015.05 WHMEG is to align the ICAO Airport Services Manual, Part 3 (Doc 9137), PANS-Aerodromes (Doc 9981) and Annex 14 Aerodromes to ensure standardized international guidance for airports and wildlife personnel. Additionally, Working Paper #54 at the Fourteenth Air Navigation Conference (AN-Conf/14-WP/54) in Montréal, Canada, 26 August to 6 September 2024 received tentative acceptance to be added to the WHMEG's JC ADOP.015.05. Based on this tentative approval the WHMEG initiated the drafting of a new ICAO manual with a working title: "Flight Safety and Wildlife Hazards." This new comprehensive manual will strive to parallel the ICAO "Flight Safety and Volcanic Ash" manual (Doc 9974) and include potential new concepts and terms which may encourage a more harmonised, cross-disciplinary and systemically effective WHM outcome.

Wildlife Hazard Assessments and Wildlife Hazard Management Plans

Using a proactive Safety Management System (SMS) approach, the FAA encourages all certificated airports to conduct Assessments and develop Plans regardless of whether a triggering event under 14 CFR Part 139 had been experienced. Joint-use facilities that maintain a Bird/ wildlife Aircraft Strike Hazard (BASH) Plan also completed Assessments as a foundation for their BASH Plans. Wildlife Hazard Assessments are critical because they allow an airport to:

- Identify trends in wildlife use of the airport (habitat preferences, seasonal composition and abundance of wildlife species, geography of strikes, seasonality of strikes, time, and phase of flight of strikes, etc.).
- Prevent future strikes through operational changes, habitat (attractant) modifications, customized harassment, and/ or species removal.
- Evaluate the overall risk level of wildlife strikes and the efficacy of the airport's wildlife hazard mitigation program (e.g., determine redundancy of species-specific hazards, monitor reduction of onsite damaging strikes, monitor wildlife program communication and response efficiency, and improve overall program through annual review).

An Assessment provides fundamental wildlife and habitat information for an effective, airport-specific Plan. The Plan outlines a blueprint for action to minimize the risk to aviation safety, airport structures or equipment, or human health posed by populations of hazardous wildlife on and around an airport. To be effective, Plans must not only be fully implemented but routinely evaluated and modified to address an airport's changing environment, hazards and capabilities.

GA airports use the guidance within AC 150/5200-38 to develop Plans based on short-duration Site Visits rather than 12-month Assessments. Now, these airports can effectively outline their wildlife mitigation strategies using an economical, condensed Site Visit investigation. If a GA airport desires to conduct a full Assessment, the FAA will continue to make AIP grant funds available to them.

Strike Reporting

The FAA has continued to update and improve the existing NWSD website (http://wildlife.faa.gov) to make it more user-friendly and to allow more advanced data mining. Search fields enable users to find data on specific airports, airlines, aircraft and engine types, as well as damage incurred, date of strike, species struck, and state without having to download the entire database. Similarly, the FAA has continued modifications to provide in-depth wildlife guidance at http://www.faa.gov/airports/airport_safety/wildlife. This guidance includes Advisory Circulars and CertAlerts, FAA NWSD analysis reports, the manual *Wildlife Hazard Management at Airports,* Airport Cooperative Research Program (ACRP) wildlife reports, hazardous wildlife mitigation and habitat attractants, Bird Hazard Mitigation Systems (e.g., AHAS and BAM) and Frequently Asked Questions.

The FAA also developed software to make strike reporting easier. Now, anyone who needs to report a wildlife strike can do so via the new web site or their mobile devices at http://www.faa.gov/mobile.

Email Notifications for Wildlife Strike Reports

The NWSD can automatically send an email notification when a wildlife strike report is received. This can be set based on airfield code, engine make/model involved, aircraft operator, and a few other select parameters. This feature allows key aviation stakeholders to know about a wildlife strike as soon as possible. Keep in mind these email notifications contain the raw report, which has not been checked or validated by the database team. Information sent in the email may change when the final report is published to the public.

If you are interested in receiving an email notification for wildlife strikes submitted to the FAA's Wildlife Strike Database, please contact the Wildlife Strike Database Team Lead, Wesley Major at wesley.major@faa.gov.

Direct Reporting to the National Wildlife Strike Database

The NWSD can receive wildlife strike reports that are completed through an organization's internal reporting system. This effectively reduces the workload on reporting personnel by eliminating the need to submit a report twice (once internally and again to the FAA database). This synchronized reporting is accomplished through an application programming interface (API). An API is a safe and secure way for different software systems to communicate and exchange data through a set of rules and specifications.

As of July 2025, the NWSD has 86 users actively submitting wildlife strike data via the API. The majority of these users are airports, but airlines and other aviation stakeholders are able to utilize this API service.

If you are interested in having your organization's internal reporting system automatically report wildlife strikes to the FAA's Wildlife Strike Database, please contact the Wildlife Strike Database Team Lead, Wesley Major at wesley.major@faa.gov.

"Excellence in Strike Reporting" Award

The Sandy Wright / Richard Dolbeer Excellence in Strike Reporting award honors the incomparable dedication of Dr. Richard Dolbeer and Sandy Wright for their exceptional and innovative oversight of the collection, quality control, analysis and summation of NWSD. The award recognizes those airports that have exhibited a noteworthy strike reporting program. The criteria for determining which airports will make the initial cuts are objective and include both quantity and quality of strike data (keep in mind though that an airport will not win based solely on number of strikes reported). The criteria include but are not limited to:

1. Number and completeness of reports filed
2. Percentage of reports identified to species
3. Percentage of reports filed on-line
4. Timeliness of reports being submitted

5. Remains collected when available or necessary

6. Consistency filing reports

Further evaluation of the finalist strike reporting programs may include:

1. Modification of filed reports online when new information is discovered

2. Airport follows up with airline or engine manufacturer for missing information

3. Airport has someone on “Notification” list to receive notice when strikes are filed for their airport

For their commitment to the identification and documentation of wildlife / aircraft strike information, the FAA proudly recognizes the strike reporting programs at **Orlando International Airport (MCO)** and **Mankato Regional Airport (MKT)** as the winners of the 2024 Sandy Wright / Richard Dolbeer Excellence in Strike Reporting award.

	AWARD WINNERS	
	PART 139 AIRPORTS	**GA AIRPORTS**
2014	DALLAS / FORT WORTH (DFW)	MORRISTOWN (MMU)
2015	LAGUARDIA (LGA)	VAN NUYS (VNY)
2016	MINNEAPOLIS / ST. PAUL (MSP)	CENTENNIAL (APA)
2017	PORTLAND (PDX)	HENDERSON FIELD - MIDWAY ATOLL (MDY)
2018	SEATTLE / TACOMA (SEA)	PAGE FIELD (FMY)
2019	Charlotte Douglas (CLT)	Kalaeloa Airport - John Rodgers Field (JRF)
2020	Chicago O'Hare (ORD)	Dekalb/Peachtree Airport (PDK)
2021	Hartsfield-Jackson Atlanta International Airport (ATL)	Prescott Regional Airport, Ernest A. Love Field (PRC)
2022	Newark Liberty International Airport (EWR)	Quonset State Airport (OQU)
2023	Boston Logan International Airport (BOS)	Chicago Executive Airport (PWK)
2024	**Orlando International Airport (MCO)**	**Mankato Regional Airport (MKT)**

Wildlife Hazard Mitigation Research

The FAA has dedicated over $30 million in research funds since Flight 1549's emergency forced landing into the Hudson River in 2009. The FAA continues to support research that explores new and novel wildlife mitigation methods, increases the Agency's understanding and application of existing technologies such as advanced detection and monitoring systems (e.g., avian radars, Foreign Object Debris (FOD) radars, and infrared / electro-optical scanning systems), as well as exploring new technologies.

One new technology under research is the efficacy of unmanned aerial systems (UAS) for monitoring and hazing of hazardous wildlife. This research started at off-airport settings, such as landfills and rooftops. In 2024, the FAA worked closely with the USDA wildlife biologists based at the Atlantic City International Airport (ACY) to explore the procedures and effectiveness of using an UAS on an active airport. The testing began in December 2023 and UAS operations continued throughout 2024. Nearly 100 hours of flight time and 190 flights occurred during the testing period. Multiple UAS platforms and payloads were used. The UAS was also used as a tool to conduct nighttime mammal surveys with great success. A dedicated report detailing findings is expected to be published in late 2025.

Another UAS research effort is taking place with a team from the University of North Dakota (UND). The UND researchers are working closely with Grand Forks International Airport (GFK) and testing the use of UAS as a tool to prevent gulls, pelicans, and waterfowl from roosting on open ponds at a wastewater treatment plant near GFK. The research is looking at using UAS as a tool to prevent target species entering the ponds in the evening.


Images of the wastewater treatment ponds and the UAS acting as a deterrent for target species. Photos by: UND

With the advent of electric vertical takeoff and landing (eVTOL) aircraft, the FAA is exploring research in this area to better understand the risks these aircraft may experience. The FAA began analyses of rotorcraft strike reports in the database. It is currently unclear how eVTOL will operate, but examining solely rotorcraft strike data offers a different perspective than looking at mixed data with fixed-winged aircraft.

Other research initiatives include understanding the vision acuity of select avian species and how their sight characteristics influence their behavioral response to moving objects. This data could help inform the design of an aircraft-mounted lighting system to make aircraft more conspicuous and enhance wildlife's detection and avoidance but not interfere with airport operations. The FAA is frequently exploring new wildlife control techniques, conducting wildlife movement analyses, working with the Smithsonian Feather ID Lab on DNA and molecular identifications, alternative habitat management

strategies to reduce attraction to airports of hazardous wildlife species, land cover analyses, and attempting to quantify strike risk.

Airport Cooperative Research Program (ACRP) Reports

The FAA recently assisted with the development of two new ACRP reports to aid airports with the mitigation of wildlife hazards. The first report (ACRP Synthesis Report 117 - *Agricultural Operations on Airport Grounds*) was published in 2022 while the second report ACRP Research Report 250: *Program Evaluation Report Card Tool for Wildlife Hazard Management Plans: User Guide* was published in 2023.

Prior to this latest wildlife-related report, two other ACRP projects were published in 2018 (ACRP Synthesis 92: Airport Waste Management and Recycling Practices and ACRP Research Report 174 Guidebook and Primer). Other recent reports published were ACRP Report 122 Innovative Airport Responses to Threatened / Endangered Species (2015), ACRP Report 125 Balancing Airport Stormwater and Bird Hazard Management (2015) and ACRP Report 145 Applying an SMS Approach to Wildlife Hazard Management (2015). The FAA is currently involved in three additional ACRP projects: 1) ACRP 10-30: Evaluating the Effectiveness of an Airport's Wildlife Hazard Management Program; 2) ACRP 11-03/Topic S10-17 Agricultural Operations on Airport Grounds and; 3) ACRP 11-03/Topic S10-18 Considerations for Establishing and Maintaining Successful Bee Programs on Airports These, and other wildlife / aviation reports are available from the Transportation Research Board of the National Academies (TRB) at http://www.trb.org/Publications/Publications.aspx.

Bird Strike Committee USA

The FAA participates in the Bird Strike Committee USA (BSC-USA) as part of its continued public outreach and education effort to increase awareness within the aviation community about wildlife hazards. A Memorandum of Understanding between the FAA and the BSC USA was signed May 2012 to formalize this cooperative relationship. The BSC USA Steering Committee is comprised of 25 diverse, subject-matter experts representing Pilots, Airlines, Airframe and Engine Manufacturers, Wildlife Biologists, Airport Managers, Department of Defense personnel, ATC Personnel, Certification Inspectors, Research, Private Sector and Government Personnel. The Steering Committee receives further guidance from distinguished emeritus members and liaisons representing a diversity of experts including the U.S. Fish and Wildlife Service (USFWS), The Wildlife Society (TWS), the National Transportation Safety Board (NTSB), Airbus and the Air Line Pilots Association (ALPA).

Throughout 2024, the BSC USA has continued its collaboration with The Wildlife Society (TWS) for the vetting of prospective Qualified Airport Wildlife Biologists (QAWB). In March 2022, TWS announced a collaboration with BSC-USA to develop a designation that would expand TWS' Wildlife Biologist Certification Program's current opportunities. That certification process for QAWB's was finalized in 2023 and continues to be available to qualified candidates. For more information, please visit TWS web site: https://wildlife.org/.

The BSC USA Executive Team Nick Atwell (past Chair), Amy Anderson (Chair) and Laura Francoeur (vice Chair) at the BSC USA conference in Minneapolis / St. Paul, MN 2024.

Performance Metrics

The FAA has adopted various performance metrics to aid with measuring program efficacy under a voluntary strike reporting environment where the absolute number of bird strikes is not known. These performance metrics allow the FAA to monitor multiple factors that affect strike reporting and the effectiveness of wildlife mitigation programs on the national or local airport level. To date, strike reporting trends continue to show an increase in overall reporting contrasted with a decline or stabilization in damaging strikes within the wildlife designation of "near airport" (5-miles and/or 1,500 feet AGL). Given that no single metric for strikes tells the complete story for wildlife concerns (e.g., risks, hazards, attractants, etc.) on or near the airport, the following indicators have proven useful:

1. Monitor triggering events – Strike events in the US or with US Air Carriers abroad that involve a damaging strike, an engine ingestion or a strike comprised of multiple animals are defined as triggering events in 14 CFR Part 139.337 that may lead to a wildlife Assessment, Plan or the review of an existing Plan. In 2024, 289 (67%) of the 434 Part 139 certificated airports that reported strikes reported at least one triggering event. For those 289 airports there were a total of 1,872 triggering events.

2. Monitor the percentage of strikes with damage compared to total reported strikes and the percentage of strikes that resulted in a negative effect on flight (NEOF). Since 1996, the percentage of strikes with damage has steadily declined; they comprised only 6.0% of all strikes in 2010 and remained low in 2024; 823 damaging strikes out of 22,372 total strikes (3.7%). Similarly, strikes resulting in a NEOF have steadily declined since 1997 and stabilized between 3-4% since 2010.

3. Monitor number damaging strikes per 100,000 operations for Part 139-certificated airports and GA airports. Both Part 139-certificated airports and general aviation airports have recorded significant increases in reported strikes per 100,000 movements from 2000-2024. However, the number of damaging strikes per 100,000 movements below 1,500 feet above ground level has remained stable at Part 139-certificated airports from 2000- 2024 whereas there has been a significant increase in the damaging strike rate at general aviation airports and at Part-139 airports for flights on approach or climb at >1,500 feet AGL.

4. Monitor the altitude of reported strikes including a comparison of damaging vs nondamaging strikes to evaluate off-airport hazards. For commercial transport and fixed-wing general aviation aircraft, about 71 and 54% of bird strikes occurred at or below 500 feet AGL from 1990 to 2024. Above 500 feet AGL, the number of strikes declined by 34% for each 1,000-foot gain in height for commercial transport aircraft. Strikes occurring above 500 feet were more likely to cause damage than strikes at or below 500 feet.

5. Monitor number of Part 139-certificated airports and GA airports with reported wildlife strikes. The 809 USA airports with strikes reported in 2024 were comprised of 433 Part 139-certificated airports and 376 general aviation airports. From 1990-2024, strikes have been reported from 2,360 different USA airports. Commercial transport and general aviation aircraft were involved in 85 and 15% of reported strikes, respectively, in 2024.

6. Monitor the percentage of reported strikes in which the bird was identified to species. In 2024, species-level bird identification remained high at 60%. In contrast, wildlife strikes involving terrestrial mammals, reptiles and bats comprised less than 5% of all strikes in 2024 but are predominantly identified to the species level. A record 410 bird species were identified as struck by civil aircraft in 2024. From 1990 through 2024, 656 species of birds, 57 species of terrestrial mammals, 52 species of bats, and 45 species of reptiles (810 species total) have been identified.

7. The mean body mass of birds reported as struck by civil aircraft in USA has declined by 64 percent from 2000 to 2024. This trend indicates that airports, pilots, and commercial transport aviation in general, are doing a better job of documenting all wildlife that are struck, many of which are small species that rarely cause damage. This downward trend reflects improved safety at U.S. airports and effective wildlife programs founded on comprehensive Assessments and Plans.

Conclusions

The 22,372 documented strikes in 2024 equated to roughly 61 wildlife strikes every day, of which only 3.7% were damaging. The 823 damaging strikes in 2024 represent an average of approximately 2.25 damaging strikes per day or about 1 per 20,000 of the estimated 45,000+ flights per day (Commercial passenger, General Aviation Air Taxi, Air Cargo, Military) handled by FAA ATC. Overall, 82% of strikes occur at or below 1,500 feet AGL. This globally reinforced strike statistic combined with the standard three-degree glide slope for approaching commercial aircraft provides the justification for the recommended 5-mile wildlife-related separation distance around airports[4]. This separation criteria can be used by airports to identify and monitor hazardous wildlife populations, attractants, and strikes. Trends in strike data have shown that on-ground wildlife mitigation activities extending out 5 miles from an airport can have a positive effect on risk reduction for 82% of all wildlife strikes.

[4] For all airports, the FAA recommends a distance of 5 miles between the closest point of the airport's aircraft operations area and the hazardous wildlife attractant (AC No: 150/5200-33C *Hazardous Wildlife Attractants on or near Airports*).

There are many reasons why reported strikes continue to increase. First and foremost, airport wildlife programs have continued to improve and broaden. All Part 139 certificated airports have approved Assessments and Plans that typically require wildlife strike documentation. Outreach efforts by the FAA and BSC USA, improved access to online reporting and a user-friendly, electronic strike reporting form have all benefited airports, pilots, airlines, Air Traffic Controllers, engine manufacturers and wildlife personnel alike.

An ever-increasing human population has given rise to more enplanements and flights for both commercial and general aviation. Correspondingly, the peak hours of operation have also expanded in response to increased demands for air travel, meaning there are more flights from early morning to late night. Further impacts from the rise in our population also include increased development on and near airports, resulting in habitat modification. This, in turn, forces animals to adapt or move. Animals such as Canada geese have adapted to changes in habitats to become resident, nonmigratory birds while white-tailed deer and coyotes continue to expand their territories. These, and other animals have habituated to human activities, aircraft and often harassment / dispersal techniques. In the end, they represent a greater risk than those less tolerant.

Equally important is the rise in some animal populations due to conservation efforts. Common avian species (e.g., Canada geese, European starlings, bald eagles and osprey) and mammals (e.g., white-tailed deer, coyotes) have increasing populations. Thirteen of the 14 avian species nesting in North America with mean body masses over 8 lbs. show population increases as do most of the 36 avian species with mean body masses over 4 lbs.

Technological improvements with aircraft have resulted in quieter, more powerful engines which may be more difficult for animals to detect and avoid. This trend towards quieter engines and the subsequent increased challenge of mitigating strikes will continue as Advanced Air Mobility (AAM) aircraft technology also advances.

Further influences to increased strike reporting into the National Wildlife Strike Database include the Air Traffic Organization (ATO) which detailed steps within its Orders to address wildlife hazards and to ensure documentation of wildlife strikes. ATO Order JO_7210.632A (October 1, 2020) *Air Traffic Organization Occurrence Reporting* established an internal mandate to report wildlife strikes in 2012. ORDER JO 7210.3DD (April 20, 2023) *Facility Operation and Administration* ensures that any reported bird strike or trend towards an increase in bird activity on or around the airport served by the ATCT are reported to airport management.

Finally, all of this is augmented by the recently[5] authorized Safety Management System (SMS) regulatory guidance, a formal, top-down approach to managing safety risk that has been mandated at certain U.S. airports. It is a structured process that requires organizations to prioritize safety as much as other core business processes and has helped usher in a cultural change that has diminished past stigmas such as sharing wildlife strike data.

[5] The FAA has required U.S. airlines to have SMS since 2018, and the rule became effective on April 24, 2023. 258 of the approximately 530 U.S. airports that fall under the FAA's federal airport certification regulation are required to follow the SMS.

Ultimately, wildlife strikes are rare events that occur every day. Although it is impossible to eliminate all strikes at all times, comprehensive assessment, planning and management techniques have successfully mitigated damaging strikes on or near airports. Combined with systematic evaluation and adaptation of techniques, safety can be increased one less strike at a time.

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TABLES

Table 1. Reported wildlife strikes to civil aircraft in USA and to U.S.-registered civil aircraft in foreign countries, 1990-2024.

Year	USA[1]		Foreign		Total	
	Strikes	Damage strikes	Strikes	Damage strikes	Strikes	Damage strikes
1990	2,088	366	34	6	2,122	372
1991	2,479	395	37	5	2,516	400
1992	2,614	359	37	5	2,651	364
1993	2,590	395	34	4	2,624	399
1994	2,673	452	35	7	2,708	459
1995	2,774	488	52	11	2,826	499
1996	2,980	493	51	10	3,031	503
1997	3,491	566	69	9	3,560	575
1998	3,742	578	67	10	3,809	588
1999	5,024	687	95	18	5,119	705
2000	5,895	743	128	21	6,023	764
2001	5,701	634	124	15	5,825	649
2002	6,081	658	141	11	6,222	669
2003	5,855	611	137	20	5,993	631
2004	6,451	615	159	16	6,610	631
2005	7,091	590	180	19	7,271	609
2006	7,130	584	163	19	7,293	603
2007	7,606	552	143	16	7,749	568
2008	7,452	513	186	14	7,638	527
2009	9,257	589	251	20	9,509	609
2010	9,669	585	229	18	9,898	603
2011	9,845	523	264	24	10,109	547
2012	10,667	607	266	21	10,934	628
2013	11,213	604	195	12	11,408	616
2014	13,463	576	230	16	13,693	592
2015	13,529	611	242	12	13,771	623
2016	13,159	587	166	11	13,325	598
2017	14,608	670	163	10	14,771	680
2018	15,983	712	222	13	16,205	725
2019	17,173	756	178	9	17,351	765
2020	11,494	484	133	8	11,627	492
2021	15,452	657	191	9	15,643	666
2022	16,983	680	233	20	17,216	700
2023	19,389	710	239	9	19,628	719
2024	22,115	809	257	14	22,372	823
Total	**313,716**	**20,439**	**5,331**	**462**	**319,047**	**20,901**

[1] Includes strikes where airport is unknown because strike was en route, or phase of flight was undetermined (see footnote 2, Table 8). Table 2 shows strikes in USA by type of wildlife.

Table 2. Reported wildlife strikes to civil aircraft in USA by wildlife group, 1990-2024.

Year	Birds	Bats	Terrestrial mammals[1]	Reptiles[1]	Total strikes	Strikes with damage[2]
1990	2,030	3	55	0	2,088	366
1991	2,418	3	58	0	2,479	395
1992	2,538	2	73	1	2,614	359
1993	2,518	6	66	0	2,590	395
1994	2,589	2	81	1	2,673	452
1995	2,677	4	85	8	2,774	488
1996	2,887	1	89	3	2,980	493
1997	3,384	1	92	14	3,491	566
1998	3,619	3	113	7	3,742	578
1999	4,920	6	97	1	5,024	687
2000	5,754	15	123	3	5,895	743
2001	5,544	8	141	8	5,701	634
2002	5,928	19	119	15	6,081	658
2003	5,707	20	123	5	5,855	611
2004	6,292	27	126	6	6,451	615
2005	6,927	27	130	7	7,091	590
2006	6,925	46	149	10	7,130	584
2007	7,377	51	171	7	7,606	552
2008	7,220	43	184	5	7,452	513
2009	8,950	66	230	11	9,257	589
2010	9,293	112	253	11	9,669	585
2011	9,491	138	201	15	9,845	523
2012	10,268	162	215	22	10,667	607
2013	10,749	223	208	33	11,213	604
2014	12,944	254	230	35	13,463	576
2015	12,964	316	213	36	13,529	611
2016	12,644	248	230	37	13,159	587
2017	13,868	408	273	59	14,608	670
2018	15,102	509	317	55	15,983	712
2019	16,100	553	420	100	17,173	756
2020	10,920	289	240	45	11,494	484
2021	14,627	451	297	77	15,452	657
2022	16,096	517	295	75	16,983	680
2023	18,406	609	324	50	19,389	710
2024	20,876	817	359	63	22,115	809
Total	**300,552**	**5,959**	**6,380**	**825**	**313,716**	**20,439**

[1] For terrestrial mammals and reptiles, species with body masses <0.5 kilogram (1 pound) such as small rodents generally are excluded from database (Dolbeer et al. 2005).

[2] Birds, terrestrial mammals, bats, and reptiles respectively accounted for 19,010 (93.0%), 1,385 (6.8%), 41 (0.2%), and 3 (<0.1%) of the 20,439 damage strikes.

Table 3. Number and rate of reported wildlife strikes and strikes with damage for transport aircraft at 338 Part-139 certificated airports[1], USA, 2000-2024 (see Figure 2).

Year	No. of reported strikes[2]		Aircraft movements (x 1 million)[3]	Strikes/100,000 movements	
	All strikes	Strikes with damage		All strikes	Strikes with damage
2000	3,225	355	25.40	12.70	1.40
2001	3,043	288	24.39	12.48	1.18
2002	3,272	303	23.76	13.77	1.28
2003	3,222	281	23.57	13.67	1.19
2004	3,642	270	24.77	14.70	1.09
2005	3,739	285	25.10	14.90	1.14
2006	3,853	301	24.35	15.82	1.24
2007	4,118	275	24.46	16.83	1.12
2008	3,894	265	23.42	16.63	1.13
2009	5,071	297	21.51	23.58	1.38
2010	4,904	287	21.50	22.81	1.33
2011	4,862	266	21.38	22.74	1.24
2012	5,033	285	21.02	23.94	1.36
2013	4,923	233	20.92	23.53	1.11
2014	6,293	255	20.68	30.43	1.23
2015	6,165	246	20.90	29.49	1.18
2016	6,106	263	21.24	28.75	1.24
2017	6,228	299	21.48	28.99	1.39
2018	6,913	326	22.12	31.25	1.47
2019	7,309	303	22.71	32.19	1.33
2020	4,125	188	14.28	28.89	1.32
2021	6,234	265	18.55	33.61	1.43
2022	7,150	299	20.49	34.90	1.46
2023	8,457	316	21.68	39.00	1.46
2024	9,273	328	22.46	41.29	1.46
Total	**131,054**	**7,079**	**552.14**	**23.74**	**1.28**

[1] Data are presented for the 338 larger Part 139-certificated airports for which movement data (Federal Aviation Administration 2025*a*) were available in all years, 2000-2024. In 2024, there were 517 Part 139 airports (Federal Aviation Administration 2025*b*).

[2] Strikes involving an unknown operator (90,123 of which 88,362 were “Carcass Found” reports-see Tables 6 and 7) were excluded from this analysis as were all strikes by USA-registered aircraft in foreign countries.

[3] Departures and arrivals for air carrier and air taxi service aircraft (Federal Aviation Administration 2025*a*).

Table 4. Number and rate of reported wildlife strikes and strikes with damage for general aviation aircraft at 115 non-Part-139 certificated (general aviation) airports[1], USA, 2000-2024 (see Figure 2).

Year	No. of reported strikes[2]		Aircraft movements (x 1 million)[3]	Strikes/100,000 movements	
	All strikes	Strikes with damage		All strikes	Strikes with damage
2000	119	39	15.10	0.79	0.26
2001	136	34	14.47	0.94	0.23
2002	144	32	14.75	0.98	0.22
2003	129	37	13.83	0.93	0.27
2004	127	45	13.34	0.95	0.34
2005	123	22	12.94	0.95	0.17
2006	103	23	12.71	0.81	0.18
2007	98	15	12.82	0.76	0.12
2008	111	30	12.00	0.93	0.25
2009	122	20	10.61	1.15	0.19
2010	123	28	9.90	1.24	0.28
2011	122	17	9.70	1.26	0.18
2012	163	35	9.60	1.70	0.36
2013	173	35	9.58	1.81	0.37
2014	209	31	9.51	2.20	0.33
2015	238	32	9.59	2.48	0.33
2016	264	24	9.67	2.73	0.25
2017	260	36	9.82	2.65	0.37
2018	291	40	10.26	2.83	0.39
2019	302	44	10.81	2.79	0.41
2020	267	29	9.74	2.74	0.30
2021	295	33	10.52	2.80	0.31
2022	240	28	10.93	2.20	0.26
2023	309	43	11.52	2.68	0.37
2024	358	54	11.84	3.02	0.46
Total	**4826**	**806**	**285.58**	**1.69**	**0.28**

[1] Data are presented for the 115 larger non-Part 139-certificated (general aviation) airports for which movement data (Federal Aviation Administration 2025*a*) were available in all years, 2000-2024.

[2] Strikes involving an unknown operator (90,123 of which 88,362 were “Carcass Found” reports-see Tables 6 and 7) were excluded from this analysis as were all strikes by USA-registered aircraft in foreign countries.

[3] Itinerant and local departures and arrivals for general aviation aircraft (Federal Aviation Administration 2025*a*).

Table 5. Methods of reporting and source of information for reported wildlife strikes to civil aircraft, USA[1], 2024 only and 1990-2024.

	2024 only		1990-2024	
Source	Total	% of total	Total	% of total
FAA Form 5200-7-E[2]	16,590	74	194,139	61
Multiple[3]	3,508	16	36,049	11
Mandatory Occurrence Report (MOR)	2,088	9	15,254	5
Air Transport Report	141	1	17,170	5
FAA Form 5200-7 (Paper)	27	<1	41,772	13
Other[4]	18	<1	5,142	1
Daily Report	0	0	2,183	1
Airport Report	0	0	7,338	2
Total	**22,372**	**100**	**319,047**	**100**

[1] Includes strikes to U.S.-registered aircraft in foreign countries.

[2] Bird/Other Wildlife Strike Report. Electronic filing of reports (http://wildlife.faa.gov) began in April 2001.

[3] More than one type of report was filed for the same strike (many of these had at least one FAA Form 5200-7E report filed).

[4] Various sources such as news media, Preliminary Aircraft Incident Report, Aviation Safety Reporting System, National Transportation Safety Board, Transport Canada, and engine manufacturers.

Table 6. Person filing report of wildlife strike to civil aircraft, USA[1], 2024 only and 1990-2024.

	2024 only		1990-2024	
Person filing report	Total	% of total	Total	% of total
Airport Operations	14,186	63	164,084	55
Misc. reports[2]	7,504	53	75,722	46
Carcass Found[3]	6,682	47	88,362	54
Pilot	4,118	18	57,685	19
Tower	2,180	10	33,483	11
Other	1,122	5	8,207	3
Air Transport Operations[4]	766	3	34,481	12
Total known	22,372	100	297,940	100
Unknown	0		21,107	
Total	22,372		319,047	

[1] Includes strikes to U.S.-registered aircraft in foreign countries.

[2] Airport personnel observed the strike or reported a strike that had been communicated to them by pilot, tower, or airline.

[3] Airport personnel found fresh wildlife remains within 250 feet of a runway centerline or elsewhere on or near airport that appeared to have been struck by aircraft, but no strike was observed or reported by pilot, tower, or airline (FAA Advisory Circular 150/5200-32B).

[4] Personnel at air transport companies (other than the pilot/flight crew) involved with flight safety, flight operations, and maintenance.

Table 7. Number of reported wildlife strikes to civil aircraft by type of operator, USA[1], 2024 only and 1990-2024.

	2024 only		1990-2024	
Type of operator	Total	% of total	Total	% of total
Commercial transport[2]	13,540	87	195,467	85
General Aviation	2,034	13	33,457	15
Business	1,710	11	26,835	12
Private	124	<1	3,963	2
Government/police[3]	200	<1	2,659	1
Total known	**15,574**	**100**	**228,924**	**100**
Unknown[4]	**6,798**		**90,123**	
Total	**22,372**		**319,047**	

[1] Includes strikes to U.S.-registered aircraft in foreign countries.

[2] Air carrier, commuter, and air taxi service with 3-letter Operator Code.

[3] U.S. Customs and Border Protection (USCBP) and U.S. Coast Guard (USCG) aircraft were respectively involved in 23 percent (556) and 34 percent (908) of the 2,659 Government/police strikes, 1990-2024. For 2024 only, 5 percent (9) and 37 percent (73) of the 200 Government/police strikes involved USCBP and USCG aircraft, respectively.

[4] Ninety-eight percent (88,362) of the 90,123 strikes involving an unknown operator were “Carcass Found” reports, 1990-2024. For 2024 only, 98 percent (6,682) of the 6,798 strikes involving an unknown operator were “Carcass Found” reports (see Table 6).

Table 8. Number of Part 139-certificated airports[1] and general aviation (GA) airports with reported wildlife strikes and number of strikes reported for these airports, civil aircraft, USA, 1990–2024 (see Figure 5)[2].

	Part 139 airports			GA airports			All USA airports	
Year	Airports	Strikes		Airports	Strikes		Airports	Strikes
1990	235	1,779		99	163		334	1,942
1991	260	2,117		96	198		356	2,315
1992	255	2,256		107	228		362	2,484
1993	256	2,266		100	218		356	2,484
1994	264	2,294		111	246		375	2,540
1995	260	2,383		120	209		380	2,592
1996	257	2,592		111	196		368	2,788
1997	283	3,011		124	201		407	3,212
1998	290	3,219		146	269		436	3,488
1999	303	3,807		146	259		449	4,066
2000	310	4,486		155	281		465	4,767
2001	315	4,433		158	300		473	4,733
2002	305	4,765		158	314		463	5,079
2003	305	4,644		154	331		459	4,975
2004	307	5,257		178	324		485	5,581
2005	321	5,548		176	330		497	5,878
2006	319	5,970		147	276		466	6,246
2007	324	6,570		167	334		491	6,904
2008	329	6,628		166	315		495	6,943
2009	362	8,014		239	460		601	8,474
2010	373	8,292		226	474		599	8,766
2011	361	8,441		238	511		599	8,952
2012	384	8,927		265	589		649	9,516
2013	377	9,129		282	628		659	9,757
2014	393	11,009		291	719		684	11,728
2015	404	11,088		275	701		679	11,789
2016	401	10,777		272	796		673	11,573
2017	420	11,736		287	835		707	12,571
2018	418	12,820		307	880		725	13,700
2019	420	13,501		352	967		772	14,468
2020	411	9,201		307	966		718	10,167
2021	429	12,350		330	1,044		759	13,394
2022	431	13,464		317	960		748	14,424
2023	432	15,152		349	1,074		781	16,226
2024	433	16,755		376	1,274		809	18,029
Total	**516**	**254,681**		**1844**	**17,870**		**2,360**	**272,551**

[1] There were 517 airports in USA certificated for passenger service under CFR Part 139 in January 2025 (FAA 2025*b*).

[2] In addition, 5,331 strikes involving USA-registered aircraft were reported from 343 foreign airports in 113 countries (257 strikes at 96 airports in 56 countries in 2024). Furthermore, 5,486 strikes (5,814 bird and 52 bat strikes) were reported in which aircraft was en route (Table 10). An additional 35,225 strikes were reported in which either evidence of strike was discovered on aircraft after landing but phase of flight where strike occurred could not be determined or an airport was not named on reporting form.

Table 9. Reported time of occurrence of wildlife strikes with civil aircraft, USA[1], 1990-2024[2].

	Birds		Terrestrial mammals		Bats	
Time of day	35-year total	% of total known	35-year total	% of total known	35-year total	% of total known
Dawn	6,121	3	134	5	21	1
Day	109,031	62	771	26	211	12
Dusk	7,704	4	213	7	71	4
Night	52,385	30	1,793	62	1,417	82
Total known	**175,241**	**100**	**2,911**	**100**	**1,720**	**100**
Unknown[3]	**130,572**		**3,480**		**4,298**	
Total	**305,813**		**6,391**		**6,018**	

[1] Includes strikes to U.S.-registered aircraft in foreign countries.

[2] In addition, 825 strikes with reptiles were reported from 1990-2024: time not reported (704), day (96), night (20), dusk (4), and dawn (1).

[3] Of the 139,054 strike reports with “Unknown” time of day (all species), 88,362 (64 percent) were “Carcass Found” reports (Table 6).

Table 10. Reported phase of flight at time of occurrence of wildlife strikes with civil aircraft, USA[1], 1990-2024[2].

Phase of flight	Birds		Terrestrial mammals[3]		Bats	
	35-year total	% of total known	35-year total	% of total known	35-year total	% of total known
Parked	112	<1	2	<1		0
Taxi	637	<1	88	3	1	<1
Take-off Run	31,556	17	976	30	62	4
Climb	28,896	15	68	2	92	5
Departure[4]	3,473	2	10	<1	60	3
En Route	5,814	3		0	52	3
Arrival[4]	873	<1	7	<1	10	1
Descent	2,686	1		0	35	2
Approach	80,900	43	290	9	1,142	66
Landing Roll	33,086	17	1,773	54	256	15
Local[4]	1,301	1	60	2	10	1
Total known	**189,334**	**100**	**3,274**	**100**	**1,720**	**100**
Unknown[5]	**116,479**		**3,117**		**4,298**	
Total	**305,813**		**6,391**		**6,018**	

[1] Includes strikes to U.S.-registered aircraft in foreign countries.

[2] In addition, 825 strikes with reptiles were reported: phase of flight not reported (685), landing roll (57), take-off run (45), taxi (25), approach (9; pilot missed approach because reptile was on runway or hit reptile before aircraft touched down), and local (4).

[3] In some cases, terrestrial mammals (e.g., deer, coyote) were hit after aircraft lifted off runway or just before touchdown, or pilot had a missed approach because mammal was on runway.

[4] Phase of flight was determined to be Arrival, Departure, or Local (i.e., pilot conducting “touch-and-go” operations) but exact phase of flight could not be determined.

[5] Of the 124,579 strike reports with “Unknown” phase of flight (all species), 88,362 (71 percent) were “Carcass Found” reports (Table 6).

Table 11. Number of reported bird strikes to commercial transport aircraft[1] by height above ground level (AGL), USA[2], 1990-2024. See Figure 8 for graphic analysis of strike data from 501 to 18,500 feet AGL[3].

Height of strike (feet AGL)	All reported strikes			Strikes with damage		
	35-year total	% of total known	% cum-ulative total[4]	35-year total	% of total known	% cum-ulative total[4]
0	55,434	43	43	2,409	28	28
1-500	36,253	28	71	2,288	26	54
501-1500	13,694	11	82	1,316	15	69
1501-2500	7,433	6	87	836	10	79
2501-3500	5,548	4	92	539	6	85
3501-4500	3,367	3	94	339	4	89
4501-5500	2,351	2	96	254	3	92
5501-6500	1,527	1	97	170	2	94
6501-7500	1,026	<1	98	109	1	95
7501-8500	795	<1	99	107	1	96
8501-9500	423	<1	99	51	<1	97
9501-10500	558	<1	99	83	<1	98
10501-11500	278	<1	100	59	<1	98
>11500[5]	524	<1	100	136	2	100
Total known	**129,211**	**100**		**8,696**	**100**	
Unknown height	**60,533**			**3,969**		
Total	**189,744**			**12,665**		

[1] Air carrier, commuter, and air taxi service with 3-letter Operator Code (see Table 7); strikes in which height of strike was reported but the type of operator was unknown were excluded from analysis. Strikes with rotorcraft are excluded.

[2] Includes strikes to U.S.-registered aircraft in foreign countries.

[3] A more detailed analysis of bird strikes by height AGL is provided by Dolbeer (2006).

[4] The cumulative percentage of strikes that occur at or below the upper range of the corresponding 1,000-foot interval.

[5] Thirty-four strikes involving commercial transport aircraft (11 with damage to aircraft) were reported at ≥20,000 feet AGL; the highest was 32,000 feet.

Table 12. Number of reported bird strikes to general aviation aircraft[1] by height above ground level (AGL), USA[2], 1990-2024.

Height of strike (feet AGL)	All reported strikes			Strikes with damage		
	35-year total	% of total known	% cum-ulative total[4]	35-year total	% of total known	% cum-ulative total[4]
0	9,201	41	41	885	18	18
1-500	7,654	34	75	1,657	33	50
501-1500	2,728	12	87	1,231	24	75
1501-2500	1,217	5	93	576	11	86
2501-3500	670	3	96	296	6	92
3501-4500	335	1	97	154	3	95
4501-5500	170	<1	98	67	1	96
5501-6500	112	<1	99	53	1	97
6501-7500	88	<1	99	34	<1	98
7501-8500	44	<1	99	21	<1	98
8501-9500	28	<1	99	14	<1	99
9501-10500	35	<1	100	19	<1	99
10501-11500	7	<1	100	3	<1	99
>11500[5]	94	<1	100	43	<1	100
Total known	**22,383**	**100**		**5,053**	**100**	
Unknown height	**5,651**			**811**		
Total	**28,034**			**5,864**		

[1] Private, Business, and Government/Police aircraft (see Table 6); Strikes in which height of strike was reported but type of operator was unknown were excluded from analysis. Strikes with rotorcraft are excluded.

[2] Includes strikes to U.S.-registered aircraft in foreign countries.

[3] A more detailed analysis of bird strikes by height AGL is provided by Dolbeer (2006).

[4] The cumulative percentage of strikes that occur at or below the upper range of the corresponding 1,000-foot interval.

[5] Seven strikes involving general aviation aircraft (6 with damage to aircraft) were reported at ≥20,000 feet AGL; the highest was 27,500 feet.

Table 13. Civil aircraft components reported as being struck and damaged by wildlife, USA[1], 1990-2024.

	Birds (35-year total)				Terrestrial mammals (35-year total)			
Aircraft component	Number struck	% of total	Number damaged	% of total	Number struck	% of total	Number damaged	% of total
Windshield	37,601	15	1,443	6	8	<1	17	1
Nose	35,861	14	1,639	7	136	3	122	5
Wing/rotor	37,138	14	5,864	26	410	10	414	17
Radome	28,065	11	2,085	9	22	1	17	1
Fuselage	27,495	11	1,008	4	193	5	199	8
Engine(s)[2]	27,486	11	5,707	25	218	6	203	8
Other[3]	42,641	17	2,102	9	594	15	349	14
Landing gear	11,257	4	719	3	1,834	46	588	24
Propeller	4,684	2	342	1	416	10	361	15
Tail	3,096	1	950	4	72	2	95	4
Light	1,459	1	966	4	59	1	61	3
Total	**256,783**	**100**	**22,825**	**100**	**3,962**	**100**	**2,426**	**100**

[1] Includes strikes to U.S.-registered aircraft in foreign countries.

[2] For birds, 27,486 engines were reported as struck in 26,327 strike events involving engines (25,201 events with one engine struck, 1,100 with two engines struck, 19 with three engines struck, and 7 with four engines struck). A total of 5,707 engines was damaged in 5,522 bird-strike events with engine damage (5,340 events with one engine damaged, 180 with two engines damaged, 1 with three engines damaged, and 1 with four engines damaged). For terrestrial mammals, 218 engines were reported as struck in 206 strike events (194 events with one engine struck and 12 with two engines struck). A total of 203 engines was damaged in 194 terrestrial mammal strike events with engine damage (163 events with one engine damaged and 20 with two engines damaged). Some engines were damaged without being struck when the landing gear collapsed.

[3] "Other" parts reported struck included 928 pitot tubes, 470 wiper blades, 310 antennae (communication, radar, or global position), 214 Angle of Attack (AOA) sensors (including SMART sensors), and 182 air temperature probes (TAT, RAT, OAT, SAT).

[4] In addition, bat strikes had 3,439 and 46 components reported as struck and damaged, respectively: radome/nose (1,167, 7), windshield (492, 7), engine (272, 9), propeller (9, 0), wing/rotor (748,13), fuselage (269, 2), tail (45, 4), other (276, 2), landing gear (148, 0), light (13, 2). For reptile strikes, there were 132 and 7 components reported struck and damaged, respectively: windshield (1, 1), wing/rotor (2, 2), fuselage (1, 1), landing gear (106, 1), tail (1, 1), nose (4, 0), other (17, 1).

Table 14. Number of civil aircraft with reported damage resulting from wildlife strikes, USA[1], 1990-2024. See Tables 1-4 and Figures 2, 3, 10, and 15 for trends in damaging strikes, 1990-2024.

	Reported strikes					
	Birds		Terrestrial mammals		Total (all species)[2]	
Damage category[3]	35-year total	% of total[4]	35-year total	% of total[4]	35-year total	% of total[4]
None	**180,789**	**59**	**1,499**	**23**	**185,288**	**58**
Unknown	**105,557**	**35**	**3,509**	**55**	**112,861**	**35**
Damage	**19,467**	**6**	**1,383**	**22**	**20,898**	**7**
Minor	8,054	3	619	10	8,687	3
Uncertain	7,508	2	251	4	7,787	2
Substantial	3,852	1	478	7	4,336	1
Destroyed[5]	53	<1	35	1	88	<1
Total	**305,813**	**100**	**6,391**	**100**	**319,047**	**100**

[1] Includes strikes to U.S.-registered aircraft in foreign countries.

[2] Included in totals are 6,018 and 825 strikes involving bats and reptiles, respectively. For bats, 2,885 reports indicated no damage, 3,088 failed to indicate if damage occurred, and 45 indicated damage (12 minor, 28 uncertain level, 5 substantial [caused by megabats at foreign airports]). For reptiles, 115 reports indicated no damage, 707 failed to indicate if damage occurred, and 3 indicated damage (2 minor, 1 substantial).

[3] The damage codes and descriptions are from the International Civil Aviation Organization (1989): Minor = the aircraft can be rendered airworthy by simple repairs or replacements and an extensive inspection is not necessary; Uncertain = the aircraft was damaged, but details as to the extent of the damage are lacking; Substantial = the aircraft incurs damage or structural failure that adversely affects the structure strength, performance, or flight characteristics of the aircraft and that would normally require major repair or replacement of the affected component (specifically excluded are bent fairings or cowlings; small dents or puncture holes in the skin; damage to wing tips, antenna, tires, or brakes; and engine blade damage not requiring blade replacement); Destroyed = the damage sustained makes it inadvisable to restore the aircraft to an airworthy condition.

[4] The percentage of strikes causing damage is calculated using the total strikes reported as the divisor, including the 112,861 reports that did not indicate if damage occurred or not (Unknown). “Carcass found” reports (see Table 6) comprised 88,362 (78 percent) of these 112,861 reports.

[5] Includes 1 Government-operated drone destroyed after being attacked by a bald eagle in 2020.

Table 15. Reported effect-on-flight of wildlife strikes to civil aircraft, USA[1], 1990-2024. See Figure 10 for trend in strikes with negative effect-on-flight (NEOF), 1990-2024.

	Reported strikes					
	Birds		Terrestrial mammals		Total[2]	
Effect-on-flight[3]	35-year total	% of total[4]	35-year total	% of total[4]	35-year total	% of total[4]
None	**138,080**	**45**	**1,367**	**21**	**141,143**	**44**
Unknown	**153,924**	**50**	**4,050**	**63**	**163,081**	**51**
Flights with NEOF	**13,809**	**5**	**974**	**15**	**14,823**	**5**
Precautionary landing[5]	9,194	3	158	2	9,375	3
Aborted take-off[5]	2,887	1	310	5	3,199	1
Engine shutdown[5]	515	<1	50	1	533	<1
Other	1,996	1	473	7	2,484	1
Total NEOF events[5]	14,592		991		15,591	
Total	**305,813**	**100**	**6,391**	**100**	**319,047**	**100**

[1] Includes strikes to U.S.-registered aircraft in foreign countries.

[2] Included in totals are 6,018 and 825 strikes involving bats and reptiles, respectively. For bats, 1,600 reports indicated no effect-on-flight, 4,393 failed to indicate if an effect-on-flight occurred, and 25 indicated a negative effect (22 precautionary landings, 3 “Other”). For reptiles, 96 reports indicated no effect-on-flight, 714 failed to indicate if an effect-on-flight occurred, and 15 indicated a negative effect (1 precautionary landing, 2 aborted take-off, 12 “Other”).

[3] Effect-on-flight: None = flight continued as scheduled, although delays and costs caused by inspections or repairs may have been incurred after landing; Aborted take-off = pilot aborted take-off after initiating take-off run (aircraft may have become airborne but pilot landed on departing runway without doing a “go around”); Precautionary landing (includes “declared emergency” landings) = pilot completed take-off but returned to land at departure airport or landed at an “other-than-destination” airport; Engine shut down = pilot shut down engine or engine stopped running; Other = miscellaneous, e.g., smoke in cabin (60 events), evasive maneuver to avoid birds, or aborted landing (go-around); Unknown = insufficient information to determine an effect-on-flight.

[4] The percentage of strikes causing negative effect-on-flight is calculated using the total strikes reported as the divisor, including the 163,081 reports that did not indicate if a negative effect occurred or not (Unknown). “Carcass found” reports (see Table 6) comprised 88,362 (54 percent) of these 149,604 reports.

[5] There were 15,591 NEOF events in the 14,823 flights with a NEOF (749 flights had 2 or more negative effects such as an engine shutdown and precautionary landing).

Table 16. Number of reported incidents where pilot made a precautionary or emergency landing after striking wildlife during departure in which fuel was jettisoned or burned (circling pattern) to lighten aircraft weight or in which an overweight (greater than maximum landing weight) landing was made (no fuel jettison or burn), civil aircraft, USA, 1990-2024[1]. See Figure 11 for trends in incidents, 1990-2024.

Action taken after bird strike on departure	Number of incidents	Comments
Fuel jettison	67	Aircraft with most incidents: B-747 (22); B-767 (8); DC-10/MD-11 (8). A mean of 94,590 lbs (13,910 gallons) of fuel jettisoned per incident in which amount of fuel jettison was reported (N = 29, range 300-270,000 lbs; 44-39,706 gallons).
Fuel burn	161	Aircraft with most incidents: EMB-120 to 190 (30); A-319 to A330 (28); CRJ Regional Jets (17); B-737 (15)
Overweight landing	155	Aircraft with most incidents: B-737 (47); A-319/330 (41); B-757 (18)
Total	**383**	**A mean of 10.6 (range 0 - 33) incidents (fuel jettison, fuel burn, or overweight landing) per year, 1990 - 2024.**

[1] Includes strikes to U.S.-registered aircraft in foreign countries.

Table 17. Indicated air speed (nautical miles/hour [knots])[1] at time pilot aborted take-off after striking or observing wildlife on runway, civil aircraft, USA[2], 1990 - 2024. See Figure 12 for trend in high-speed aborted take-offs at >100 knots caused by wildlife, 1990-2024.

	Commercial transport aircraft[3]		General aviation aircraft[4]		All aircraft[5]	
Aircraft speed (knots)	35-year total	% of total known	35-year total	% of total known	35-year total	% of total known
1-49	33	3	124	17	159	9
50-99	497	50	440	62	942	55
≥100	471	47	148	21	623	36
Total known	**1,001**	**100**	**712**	**100**	**1,724**	**100**
Unknown	**813**		**637**		**1,475**	
Total	**1,814**		**1,349**		**3,199**	

[1] A speed of 100 knots equals 185 kilometers/hour (115 miles/hour).

[2] Includes strikes to U.S.-registered aircraft in foreign countries.

[3] Air carrier, commuter, and air taxi service with 3-letter identifying code (see Table 7).

[4] Business, Private, or Government aircraft (see Table 7).

[5] Included in totals are 36 aborted take-offs in which type of operator was unknown: speed unreported (25), 1-49 knots (2), 50-99 knots (5), and ≥100 knots (4).

Table 18. Total reported strikes, strikes causing damage, strikes having a negative effect-on-flight (NEOF), strikes involving >1 animal, and reported aircraft downtime and costs by identified wildlife species, civil aircraft, USA[1], 1990-2024 (page 1 of 30).

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Birds						
Loons	**83**	**43**	**24**	**1**	**7,076**	**4,739,726**
Loons	2	1	1			
Common loon	59	32	15		6,533	4,542,755
Red-throated loon	20	9	8	1	351	195,230
Pacific loon	2	1			192	1,741
Grebes	**225**	**55**	**24**	**29**	**3,015**	**8,296,791**
Grebes	12	2		1		
Eared grebe	32	7	2	6	586	1,061,119
Western grebe	40	12	7	8	334	3,123,454
Pied-billed grebe	68	7	3	1	119	56,248
Horned grebe	25	6	3	3	150	179,086
Red-necked grebe	7	3	2	1		
Clark's grebe	3					
Great crested grebe	1					
White-tufted grebe	1			1		
Western/Clark's grebe	36	18	7	8	1,826	3,876,884
Albatrosses, shearwaters	**118**	**9**	**4**	**10**	**197**	**104,356**
Laysan albatross	37	8	3	1	197	104,356
Black-footed albatross	8	1				
Bonin petrel	28			9		
Hawaiian petrel	1					
Northern fulmar	1					
Shearwaters	1					
Wedge-tailed shearwater	27		1			
Newell's shearwater	11					
Storm-petrels	1					
Fork-tailed storm-petrel	2					
Band-rumped storm-petrel	1					
Tropicbirds	**43**	**23**	**15**	**1**	**265**	**214,773**
Tropicbirds	10	7	4		150	84,347
White-tailed tropicbird	29	15	10	1	115	120,525
Red-tailed tropicbird	4	1	1			9,901

Table 18. Continued (page 2 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Pelicans	**150**	**63**	**42**	**24**	**10,707**	**19,120,613**
Pelicans	9	3			108	27,784
Australian pelican	1	1	1			
Brown pelican	104	36	24	13	595	607,459
American white pelican	36	23	17	11	10,005	18,485,370
Gannets, boobies	**7**				**13**	
Northern gannet	1					
Red-footed booby	4					
Brown booby	2				13	
Cormorants	**272**	**81**	**51**	**45**	**4,286**	**8,503,291**
Cormorants	3	1			12	19,845
Great cormorant	2	1		2		
Double-crested cormorant	257	78	50	43	4,248	8,483,446
Pelagic cormorant	2					
Brandt's cormorant	5	1	1		26	
Neotropic cormorant	3					
Anhinga	**81**	**42**	**25**	**12**	**671**	**1,402,415**
Frigatebirds	**32**	**13**	**9**	**1**	**90**	**44,966**
Frigatebirds	1				1	
Great frigatebird	15	4	3		69	36,902
Magnificent frigatebird	16	9	6	1	20	8,064
Herons, egrets, bitterns	**3,019**	**279**	**268**	**340**	**10,441**	**32,304,769**
Herons, egrets, bitterns	14		2	1		
Herons	68	13	9	2	211	6,398
Gray heron	3	1	1			
Great blue heron	637	118	77	11	4,644	19,409,705
Black-crowned night heron	180	11	4	9	240	567,496
Little blue heron	29	1	3	1	1	397
Green heron	62	3	4	1		606
Yellow-crowned night heron	141	12	7	7	188	1,033,198
Tricolored heron	11		2			
Purple heron	2	1			36	
American bittern	30	8	3	1	695	78,621
Yellow bittern	187		2	18		
Least bittern	7		1		2	
Egrets	395	36	55	94	3,627	6,082,997

Table 18. Continued (page 3 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Western cattle egret	997	55	83	175	518	1,886,445
Great egret	185	14	12	16	180	3,176,410
Medium egret	1					
Eastern cattle egret	3				1	
Snowy egret	63	6	3	4	99	62,496
Reddish egret	4					
Storks	**31**	**11**	**6**	**4**	**112**	**29,203**
White stork	1	1				
Wood stork	30	10	6	4	112	29,203
Ibises, spoonbills	**93**	**21**	**15**	**17**	**1,993**	**1,475,552**
Ibises	8		1	1		
Glossy ibis	9	2	2	1		2,728
White ibis	46	5	6	5	137	78,012
White-faced ibis	25	13	4	10	1,844	1,378,948
Roseate spoonbill	5	1	2		12	15,864
Waterfowl	**7,776**	**2,866**	**1,361**	**2,462**	**204,987**	**367,295,444**
Ducks, geese, swans	152	74	34	61	804	1,802,741
Ducks	968	316	152	294	10,947	11,027,256
American wigeon	131	48	15	35	5,076	2,518,602
Northern pintail	281	127	49	111	2,952	14,216,855
Green-winged teal	165	34	11	37	1,277	1,594,247
Blue-winged teal	111	40	13	26	781	1,616,308
Eurasian wigeon	3	1		1		
Mallard	1,473	288	148	322	16,058	35,149,298
Common eider	7	3	1	2	12	6,817
Ring-necked duck	64	27	13	14	2,128	1,318,283
Greater scaup	25	4	2	5		
Wood duck	124	33	10	19	1,126	327,186
Muscovy duck	5	1			120	771,398
Common goldeneye	17	5	3	4	1	3,104
Red-breasted merganser	14	4	1	4	99	
Hooded merganser	27	8	3	4	2,149	522,224
Common merganser	14	4	4	3	120	4,803
Northern shoveler	157	56	19	48	3,057	5,542,158
Gadwall	148	52	16	42	812	14,509,172
Canvasback	36	18	5	10	956	3,360,270

Table 18. Continued (page 4 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
American black duck	98	11	5	24	2,672	1,417,733
Mottled duck	40	6	5	8	25	69,420
Lesser scaup	105	43	21	34	2,296	445,139
Ruddy duck	125	29	10	17	418	437,217
Redhead	23	10	4	9	102	296,250
Bufflehead	43	8	4	5	433	278,987
Long-tailed duck	8	4	3	1	20	62,817
Philippine duck	1	1	1	1	96	15,148,512
Black-bellied whistling-duck	29	8	3	8	120	
Cinnamon teal	15	4	1	3	46	43,762
White-winged scoter	8	7	5	2	1,472	935,700
Hawaiian duck	17			6		
Harlequin duck	1					
Barrow's goldeneye	4					
Surf scoter	6	2		1	10	
Mallard/Amer. black duck	58	12	5	11	161	1,063,753
Mallard/mottled duck	6	1	1	1	68	28,705
Diving duck (Aythya)	38	5	2	9	149	331,029
Geese	482	257	108	165	28,621	5,021,398
Snow goose	197	133	67	97	13,682	44,153,038
Canada goose	2,225	1,026	553	885	102,417	189,764,550
Brant	71	17	6	21	142	735,767
Greater white-fronted goose	105	61	24	53	1,284	7,858,368
Emperor goose	2	1				12,957
Cackling goose	47	22	6	13	342	1,792,819
Hawaiian goose	10	1		3	9	
Egyptian goose	2			1		
Ross's goose	2			1		
Snow goose/Ross's goose	41	30	11	26	987	799,760
Swans	4	1				
Mute swan	13	3	1	2	48	92,610
Tundra swan	26	18	14	12	824	741,731
Trumpeter swan	2	2	2	1	72	1,472,700
Hawks, eagles, vultures	**10,817**	**2,452**	**1,482**	**321**	**191,138**	**253,436,585**
Unidentified raptors	86	26	18	1	6,669	292,918
New World vultures	420	239	120	30	27,334	18,796,743

Table 18. Continued (page 5 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Black vulture	382	243	107	18	29,982	18,146,463
Turkey vulture	1,246	592	364	63	55,920	66,614,521
Osprey	678	151	74	9	4,650	10,808,088
Kites, eagles, hawks	8		2		1	
Kites	1					
White-tailed kite	102	4	2	2	46	7,760,000
Black kite	6	4	1			
Mississippi kite	36		2			
Swallow-tailed kite	10	1	2	1	13	3,798
Eagles	8	3	2	1		
Bald eagle	542	190	126	30	14,234	39,709,260
White-bellied sea-eagle	1	1	1			
Golden eagle	39	13	7	2	4,872	1,422,385
Wedge-tailed eagle	1	1	1			
Greater spotted eagle	1	1				
Hawks	1,702	321	227	46	18,398	9,663,026
American goshawk	5					
Red-tailed hawk	4,309	547	358	94	24,327	64,288,046
Rough-legged hawk	138	12	5	1	70	109,152
Red-shouldered hawk	136	9	11		214	5,159
Swainson's hawk	260	39	21	7	2,143	1,116,611
Sharp-shinned hawk	62	2	1	1	1,049	527,940
Cooper's hawk	235	11	11	3	62	266,003
Ferruginous hawk	74	5	1		96	4,816,111
Broad-winged hawk	68	24	10	7	649	929,944
Harris's hawk	6					
Hawaiian hawk	3	2	3		2	
White-tailed hawk	5					
Eurasian buzzard	5	1			26	
Short-tailed hawk	5	2				50,000
Western marsh harrier	1					
Northern harrier	232	6	4	4	144	426,417
Old World vultures	3	1		1		
Lappet-faced vulture	1	1	1		240	7,684,000
Falcons, caracaras	**10,882**	**119**	**184**	**449**	**3,426**	**6,762,919**
Falcons, caracaras	14	2	1		96	62,400

Table 18. Continued (page 6 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Falcons, kestrels, falconets	73	7	8	6	104	72,709
Peregrine falcon	664	36	22	29	350	1,150,527
Gyrfalcon	2					
Merlin	257	3	6	12	29	684,669
Prairie falcon	45	1	4	2		7,904
American kestrel	9,778	59	138	394	2,759	4,784,710
Eurasian kestrel	7	1	1			
Crested caracara	41	10	4	6	89	
Yellow-headed caracara	1					
Gallinaceous birds	**464**	**90**	**67**	**79**	**5,867**	**9,512,425**
Grouse	3	1				
Greater sage-grouse	42	12	5	15	556	645,483
Sharp-tailed grouse	33	2	3	5	24	998
Ruffed grouse	4					
Spruce grouse	1					
Ptarmigans	4	1	1	3	18	90,900
Willow ptarmigan	10	3	1	5	209	177,630
Rock ptarmigan	3	1				
Quails, pheasants	4	1				23,221
New World quail	10		3	3		
Northern bobwhite	19	3	4	2	93	10,537
California quail	1					
Scaled quail	6					
Gambel's quail	4	1	1	2	1,845	
Pheasants	1			1		
Ring-necked pheasant	111	20	10	6	883	137,953
Greater prairie chicken	1		1			
Partridges	3			1		
Red-legged partridge	1					
Gray partridge	43	4	4	15	44	7,176,073
Chukar	4			1		
Gray francolin	8	1	1	1	92	409,474
Black francolin	10				1	
Helmeted guineafowl	3	1		2		
Wild turkey	135	39	33	17	2,102	840,156

Table 18. Continued (page 7 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Cranes	**219**	**79**	**45**	**58**	**3,930**	**561,101**
Cranes	1					
Sandhill crane	217	78	45	58	3,882	485,148
Whooping crane	1	1			48	75,953
Limpkin	**3**					
Rails, gallinules	**767**	**117**	**40**	**30**	**5,305**	**11,303,452**
Rails	17	1	1	1	4	309
Sora	162	12	2	7	178	892,846
Common gallinule	12	2	1		24	1,639
American coot	482	99	35	19	4,945	10,266,098
Eurasian coot	2					
Purple gallinule	7	1	1		72	38,430
Virginia rail	60	1		1	83	104,130
Clapper rail	15					
Yellow rail	3			1		
King rail	5			1		
Eurasian moorhen	1	1				
Corn crake	1					
Shorebirds	**6,536**	**278**	**251**	**1,976**	**7,075**	**12,282,060**
Shorebirds	60	4	2	12	19	
American oystercatcher	54			5		
Plovers, lapwings	12			1		
Plovers	111	2	4	16	29	5,000
American golden-plover	342	10	7	75	86	149,350
Black-bellied plover	289	11	7	42	64	591,868
Snowy plover	8			3	1	
Common ringed plover	1					
Siberian sand-plover	1					
Killdeer	10,657	81	105	868	2,129	5,336,257
Pacific golden-plover	1,576	17	20	206	354	479,689
Semipalmated plover	160		2	42	9	
Piping plover	5	1		1	2	299
Wilson's plover	7			1		
Kentish plover	2					
Oriental plover	2					
Northern lapwing	1	1	1	1	25	

Table 18. Continued (page 8 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Red-wattled lapwing	1					
Southern lapwing	8	2	1			13,608
Spur-winged lapwing	1	1				
Sandpipers, curlews, allies	405	19	33	110	214	263,271
Upland sandpiper	450	10	6	46	81	9,611
Spotted sandpiper	63	3	2	10	6	
Willet	25	1		2		
Common snipe	2					
American woodcock	257	14	4	8	1,185	129,093
Sharp-tailed sandpiper	1		1			
Dunlin	167	9	10	54	688	423,291
Baird's sandpiper	87	2	1	13	79	495,887
Western sandpiper	323	10	8	158	254	230,685
Pectoral sandpiper	81	10	1	21	220	411,612
Sanderling	58	1	3	12	6	
Buff-breasted sandpiper	92	1		13		
Surfbird	1	1		1		7,218
Ruddy turnstone	43		1	7		
Bar-tailed godwit	1					
Least sandpiper	328	2	5	80	23	8,371
Semipalmated sandpiper	201	4	2	69	1	13,141
Lesser yellowlegs	30	8	1	7	105	133,517
Short-billed dowitcher	26	6	1	7	19	13,640
Hudsonian godwit	8	1	1	4	97	44,147
Solitary sandpiper	23	1		2		
Greater yellowlegs	41	5	1	4	121	79,631
Long-billed dowitcher	18	1	1	6	3	
Red knot	5		1			
White-rumped sandpiper	24			6		
Black turnstone	2					
Marbled godwit	12	2	2	3	48	217,538
Wilson's snipe	286	17	6	15	177	1,936,716
Rock sandpiper	2			2		
South American snipe	1					
Stilt sandpiper	4			1		
Purple sandpiper	1					

Table 18. Continued (page 9 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Wood sandpiper	1					
Gray-tailed tattler	1					
Pin-tailed snipe	2					
Wilson/Common snipe	1					
Eurasian curlew	2	1				
Whimbrel	30	2	2	9	384	69,650
Long-billed curlew	24	3	1	1	505	913,920
Red-necked phalarope	23	3	3	5	74	
Wilson's phalarope	32	8	5	18	46	17,170
Red phalarope	6					
American avocet	17	1		4		
Black-necked stilt	25			5		
Red-necked stint	1					
Double-striped thick-knee	3	1			22	287,880
Spotted thick-knee	2	1				
Jaegers	**10**					
Parasitic jaeger	3					
Long-tailed jaeger	7					
Gulls	**15,418**	**1,755**	**1,454**	**2,732**	**59,617**	**82,961,440**
Gulls	7,558	1,150	960	1,763	35,020	33,544,198
Herring gull	2,167	166	141	208	3,715	7,888,999
Short-billed gull	85	7	4	15	52	136,237
Ring-billed gull	2,393	150	142	376	9,526	6,775,087
Glaucous-winged gull	230	32	19	23	650	2,981,593
Great black-backed gull	203	16	12	17	227	2,658,099
Franklin's gull	285	20	29	84	468	285,403
Laughing gull	1,288	33	41	110	1,194	1,283,610
Bonaparte's gull	93	4	7	19	78	163,446
Lesser black-backed gull	9	4	1	2	24	
Western gull	231	25	12	17	753	2,753,861
California gull	356	33	29	43	5,385	968,339
Heermann's gull	1			1		
Black-headed gull	11					
Iceland gull	3					
Yellow-legged gull	3	3	3	3	456	14,958,136

Table 18. Continued (page 10 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Glaucous gull	47	5	4	7	563	941,382
Vega gull	1	1			18	16,165
White-headed gull complex	441	106	50	44	1,489	7,606,885
Black-headed gull complex	4					
Common gull	8					
Sabine's gull	1					
Terns, noddies, kittiwakes	**444**	**18**	**13**	**64**	**273**	**1,246,984**
Terns, noddies	57	3	1	17	1	305,760
White-winged tern	2			1		
Little tern	2			1		
Caspian tern	61	3	1	3	24	771,200
Common tern	59	2		3		102,314
Sandwich tern	6					
Gull-billed tern	8			1		
Black tern	13			3	2	
White tern	32	4	4	3	154	46,176
Arctic tern	6	1		2		
Roseate tern	1					
Forster's tern	26		1	2	5	256
Least tern	45			5		
Royal tern	12	2	2	1	37	
Sooty tern	8	1	1		48	21,168
Elegant tern	4					
Whiskered tern	3			1		
Noddies	8			3		
Black noddy	32		2	9		110
Brown noddy	18		1	4		
Kittiwakes	2	1			2	
Black-legged kittiwake	2					
Red-legged kittiwake	1					
Black skimmer	36	1		5		
Alcidae	**4**		**1**		**1**	**134**
Pigeon guillemot	1					
Common murre	1					
Horned puffin	1		1		1	134
Marbled murrelet	1					

Table 18. Continued (page 11 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Pigeons, doves	**23,638**	**713**	**836**	**3,437**	**34,379**	**32,413,201**
Pigeons, doves	71	7	10	17	1,687	1,323
Pigeons	33	1	2	11	7	161
Common wood-pigeon	11	1		2		
Band-tailed pigeon	40	12	2	7	233	465,041
Rock pigeon	4,522	315	329	1,162	18,232	17,167,879
Picazuro pigeon	1					
White-crowned pigeon	4	1				
Bare-eyed pigeon	2					
Scaly-naped pigeon	5	1	2		24	
Speckled pigeon	1					
Doves	1,369	57	93	270	792	722,348
Eurasian collared dove	105	3	3	15	26	1,323
Mourning dove	16,365	297	366	1,871	12,972	13,571,616
Spotted dove	282	6	11	14	184	459,280
Zebra dove	508	5	15	47	84	21,241
Inca dove	15			1		
White-winged dove	180	6	1	16	106	2,989
Common ground dove	65		1			
Zenaida dove	33	1	1	1	32	
Ruddy ground dove	1					
Eared dove	3					
Philippine collared dove	17			2		
African collared dove	3			1		
Oriental turtle dove	2					
Parrots	**56**			**12**	**5**	**9,915**
Parrots	5			1		
Budgerigar	20			1		
Monk parakeet	5			1		
Olive-throated parakeet	1			1		
Brown-throated parakeet	1					
Lilac-crowned parrot	1			1		
Red-crowned amazon	2					
Rainbow lorikeet	1					
Parakeets	2					
Nanday parakeet	7			1	5	9,915

Table 18. Continued (page 12 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Red-masked parakeet	6			3		
Yellow-chevroned parakeet	1			1		
Rose-ringed parakeet	1					
Mitred parakeet	1					
Blue-crowned parakeet	2			2		
Cuckoos, roadrunners	**228**	**30**	**8**	**16**	**808**	**679,267**
Cuckoos	44	6	3	5	689	486,489
Yellow-billed cuckoo	156	22	5	10	101	192,778
Common cuckoo	1					
Black-billed cuckoo	19	1			19	
Dark-billed cuckoo	1	1				
Greater roadrunner	7			1		
Owls	**5,071**	**214**	**120**	**63**	**4,287**	**18,670,803**
Owls	412	34	24	9	1,500	664,747
American barn owl	2,236	65	37	28	795	4,152,281
Western barn owl	13	1				
Eastern barn owl	1					
Typical owls	1					
Snowy owl	386	33	20	3	1,024	3,454,685
Little owl	1					
Short-eared owl	973	17	17	11	261	2,261,204
Long-eared owl	25	4			25	68,200
Northern saw-whet owl	11	2			96	
Burrowing owl	496	5	5	10	9	1,067
Barred owl	57	1	1			216
Northern pygmy-owl	1					
Great gray owl	4	1				
Flammulated owl	5	1				
Eastern screech-owl	7	2			24	16,885
Western screech-owl	3					
Great horned owl	437	48	16	2	553	8,051,518
Northern hawk owl	2					
Nightjars	**1,562**	**10**	**5**	**61**	**126**	**756**
Nightjars	29				1	
Eastern whip-poor-will	19			2		
Common poorwill	24	1		1	1	

Table 18. Continued (page 13 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Lesser nighthawk	39			2	12	
Chuck-will's-widow	25	1			1	500
Common nighthawk	1,395	8	4	54	111	256
Common pauraque	19			2		
Nacunda nighthawk	2					
Antillean nighthawk	10		1			
Swifts	**2,147**	**29**	**24**	**137**	**1,372**	**283,633**
Swifts	27	1		3	1	368
Black swift	8			1		
Chimney swift	1,845	21	18	127	1,310	142,321
Common swift	33	2		2	2	18,390
Vaux's swift	94	1		2	25	
Pallid swift	2					
White-throated swift	124	4	6	2	35	122,554
Alpine swift	1					
Little swift	1					
Antillean palm swift	12					
Hummingbirds	**169**		**1**	**5**	**4**	**41**
Hummingbirds	23					13
Ruby-throated hummingbird	82			2	1	
Rufous hummingbird	26		1	1	1	28
Anna's hummingbird	19			2	2	
Black-chinned hummingbird	8					
Allen's hummingbird	3					
Calliope hummingbird	3					
Broad-tailed hummingbird	1					
Costa's hummingbird	**4**					
Kingfishers	**21**					
Belted kingfisher	20					
Mariana kingfisher	1					
Blue-tailed bee-eater	**1**					
Woodpeckers	**504**	**36**	**8**	**18**	**983**	**528,850**
Woodpeckers	15	1	1		1	
Northern flicker	237	16	1	3	657	328,759
Yellow-bellied sapsucker	207	15	3	14	242	166,077
Hairy woodpecker	3					

Table 18. Continued (page 14 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Red-naped sapsucker	6	3	2			24,030
Downy woodpecker	14				1	
Red-bellied woodpecker	14			1	10	
Red-breasted sapsucker	4					
Red-headed woodpecker	1					
Ladder-backed woodpecker	1	1	1		72	9,984
Golden-fronted woodpecker	1					
Pileated woodpecker	1					
Unidentified passiformes	**1,774**	**51**	**28**	**118**	**310**	**327,697**
Old World flycatchers	**6**					
Spotted flycatcher	1					
Black redstart	1					
Rufous-tailed robin	2					
European robin	1					
Mugimaki flycatcher	1					
Tyrant flycatchers	**2,008**	**20**	**17**	**118**	**123**	**28,925**
Tyrant flycatchers	57			6	1	1,498
Eastern wood-pewee	80	2	1	6		
Gray kingbird	35	1		3		
Great crested flycatcher	52	3		2	73	579
Eastern kingbird	121	2	3	10	4	18,350
Scissor-tailed flycatcher	445	1	5	25	3	860
Acadian flycatcher	23			2		
Say's phoebe	38				1	
Western kingbird	620	3	6	42	7	4,196
Ash-throated flycatcher	16	1				
Great kiskadee	3			1		
Western wood-pewee	14					
Sulphur-bellied flycatcher	5	1		1	12	
Eastern phoebe	84	1		5		
Yellow-bellied flycatcher	46	1		3	1	1,431
Least flycatcher	62	2		2	2	
Hammond's flycatcher	36		1		1	
Western flycatcher	98			4	11	1,985
Gray flycatcher	7			1	1	26
White-crested elaenia	5	1				

Table 18. Continued (page 15 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Willow flycatcher	27			1	1	
Alder flycatcher	24			1		
Dusky flycatcher	8		1			
Couch's kingbird	3					
Thick-billed kingbird	2					
Olive-sided flycatcher	7			1	6	
Loggerhead kingbird	1					
Black phoebe	9					
Tropical kingbird	3					
Olivaceous elaenia	1					
Brown-crested flycatcher	4			1		
Alder/willow flycatcher	72	1		1		
Larks	**9,370**	**47**	**107**	**1,341**	**1,065**	**1,457,011**
Larks	6					
Eurasian skylark	165		3	8	5	1,211
Horned lark	9,197	47	104	1,333	1,060	1,455,800
Hume's short-toed lark	1					
Black-crowned sparrow lark	1					
Swallows	**8,707**	**83**	**204**	**3,458**	**1,715**	**3,905,002**
Swallows	1,582	11	45	408	171	173,852
Purple martin	423	18	12	81	345	3,159,754
Bank swallow	895	2	9	295	80	15,493
Barn swallow	10,830	38	84	1,846	844	153,756
Western house-martin	1					
Cliff swallow	3,321	8	33	484	183	395,010
Tree swallow	1,320	1	17	312	62	6,763
Violet-green swallow	60	2	1	3	2	374
N. rough-winged swallow	169	1	2	9	5	
Cave swallow	97	2	1	20	24	
Gray-breasted martin	3					
White-winged swallow	2					
Caribbean martin	1					
Black-and-white swallow	3					
Black drongo	**25**			**3**		

Table 18. Continued (page 16 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Starlings, mynas	**6,773**	**168**	**237**	**1,997**	**4,310**	**10,204,933**
European starling	6,611	163	233	1,961	4,239	10,202,433
Mynas	2	1				
Common myna	160	4	4	36	71	2,500
Crows, ravens	**1,115**	**99**	**78**	**118**	**11,090**	**3,843,301**
Crows, ravens	9	2		1	50	
Crows	237	25	13	34	511	190,648
American crow	766	54	55	75	7,291	2,681,926
Carrion crow	3	1			35	6,525
Hooded crow	1	1	1			
Rook	2					
Fish crow	5					
Common raven	92	16	9	8	3,203	964,202
Jays, magpies	**111**	**4**	**2**	**8**	**3**	**1,547**
Blue jay	59	1		2	2	374
Canada jay	2					
Clark's nutcracker	1					
Magpies	1					
Yellow-billed magpie	9		1	3		
Black-billed magpie	39	3	1	3	1	1,173
Titmice, chickadees	**50**	**1**	**2**	**11**		
Tufted titmouse	4					
Chickadees	1					
Black-capped chickadee	31	1	1	7		
Mountain chickadee	8		1	2		
Gray-headed chickadee	1			1		
Carolina chickadee	3			1		
Bushtit	2					
Nuthatches, creepers	**23**				**30**	
White-breasted nuthatch	5					
Red-breasted nuthatch	11					
Brown creeper	6					
Pygmy nuthatch	1				30	
Leaf warblers	**2**					
Yellow-browed warbler	1					
Greenish warbler	1					

Table 18. Continued (page 17 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Red-vented bulbul	**8**			**2**		
Wrens	**390**	**6**	**5**	**31**	**378**	**45,250**
Wrens	77	1	3	11	2	
Marsh wren	65	1	1	3	35	41,107
Northern house wren	126	2		11	2	672
Carolina wren	19	1		1	1	
Rock wren	15			1		
Cactus wren	7					
Winter wren	38		1		2	
Bewick's wren	4					
Sedge wren	26	1		4	336	3,471
Pacific wren	13					
Mimics	**861**	**14**	**9**	**53**	**281**	**3,002,264**
Thrashers	3					
Brown thrasher	61	3	1	1	177	2,781,072
Sage thrasher	8					
Curve-billed thrasher	2					
Long-billed thrasher	11			4		
Pearly-eyed thrasher	1					
Northern mockingbird	211	3	2	12	1	
Tropical mockingbird	1					
Gray catbird	563	8	6	36	103	221,192
Thrushes	**4,661**	**287**	**64**	**337**	**6,816**	**10,039,693**
Thrushes	70	4		4	17	47,327
Western bluebird	24	1		2	21	1,520
Swainson's thrush	828	39	9	72	490	3,911,960
Redwing	2					
American robin	2,548	189	40	161	4,594	5,496,232
Song thrush	3			1		
Hermit thrush	543	15	5	42	818	101,342
Eastern bluebird	39			2		
Gray-cheeked thrush	100	2	1	8	9	321
Varied thrush	146	19	2	10	157	251,693
Wood thrush	126	7	4	11	74	146,958
Mountain bluebird	113	1	1	17	5	
Veery	113	8	2	7	632	82,340

Table 18. Continued (page 18 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Townsend's solitaire	4	2				
Bicknell's thrush	2					
Old World warblers	**111**	**1**	**2**	**5**	**4**	
Garden warbler	1					
Wrentit	1					
Blue-gray gnatcatcher	107	1	2	5	4	
Lesser whitethroat	1					
Lanceolated warbler	1					
Kinglets	**539**		**1**	**21**	**28**	**972**
Golden-crowned kinglet	134			4		
Ruby-crowned kinglet	405		1	17	28	972
Pipits	**509**	**2**	**6**	**79**	**110**	**3,308**
Meadow pipit	3	1			68	
American pipit	489	1	6	79	42	3,308
Sprague's pipit	14					
Olive-backed pipit	2					
Tree pipit	1					
Waxwings	**675**	**16**	**12**	**137**	**406**	**469,922**
Bohemian waxwing	3			2		
Cedar waxwing	672	16	12	135	406	469,922
Shrikes	**83**		**1**	**2**	**1**	
Northern shrike	3					
Loggerhead shrike	80		1	2	1	
Vireos	**686**	**15**	**8**	**36**	**135**	**54,994**
Vireos	7				1	500
White-eyed vireo	21			2	2	13
Blue-headed vireo	51	3		2	5	
Yellow-throated vireo	11			1		
Warbling vireo	88	2		2	12	16,992
Red-eyed vireo	477	9	8	27	116	37,489
Cassin's vireo	9			1		
Philadelphia vireo	20	1		1		
Bell's vireo	1					
Gray vireo	1					
Japanese white-eye	**4**					

Table 18. Continued (page 19 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
New World wood-warblers	**4,485**	**30**	**28**	**243**	**771**	**619,919**
New World wood-warblers	159	1	1	10	8	3,870
Canada warbler	36		1		2	136
Yellow-breasted chat	77	1	1	2	6	282
Pine warbler	57			3	4	300
Black-and-white warbler	127	2	2	7		103
Northern parula	109	1		2	32	3,657
Ovenbird	316	4	3	19	21	7,316
Wilson's warbler	228	1	1	7	4	7,602
Common yellowthroat	365	3	1	23	125	512,924
Yellow-rumped warbler	853	4	7	43	128	12,298
Blackpoll warbler	190	1	2	14	19	14,089
Mourning warbler	15					
American redstart	213	2	1	13	20	1,341
Orange-crowned warbler	128			3	5	25
Yellow warbler	208	2	1	12	188	760
Cape May warbler	63			2		
Hooded warbler	11	1				
Prairie warbler	28				1	
Northern waterthrush	98	2		5	64	9,568
Nashville warbler	104		1	6	33	10,000
Townsend's warbler	40			2		132
Louisiana waterthrush	4	1				
Palm warbler	218		2	8	12	10,258
Magnolia warbler	96		2	8	27	1,524
Black-throated blue warbler	104		1	6	6	353
Prothonotary warbler	7		1		4	294
MacGillivray's warbler	34					
Yellow-throated warbler	58	1		6	2	
Black-throated gray warbler	10				2	
Black-throated green warbler	79			1	25	20,654
Hermit warbler	8					
Tennessee warbler	170	2		11	2	
Chestnut-sided warbler	59			7	1	1,305
Blackburnian warbler	57			10		
Bay-breasted warbler	101			9	30	1,128

Table 18. Continued (page 20 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Connecticut warbler	8			1		
Kentucky warbler	20			2	2	
Worm-eating warbler	14	1				
Blue-winged warbler	3					
Golden-winged warbler	2			1		
Lawrence's warbler	2					
Cerulean warbler	1					
Kirtland's warbler	1					
Swainson's warbler	3					
Virginia's warbler	1					
Meadowlarks	**8,448**	**79**	**99**	**663**	**1,093**	**2,086,270**
Meadowlarks	883	5	13	72	20	20,352
Eastern meadowlark	4,775	40	42	304	550	948,922
Western meadowlark	2,789	34	44	287	524	1,116,996
Chihuahuan meadowlark	1					
Blackbirds	**2,960**	**106**	**119**	**606**	**1,171**	**2,366,779**
Blackbirds	1,348	86	87	379	802	1,981,351
Red-winged blackbird	844	8	19	94	322	343,758
Yellow-headed blackbird	37	5	2	3	7	33,050
Brewer's blackbird	105	3	1	14	1	
Brown-headed cowbird	521	3	8	105	37	8,363
Bobolink	71	1	2	8	2	
Rusty blackbird	32			2		257
Tricolored blackbird	2			1		
Orioles	**105**	**1**	**4**	**7**	**9**	**351**
Orioles	6					
Baltimore oriole	60	1	3	5	9	351
Orchard oriole	21			2		
Bullock's oriole	11		1			
Hooded oriole	7					
Grackles	**774**	**25**	**20**	**125**	**914**	**326,374**
Grackles	189	13	6	34	771	287,215
Common grackle	383	9	10	67	89	37,733
Boat-tailed grackle	96	1	2	11	32	
Great-tailed grackle	105	2	2	13	22	1,426
Greater Antillean grackle	1					

Table 18. Continued (page 21 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Neotropical tanagers	**20**			**3**	**1**	
Red-crested cardinal	7			1	1	
Morelet's seedeater	2					
Saffron finch	10			2		
Blue-black grassquit	1					
Finches, euphonias	**804**	**11**	**14**	**94**	**62**	**54,366**
Finches, euphonias	148	2	4	28	7	1,812
Common chaffinch	7			1		
Island canary	1					
Pine siskin	59	2	1	13	3	121
Redpoll	20		2	5	3	1,322
Purple finch	28			3		
Red crossbill	10	1	1	5		1,817
Evening grosbeak	5	1		1		
American goldfinch	195		3	8	4	
House finch	276	2	2	22	22	1,678
White-winged crossbill	6	1	1	2	4	
Lesser goldfinch	14					
Cassin's finch	6	1		1	16	47,334
Pine grosbeak	1					
Gray-crowned rosy-finch	1					
Blue grosbeak	19	1		3	4	282
Eurasian siskin	1					
Yellow-fronted canary	4			2		
Lawrence's goldfinch	2					
European goldfinch	1					
Cardinalidae	**580**	**18**	**6**	**45**	**1,275**	**94,755**
Northern cardinal	18			1		
Rose-breasted grosbeak	74	1	1	8	6	1,079
Black-headed grosbeak	42	4		2	24	60,500
Dickcissel	58	1		8		1,476
Indigo bunting	112	2	2	12	1,122	1,077
Lazuli bunting	16					
Painted bunting	12					
Scarlet tanager	107	4		6	92	416
Western tanager	123	6	3	6	32	29,471

Table 18. Continued (page 22 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Summer tanager	18			2		736
Black-faced bunting	1			1		
New World sparrows	**9,869**	**118**	**167**	**1,228**	**1,988**	**1,664,301**
Sparrows	4,316	57	138	904	873	119,043
Harris's sparrow	9			1		
Swamp sparrow	241	3	1	11	255	6,478
Savannah sparrow	1,718	12	12	85	105	42,690
Fox sparrow	149	5	2	8	47	78,364
White-throated sparrow	681	9	2	58	67	52,375
Golden-crowned sparrow	24				5	
Field sparrow	93		1	7	1	
Lark sparrow	74	1	1	12		19,845
White-crowned sparrow	146	5	1	9	66	295,024
Grasshopper sparrow	189	4	2	7	19	43,362
Vesper sparrow	154	1		9	2	
Chipping sparrow	263	4	1	13	6	474
Lincoln's sparrow	234	3	2	12	49	21,620
Song sparrow	536	3		30	23	78,477
Bell's sparrow	7				1	
American tree sparrow	55			2	4	336
Nelson's sparrow	9			1	1	287
Black-throated sparrow	13				1	
Brewer's sparrow	61		3	5	1	
LeConte's sparrow	12					
Cassin's sparrow	9					
Clay-colored sparrow	33					
Baird's sparrow	8					
Olive sparrow	2					
Sagebrush sparrow	3					
Lark bunting	167	2		21	26	
Dark-eyed junco	504	4	1	26	88	17,080
White/golden-crown sparrow	156	5		7	349	888,846
Seaside sparrow	3					
Towhees	**92**	**4**		**4**	**27**	**22,414**
Towhees	1					
Eastern towhee	53	2		3	27	22,414

Table 18. Continued (page 23 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Green-tailed towhee	22	2		1		
California towhee	3					
Spotted towhee	13					
Longspurs, snow buntings	**647**	**8**	**39**	**297**	**212**	**32,572**
Longspurs, snow buntings	2			1		
Lapland longspur	155	2	6	36	36	
Chestnut-collared longspur	13					
Smith's longspur	9			1		
Thick-billed longspur	8			1		
Snow bunting	459	6	32	257	176	32,572
McKay's bunting	1		1	1		
Estrildid finches	**405**	**2**	**2**	**131**	**25**	**12,930**
Waxbills, mannikins	4					
Common waxbill	18		1	7		
African silverbill	6			1		
Munias	119			11		
Scaly-breasted munia	149	1	1	67	22	8,938
Chestnut munia	91	1		37	3	3,992
Indian silverbill	5			4		
Java sparrow	2			1		
Bronze mannikin	1					
Red avadavat	10			3		
House sparrow	**621**	**5**	**4**	**62**	**155**	**56,416**
Total known birds	**179,193**	**10,667**	**7,668**	**23,788**	**596,952**	**914,907,731**
Total unknown birds	**126,620**	**8,800**	**6,141**	**10,881**	**259,406**	**207,148,941**
Unknown bird-unk size	**31,097**	**1,437**	**1,485**	**1,316**	**24,668**	**9,517,057**
Unknown bird or bat	**398**	**10**	**14**	**11**	**656**	**918,310**
Unknown bird - large	**3,864**	**1,422**	**671**	**380**	**63,285**	**84,751,062**
Unknown bird - medium	**38,963**	**4,570**	**2,155**	**3,073**	**127,492**	**84,196,073**
Unknown bird - small	**52,298**	**1,361**	**1,816**	**6,101**	**43,305**	**27,766,439**
Total birds[5]	**305,813**	**19,467**	**13,809**	**34,669**	**856,358**	**1,122,056,672**

Table 18. Continued (page 24 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Flying mammals (bats)						
Bats (mega or micro)	**1**	**1**				**12,430**
Megabats (fruit bats)	**17**	**3**	**2**	**4**	**99**	**5,735,097**
Megabats (unk species)	11	2	1	4	99	5,735,097
Flying foxes	1					
Little red flying fox	1					
Indian flying fox	2	1	1			
Grey-headed flying fox	1					
Leschenault's rousette	1					
Microbats (echo locating)	**6,000**	**41**	**23**	**389**	**531**	**900,499**
Microbats	1,683	7	12	165	99	7,008
Vesper bats	320	5	1	9	40	4,730
Eastern red bat	794	5	2	31	74	19,916
Hoary bat	259	9		9	99	265,973
Eastern small-footed myotis	2					
Little brown bat	461			26	1	
Big brown bat	350		2	18	1	256
Silver-haired bat	147	1		6	19	1,202
Seminole bat	40			1	11	309
Tri-colored bat	47					
Northern yellow bat	25			4		
Evening bat	108	2		6		
Indiana bat	5					
Yuma myotis	3					
Long-eared myotis	2					
Western yellow bat	2					
Common pipistrelle	2					
Long-legged myotis	3					
Western small-footed myotis	4			1		
Kuhl's pipistrelle	1					
Western red bat	2					
Western pipistrelle	4				2	
Indian pipistrelle	5					
African yellow bat	1					
Kelaart's pipistrelle	1					
Spotted bat	2					

Table 18. Continued (page 25 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
California myotis	3					
Gray bat	18			2		
Cape serotine	1					
Free-tailed bats	187			4	12	763
Brazilian free-tailed bat	1,473	9	5	104	139	28,392
Pocketed free-tailed bat	4					
Big free-tailed bat	4		1			
Western mastiff bat	7	2			24	440,910
Florida bonneted bat	1					
Pallas's mastiff bat	8			1	1	
Egyptian free-tailed bat	4					
Black mastiff bat	1	1			8	131,040
Angolan free-tailed bat	1			1		
Broad-eared bat	1					
Sinaloan mastiff bat	1					
Wagner's bonneted bat	1					
Gray sac-winged bat	2					
Naked-rumped tomb bat	1					
Mauritian tomb bat	1					
Jamaican fruit bat	3			1		
Antillean fruit-eating bat	1					
Cuban flower bat	1					
Brown flower bat	1					
Lesser bulldog bat	1					
Sooty mustached bat	1					
Total Megabats	**17**	**3**	**2**	**4**	**99**	**5,735,097**
Total Microbats	**6,000**	**41**	**23**	**389**	**531**	**900,499**
Unknown bat	**1**	**1**				**12,430**
Total bats[6]	**6,018**	**45**	**25**	**393**	**630**	**6,648,026**
Terrestrial mammals						
Virginia opossum	**510**	**1**	**2**	**6**		
Nine-banded armadillo	**66**	**1**	**4**		**11**	**1,656**
Lagomorphs	**1,276**	**13**	**12**	**13**	**60**	**168,104**
Lagomorphs (rabbits, hares)	14	2				
Hares	11		1		1	

Table 18. Continued (page 26 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Black-tailed jackrabbit	573	8	4	4	51	47,048
White-tailed jackrabbit	257		1	3	1	
Antelope jackrabbit	2					
Snowshoe hare	1					
Rabbits	76		2	2	1	
Eastern cottontail	228	3	4	2	6	121,056
Desert cottontail	111			2		
Mountain cottontail	1					
Brush rabbit	1					
Marsh rabbit	1					
Rodents	**465**	**3**	**16**	**6**	**7**	**9,374**
North American beaver	4					
Prairie dogs, marmots	2					
Black-tailed prairie dog	102		2	2		
White-tailed prairie dog	6					
Gunnison's prairie dog	19		1	3		
Woodchuck	212	3	12		6	9,374
Yellow-bellied marmot	6					
Tree squirrels	4					
Fox squirrel	1					
American red squirrel	1					
Eastern gray squirrel	2					
Ground squirrels	5					
Piute ground squirrel	1					
California ground squirrel	14					
13-lined ground squirrel	2					
Richardson's g. squirrel	7			1		
Muskrat	47					
North American porcupine	27		1		1	
Coypu (nutria)	3					
Carnivores	**2,524**	**110**	**300**	**31**	**20,015**	**6,386,953**
Canids	6	2	2			
Coyote	932	72	214	9	14,559	5,004,321
Domestic/feral dog	58	16	30	1	559	506,975
Foxes	41	3	5		10	1,364
Red fox	308	6	32	1	364	77,168

Table 18. Continued (page 27 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Common gray fox	25	2	2		5	681
Kit fox	4					
Raccoon	193	5	7	9	4,396	74,688
White-nosed coati	1					
Skunks	19					
Striped skunk	848	2	4	11	3	
River otter	2	1				
American badger	8					
American mink	7					
Long-tailed weasel	2					
Least weasel	2					
Domestic/feral cat	52		2			
Small Indian mongoose	11					
American black bear	3		1			
Brown bear	1	1			120	721,756
Bearded seal	1		1			
Artiodactyls	**1,500**	**1,239**	**625**	**112**	**327,311**	**80,461,710**
Deer	17	14	8		1,488	180,936
White-tailed deer	1,332	1,098	545	99	273,565	66,922,191
Mule deer	92	78	40	3	22,297	2,449,645
Axis deer	1		1			
Wapiti (elk)	12	12	6	2	11,660	9,674,063
Moose	6	5	5			
Caribou	3	2	2			
Cattle	12	12	8	4	9,215	639,617
Domestic sheep	1	1	1			
Pronghorn	10	9	6	2	5,298	381,126
Swine (pigs)	8	6	2	1	3,788	214,132
Collared peccary	6	2	1	1		
Perissodactyls (horse)	**5**	**4**	**4**	**1**	**1,008**	**46,529**
Total known t. mammals	**6,346**	**1,371**	**963**	**169**	**348,413**	**87,074,326**
Total unknown t. mammal	**45**	**12**	**11**	**1**		
Total t. mammals[7]	**6,391**	**1,383**	**974**	**170**	**348,413**	**87,074,326**

Table 18. Continued (page 28 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Reptiles						
Turtles	**508**	**1**	**5**	**6**	**1**	
Turtles	152		3			
Florida softshell turtle	17	1		1		
Common box turtle	38					
Common snapping turtle	68		1		1	
Diamondback terrapin	78			5		
Painted turtle	63					
Florida red-bellied cooter	3					
Gopher tortoise	56		1			
Alligator snapping turtle	4					
Coastal plain cooter	4					
Pond slider	13					
Eastern mud turtle	2					
Chicken turtle	1					
Striped mud turtle	3					
Ornate box turtle	2					
Spiny softshell turtle	2					
River cooter	1					
Northern map turtle	1					
Alligators, caimans	**35**	**2**	**3**		**3**	
American alligator	34	2	3		3	
Spectacled caiman	1					
Green iguana	**54**		**6**			
Snakes	**228**		**1**			
Snakes	37		1			
Gopher snake	115					
Northern water snake	4					
E diamondback rattlesnake	2					
Water moccasin	2					
Eastern pine snake	1					
W diamondback rattlesnake	5					
Prairie rattlesnake	3					
Western rat snake	5					
Plains garter snake	6					
Common kingsnake	5					

Table 18. Continued (page 29 of 30)

Wildlife group or species[2]	35-year totals (1990-2024)					
	Number of reported strikes				Reported economic losses[4]	
	Total	With dam-age	With NEOF	With multiple animals[3]	Aircraft down time (hrs.)	Reported costs ($)
Western hognose snake	1					
Diamondback water snake	2					
Corn snake	3					
Eastern hognose snake	1					
California kingsnake	2					
Eastern rat snake	5					
Checkered garter snake	2					
Common garter snake	11					
Texas blind snake	1					
Lined snake	8					
Milk snake	2					
Western ribbon snake	2					
Mohave rattlesnake	1					
Western fox snake	1					
Eastern racer	1					
Total reptiles[8]	**825**	**3**	**15**	**6**	**4**	
Total known (all species)	**192,381**	**12,085**	**8,671**	**24,356**	**945,998**	**1,008,617,653**
Total (unknown species)	**126,666**	**8,813**	**6,152**	**10,882**	**259,406**	**207,161,371**
Grand total	**319,047**	**20,898**	**14,823**	**35,238**	**1,205,404**	**1,215,779,024[9]**

[1] Includes strikes to U.S.-registered aircraft in foreign countries.

[2] The scientific (taxonomic) name and mean and maximum (when available) body mass for each species are listed in Appendix C.

[3] More than 1 animal was struck by the aircraft.

[4] These reported economic losses by species and species groups should be considered as relative indices of losses and not as actual estimated losses. For commercial aviation, an estimated 20 percent of strikes were reported in the 1990s. More recent analyses estimated that strike reporting for all civil aircraft combined (commercial and general aviation) at Part 139 airports had improved to 39 percent in 2004-2008 and to 47 percent in 2009-2013 (Dolbeer 2009, 2015). Strike reporting for commercial aircraft only at Part 139 airports was an estimated 79 percent in 2004-2008 and 91 percent in 2009-2013; reporting of strikes with damage was estimated at 78 percent and 93 percent for these respective time periods. In addition, only about 60 percent of reported strikes identified the wildlife species (51 percent) or species group (9 percent) responsible, 1990-2024. Furthermore, of the 20,898 reports indicating damage to the aircraft, only 25 percent (5,261) also provided an estimate of repair costs, and only 39 percent (15,035) of the 38,262 strikes indicating an adverse effect

Table 18. Continued (page 30 of 30)

estimated the downtime (see Tables 23, 24). Finally, even when cost estimates were provided, some reports were filed before aircraft damage had been fully assessed. See Tables 23 and 24 for a more detailed projection of actual economic losses.

[5] Of the 305,813 reported bird strikes, 152,606 (50 percent) identified the bird to exact species (a total of 656 species of birds of which 337 caused damage) and an additional 26,587 strikes (9 percent) identified the bird at least to species group (e.g., gull, hawk, duck). Exact species identification has improved from less than 20 percent in the early 1990s to 60 percent in 2024 (Figure 7).

[6] Of the 6,018 reported bat strikes, 3,815 (63 percent) identified the bat to exact species (52 species total of which 8 caused damage) and 2,202 (37 percent) identified the bat to species group (12 megabats [old world fruit bats] and 2,190 microbats [echo-locating bats]) of which 1,683 were microbats of unknown species, 187 were free-tailed bats (Molossidae) and 320 were vesper bats (Vespertilionidae). One foreign bat strike was classified as unknown bat (either megabat or microbat).

[7] Of the 6,391 reported terrestrial mammal strikes, 6,151 (96 percent) identified the mammal to exact species (a total of 57 species of which 24 caused damage), 195 (3 percent) identified the mammal at least to species group, and 45 (<1 percent) were unknown species group.

[8] All 825 reported reptile strikes were identified to species group and 636 (77 percent) were identified to exact species (45 species total of which 2 caused damage).

[9] Reported costs of $1,215,779,024 include $1,060,150,981 in direct repair costs and $155,628,043 in other costs.

Table 19. Number of reported strikes, strikes with damage, and strikes involving multiple animals for the five most struck bird groups and three most struck terrestrial mammal groups, civil aircraft, USA[1], 1990-2024.

	Reported strikes		Strikes with damage		Strikes with >1 animal	
Species group[2]	35-year total	% of total known	35-year total	% of total known	35-year total	% of total known
Birds						
Pigeons, doves	23,638	13	713	7	3,437	14
Raptors[3]	21,699	12	2,571	24	770	3
Shorebirds	16,536	9	278	3	1,976	8
Gulls	15,418	9	1,755	16	2,732	11
Waterfowl	7,776	4	2,462	23	2,462	10
All other known	94,126	53	2,888	27	12,411	52
Total known	**179,193**	**100**	**10,667**	**100**	**23,788**	**100**
Total unknown	**126,620**		**8,800**		**10,881**	
Total birds	**305,813**		**19,467**		**34,669**	
Terrestrial mammals						
Carnivores	2,524	40	110	8	31	18
Artiodactyls	1,500	24	1,239	90	112	66
Lagomorphs	1,276	20	13	1	13	8
All other known	1,046	16	9	1	13	8
Total known	**6,346**	**100**	**1,371**	**100**	**169**	**100**
Total unknown	**45**		**12**		**1**	
Total Terr. Mammals	**6,391**		**1,383**		**170**	

[1] Includes strikes to U.S.-registered aircraft in foreign countries.

[2] See Table 18 for listing of species within each species group and Table 20 for the most frequently struck species.

[3] Hawks, eagles, vultures, falcons, and caracaras.

Table 20. The 33 species of birds identified most frequently as struck by civil aircraft in USA, 1990-2024 and 2024 only. See Figure 14 for relation between mean body mass and percent of strikes causing damage for these 33 species in 2024.

	Strikes (1990-2024)[1]				Strikes (2024 only)[1]		
Rank	Bird species	Num-ber	% with damage		Bird species	Num-ber	% with damage
1	Mourning dove	16,365	1.8		Mourning dove	1404	1.6
2	Barn swallow	10,830	0.4		Horned lark	930	0.5
3	Killdeer	10,657	0.8		Barn swallow	914	0.2
4	American kestrel	9,778	0.6		Killdeer	773	0.3
5	Horned lark	9,197	0.5		American kestrel	663	0.5
6	European starling	6,611	2.5		Eastern meadowlark	431	0.7
7	Eastern meadowlark	4,775	0.8		European starling	398	0.8
8	Rock pigeon	4,522	7.0		Cliff swallow	389	0.3
9	Red-tailed hawk	4,309	12.7		Western meadowlark	263	2.3
10	Cliff swallow	3,321	0.2		Red-tailed hawk	259	9.7
11	Western meadowlark	2,789	1.2		American robin	227	7.9
12	American robin	2,548	7.4		American barn owl	189	1.1
13	Ring-billed gull	2,393	6.3		Rock pigeon	187	4.3
14	American barn owl	2,236	2.9		Chimney swift	181	1.1
15	Canada goose	2,225	46.1		Savannah sparrow	163	0.0
16	Herring gull	2,167	7.7		Swainson's thrush	146	2.7
17	Chimney swift	1,845	1.1		Ring-billed gull	141	3.5
18	Savannah sparrow	1,718	0.7		Yellow-rumped warbler	111	0.0
19	Pacific golden-plover	1,576	1.1		Western cattle egret	103	3.9
20	Mallard	1,473	19.6		Common nighthawk	102	1.0
21	Common nighthawk	1,395	0.6		White-throated sparrow	94	0.0
22	Tree swallow	1,320	0.1		Short-eared owl	90	0.0
23	Laughing gull	1,288	2.6		Mallard	85	18.8
24	Turkey vulture	1,246	47.5		Laughing gull	84	1.2
25	Western cattle egret	997	5.5		Turkey vulture	83	31.3
26	Short-eared owl	973	1.7		Canada goose	81	40.7
27	Bank swallow	895	0.2		Herring gull	78	7.7
28	Yellow-rumped warbler	853	0.5		Cedar waxwing	76	1.3
29	Red-winged blackbird	844	0.9		Gray catbird	72	0.0
30	Swainson's thrush	828	4.7		Pacific golden-plover	71	2.8
31	American crow	766	7.0		Bank swallow	69	0.0
32	White-throated sparrow	681	1.3		Ruby-crowned kinglet	69	0.0
33	Osprey	678	22.3		Red-winged blackbird	69	0.0

[1] Actual number struck was higher for each species because only 50 and 60 percent of the bird strike reports from 1990-2024 and in 2024, respectively, identified the bird to species (an additional 9 and 4 percent of the reports, respectively, identified the bird to species group). As examples, the species of gull was not identified in 7,558 (49 percent) of 15,418 gull strikes reported from 1990-2024, and the species of vulture (turkey or black) was not identified in 420 (21 percent) of the 2,048 new-world vulture strikes (Table 18).

Table 21. Number of strikes to civil aircraft causing human fatality and number of fatalities by wildlife species, USA[1], 1990-2024.[2]

Species group	Number of strikes	Human fatalities
Birds	**24**	**51**
Raptors[3]	4	10
Pelicans[4]	3	9
Waterfowl[5]	5	16
Misc. birds[6]	2	3
Unknown bird	10	13
Terrestrial mammals	**1**	**1**
White-tailed deer	1	1
Total	**25**	**52**

[1] Includes strikes to U.S.-registered aircraft in foreign countries.

[2] In addition, there were 292 strikes in which 373 humans received injuries (e.g., facial lacerations). Waterfowl (67 strikes, 78 injuries), vultures (40, 49), and deer (26, 37) were responsible for 164 (54 percent) of the injuries with identified species or species groups.

[3] Black vulture (1, 1); turkey vulture (2, 3); bald eagle (1, 4); red-tailed hawk (1, 8).

[4] American white pelican (2, 8); brown pelican (1, 1).

[5] Green-winged teal (1, 2); snow goose (1, 3); Canada goose (1, 2), Cackling goose (1,3).

[6] Rock pigeon (1,2); unidentified gull (1, 1).

Table 22. Number of civil aircraft lost (destroyed or damaged beyond repair) after striking wildlife by wildlife species group and aircraft mass category, USA[1], 1990-2024. See Figure 15 for number of lost aircraft by year, 1990-2024.

Wildlife species group	Aircraft[2] mass category (Maximum take-off mass in kilograms) ≤2,250	2,251-5,700	5,701-27,000	>27,000	Total aircraft lost
Birds	**36**	**10**	**5**	**2**	**53**
Raptors	12	1	0	1	14
Waterfowl	3	4	1	1	9
Pelicans	3	1	0	0	4
Gulls	1	2	0	0	3
Other birds	3	0	1	0	4
Unknown bird	14	2	3	0	19
Terrestrial mammals	**22**	**7**	**6**	**0**	**35**
Artiodactyls	20	7	5	0	32
Other T. mammals	2	0	1	0	3
Total[3]	**58**	**17**	**11**	**2**	**88**

[1] Includes strikes to U.S.-registered aircraft in foreign countries.

[2] Engine types on the 88 destroyed aircraft were piston (63), turbofan (11), turboprop (6), turboshaft (4), turbojet (3), and electric (drone, 1). Aircraft operators were business (46), private (35), commercial transport (5), government (2).

[3] Fifty-one (58 percent) of the 88 wildlife strikes resulting in a destroyed aircraft occurred at USA general aviation airports, 25 (28%) occurred “en route”, 7 occurred at USA airports certificated for passenger service under 14 CFR Part 139, 3 occurred in miscellaneous situations (taking off from river, herding cattle, aerial application of pesticides) and 2 occurred at foreign airports.

Table 23. Number of reported wildlife strikes indicating damage, a negative effect-on-flight (NEOF), aircraft downtime, repair costs, and other costs; and the mean losses per report in hours of downtime and inflation-adjusted U.S. dollars, civil aircraft, USA[1], 1990-2024.

	Number of reports indicating:						Mean losses per report[2]		
Year	Damage	NEOF	Aircraft down time	Repair costs	Other costs		Down-time (hours)	Repair costs ($)	Other costs ($)
1990	372	144	60	33	16		56.4	276,058	79,246
1991	400	176	61	49	25		79.8	93,651	50,483
1992	364	207	81	51	28		111.9	134,013	6,743
1993	399	228	67	57	19		277.9	113,836	12,016
1994	459	256	103	73	29		388.4	98,013	117,042
1995	499	292	96	62	33		95.8	644,745	281,468
1996	503	336	143	86	39		138.2	108,046	32,333
1997	575	361	182	126	47		230.7	97,412	50,990
1998	588	385	205	135	54		119.5	256,709	36,602
1999	705	405	282	179	79		148.8	141,256	26,758
2000	764	445	350	205	93		193.6	125,628	146,286
2001	649	411	294	157	65		143.5	363,319	49,834
2002	669	437	383	165	63		135.6	193,991	81,966
2003	630	407	352	171	81		107.1	205,575	54,609
2004	631	395	325	213	92		166.4	134,414	29,016
2005	609	381	327	227	125		88.0	341,489	98,376
2006	603	372	334	172	102		116.5	273,934	17,035
2007	568	395	364	178	135		165.2	220,436	42,437
2008	527	345	371	156	141		116.2	150,755	17,908
2009	608	463	561	194	192		73.9	480,683	18,590
2010	603	412	526	174	164		66.5	166,150	17,653
2011	547	442	526	180	208		70.8	305,294	19,332
2012	627	447	689	228	263		75.4	140,744	10,796
2013	616	454	802	238	304		75.7	83,540	15,937
2014	592	502	718	210	278		61.5	178,397	13,587
2015	623	496	705	208	293		50.0	194,206	24,863
2016	598	495	578	151	221		63.7	87,260	15,728
2017	680	543	627	189	264		35.7	228,884	15,844
2018	725	589	636	168	298		53.2	75,703	9,960
2019	765	598	711	160	249		28.7	133,369	25,482
2020	492	448	482	113	189		37.9	126,375	9,815
2021	666	451	617	147	224		60.1	279,853	18,560
2022	700	599	640	116	177		40.9	194,331	94,856
2023	719	727	861	141	271		37.0	223,261	30,254
2024	823	779	976	149	298		35.3	212,327	12,270
Total	20,898	14,823	15,035	5,261	5,159		1,205,053	1,060,150,981	155,628,043
Mean	597	424	430	150	147		80.1	201,511	30,166

[1] Includes strikes to U.S.-registered aircraft in foreign countries.

[2] Total downtime and $ losses reported for 1990-2024 (see last row and footnote 9, Table 18).

Table 24. Projected annual losses in aircraft downtime (hours) and in repair and other costs (inflation-adjusted U.S. dollars) from wildlife strikes with civil aircraft, USA[1], 1990-2024. Losses are projected from mean reported losses per incident (Table 24). (Page 1 of 2).

Year	No. of adverse incidents[4]		Projected losses[2, 3]			
			Down-time (hours)	Repair costs (x $1 million)	Other costs (x $1 million)	Total costs (x $1 million)[5]
1990	429		24,174	118	34	152
1991	481		38,362	45	24	69
1992	485		54,284	65	3	68
1993	506		140,623	58	6	64
1994	576		223,740	56	67	124
1995	652		62,432	420	184	604
1996	681		94,128	74	22	96
1997	775		178,761	75	40	115
1998	804		96,080	206	29	236
1999	963		143,268	136	26	162
2000	1,101		213,172	138	161	299
2001	977		140,196	355	49	404
2002	1,080		146,451	210	89	298
2003	983		105,309	202	54	256
2004	944		157,041	127	27	154
2005	951		83,697	325	94	418
2006	928		108,072	254	16	270
2007	955		157,806	211	41	251
2008	885		102,803	133	16	149
2009	1,171		86,581	563	22	585
2010	1,114		74,077	185	20	205
2011	1,135		80,328	347	22	368
2012	1,317		99,360	185	14	200
2013	1,432		108,414	120	23	142
2014	1,441		88,592	257	20	277
2015	1,446		72,299	281	36	317
2016	1,316		83,860	115	21	136
2017	1,441		51,497	330	23	353
2018	1,580		84,010	120	16	135
2019	1,655		47,518	221	42	263
2020	1,118		42,426	141	11	152
2021	1,403		84,374	393	26	419
2022	1,566		64,107	304	149	453
2023	1,865		69,053	416	56	473
2024	2,106		74,268	447	26	473
Total	38,262		3,481,163	7,186	1,480	8,666
Mean	1,093		99,462	205	43	248

Table 24. Continued (page 2 of 2)

[1] Includes strikes to U.S.-registered aircraft in foreign countries.

[2] Values assume that all 38,262 reported strikes (mean of 1,093/year) indicating an adverse effect (see footnote 3) incurred similar amounts of damage and/or downtime and that these reports are all the adverse-effect strikes that occurred, 1990-2024.

[3] Strike reporting for commercial transport aircraft at Part 139 airports was an estimated 91 percent in 2009-2013; reporting of strikes with damage was estimated at 93 percent (Dolbeer 2015). Strike reporting for aircraft at General Aviation airports is lower (Dolbeer et al. 2008).

[4] Number of reports indicating one or more of the following: damage, negative effect on flight (EOF), downtime, repair costs, other costs.

[5] Altringer et al. (2022) estimated that damaging wildlife strike events generate additional "spillover" costs of around $25 million (2020 US$) each year related to delays in subsequent flights.

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Figures

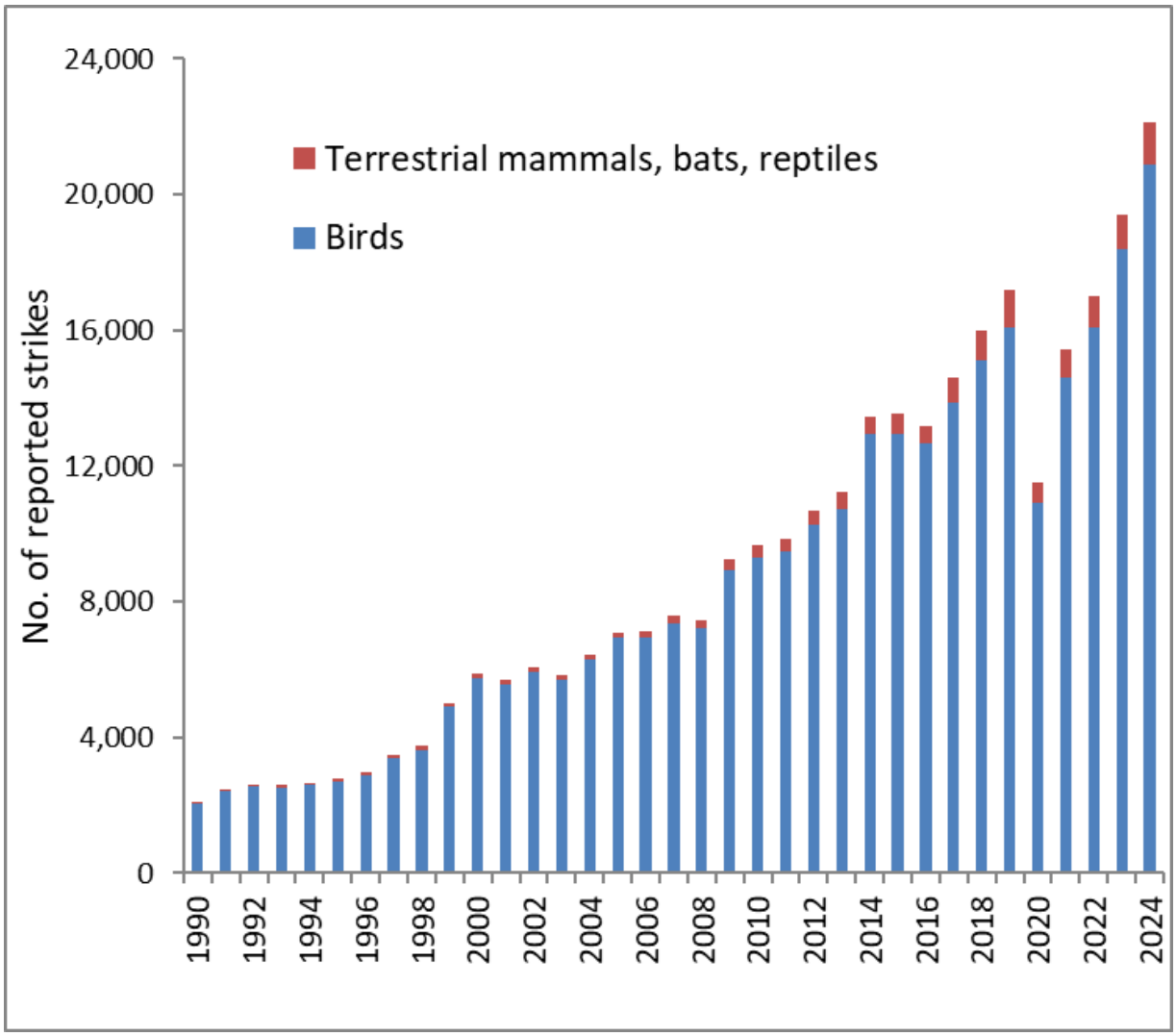
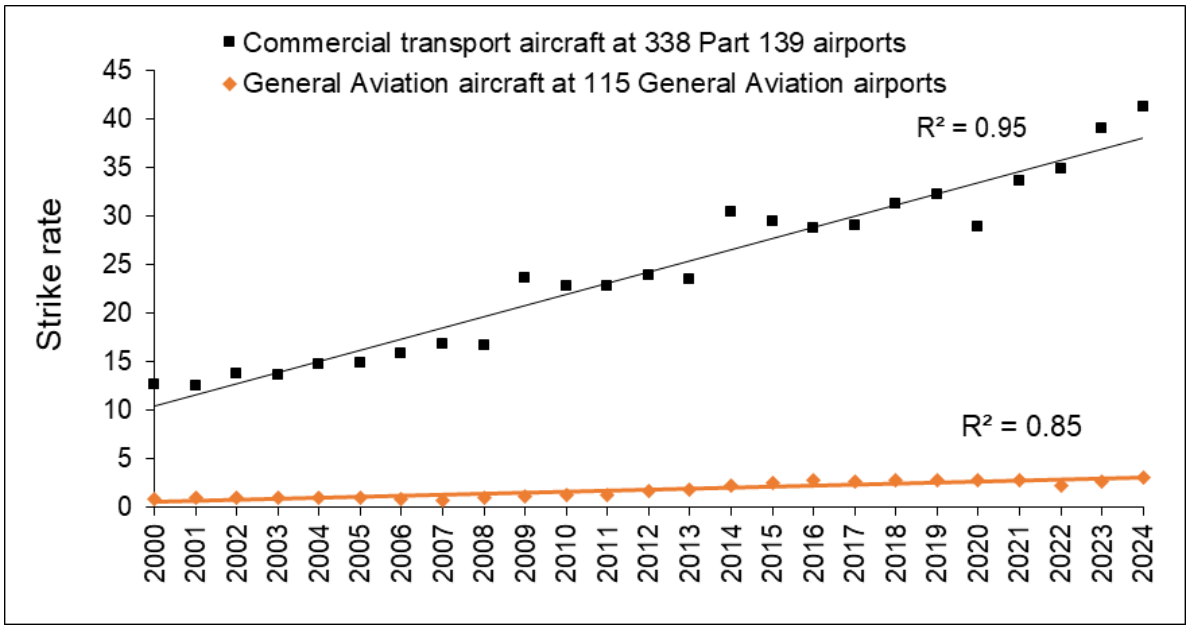


Figure 1. Number of reported wildlife strikes with civil aircraft, USA, 1990-2024. The 313,716 strikes involved birds (300,552), terrestrial mammals (6,380), bats (5,959), and reptiles (825). An additional 5,328 strikes were reported for U.S.-registered aircraft in foreign countries for a total of 319,047 strikes (see Tables 1, 2, and 18).



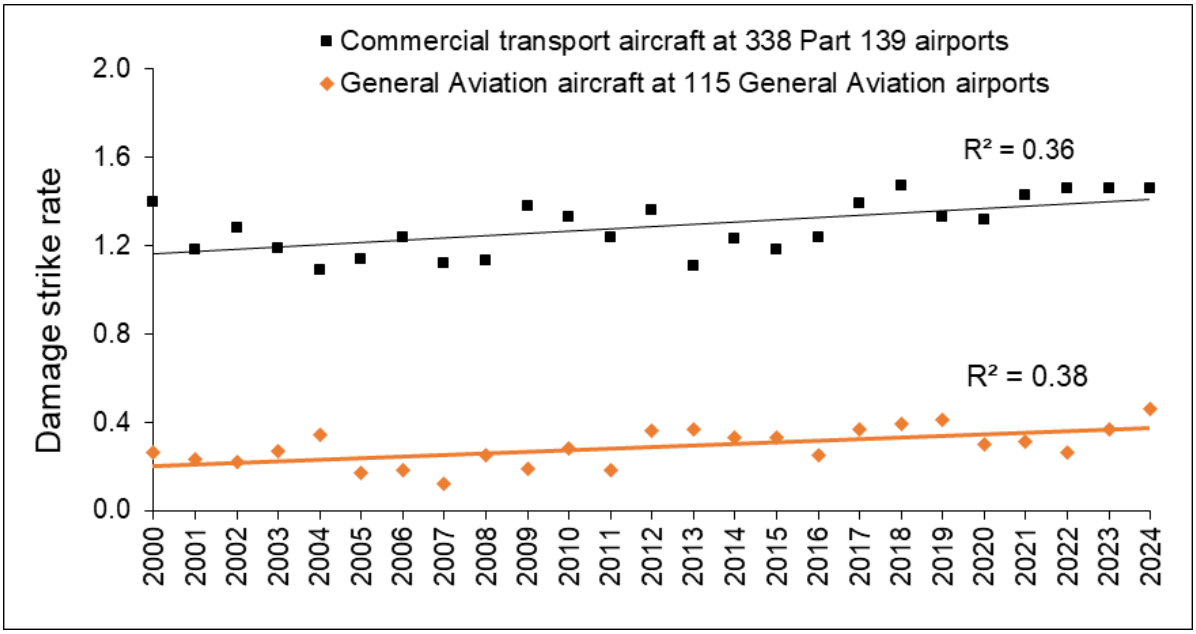
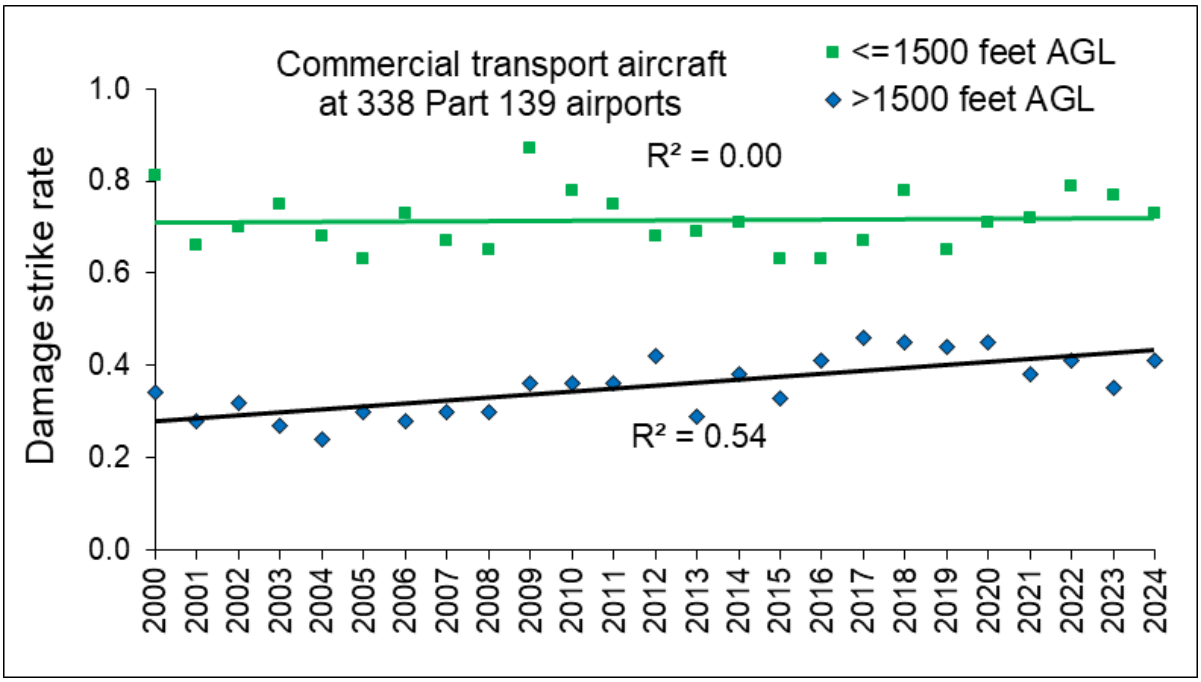


Figure 2. The strike rate and damage strike rate (number of reported strikes and damage strikes per 100,000 aircraft movements) for commercial (air carrier and air taxi service) transport aircraft at 338 Part 139-certificated airports and general aviation aircraft at 115 general aviation airports, USA, 2000 - 2024. Strikes involving U.S.-registered aircraft in foreign countries are excluded. R^2 values greater than 0.12 and 0.18 indicate significant trends at the 0.05 and 0.01 levels of probability, respectively (Steele and Torrie 1960; see Tables 3 and 4 for complete data).



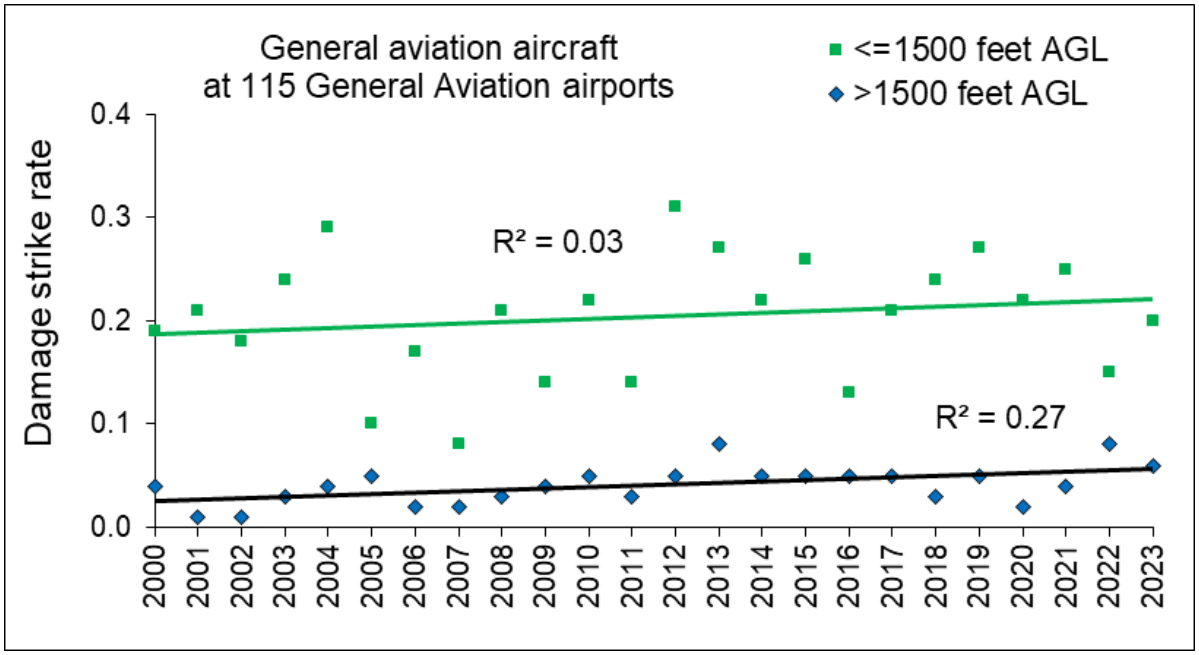


Figure 3. The damage strike rate (number of reported damaging strikes per 100,000 aircraft movements) with commercial transport aircraft at 338 Part 139-certificated airports (top graph) and general aviation aircraft at 115 general aviation airports (bottom graph) occurring at ≤ and >1,500 feet above ground level (AGL) for all wildlife species, USA, 2000 - 2024. Strikes with unknown height AGL and strikes involving U.S.-registered aircraft in foreign countries are excluded. R^2 values greater than 0.12 and 0.18 indicate significant trends at the 0.05 and 0.01 levels of probability, respectively (Steele and Torrie 1960).

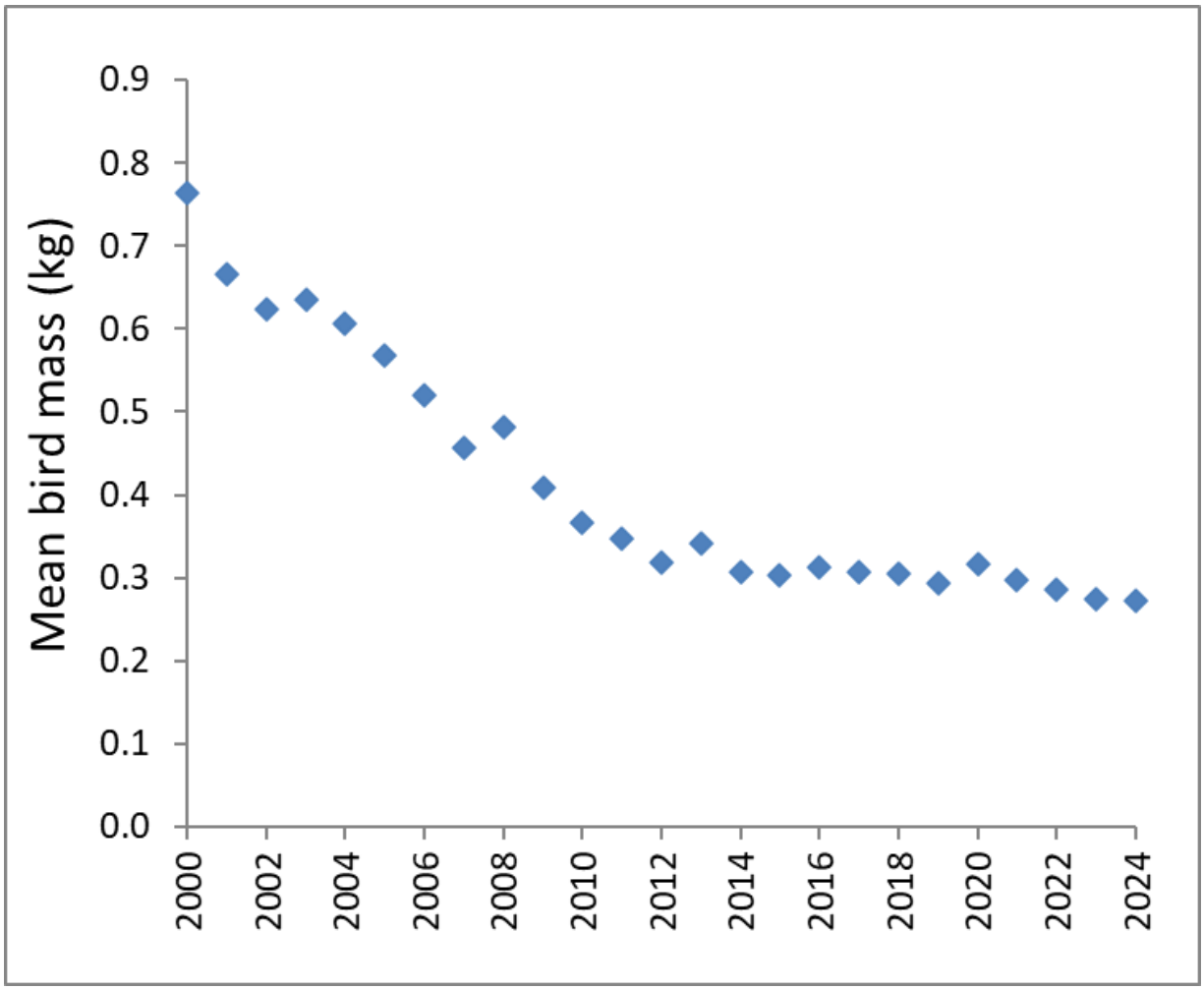


Figure 4. The mean body mass of birds reported as struck by civil aircraft in USA has declined by 64 percent from 2000 to 2024. This trend indicates that airports, pilots, and commercial transport aviation in general, are doing a better job of documenting all wildlife that are struck, many of which are small species that rarely cause damage. Means were calculated from all strikes in USA in which the bird was identified to species. See Figure 13 for number of identified bird species struck each year and Table 18 and Appendix C for numbers struck and mean biomass by species.

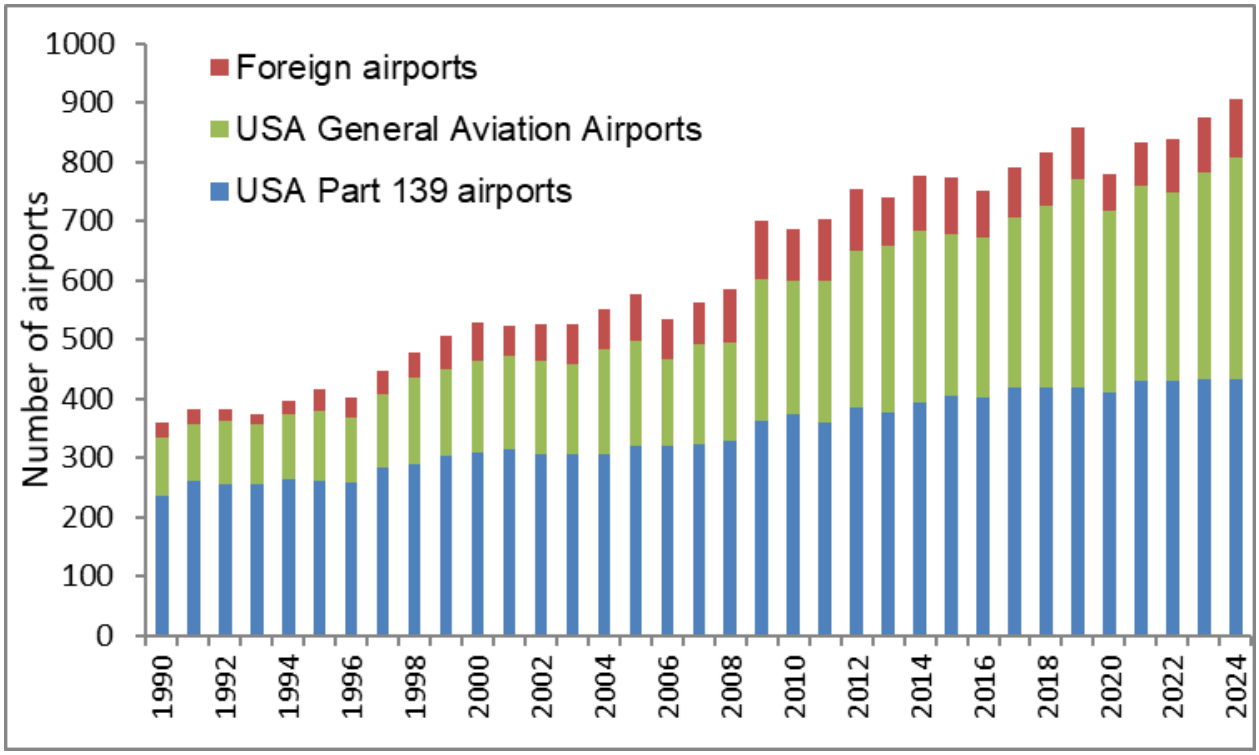


Figure 5. Number of Part 139-certificated airports and general aviation (GA) airports in USA with reported wildlife strikes and number of foreign airports at which strikes were reported for U.S.-registered civil aircraft, 1990-2024. Strikes were reported from 2,360 USA airports (516 Part 139-certificated, 1,844 GA) and 343 foreign airports in 113 countries, 1990-2024 (Table 8).

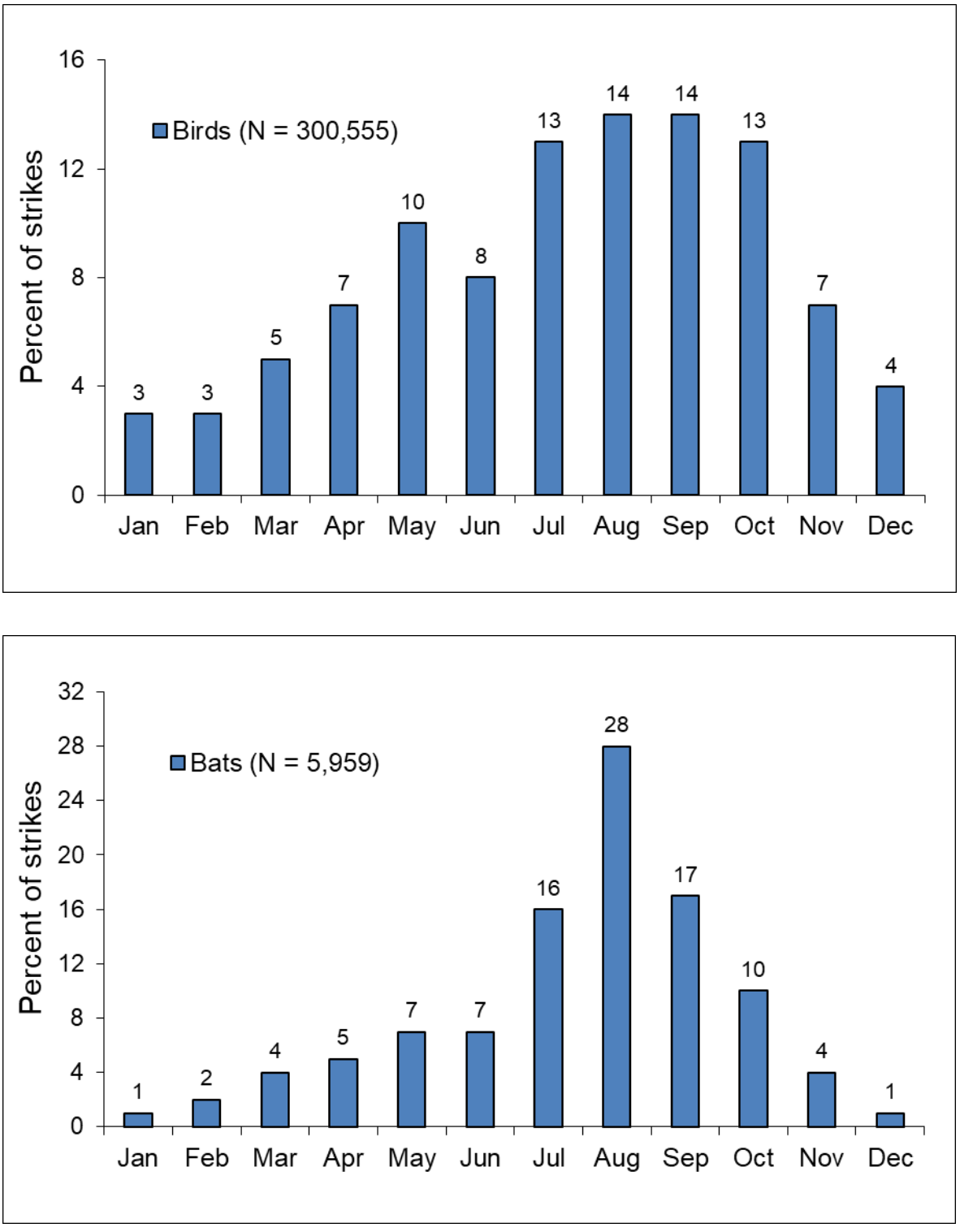
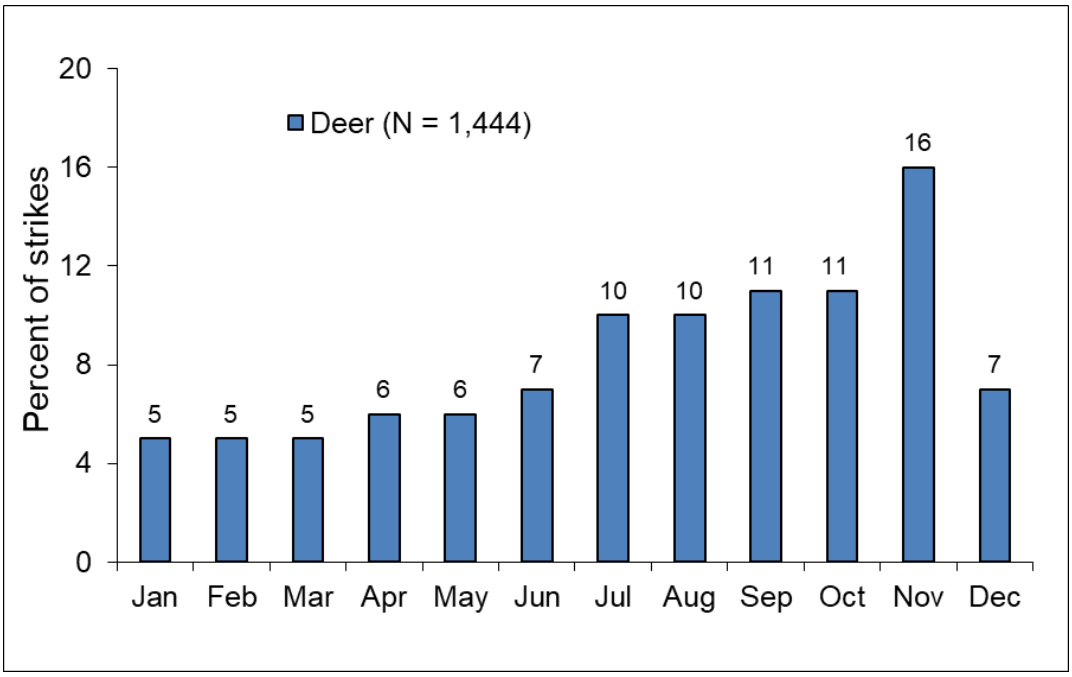


Figure 6. Percentage of reported bird (top graph) and bat (bottom graph) strikes with civil aircraft by month, USA, 1990-2024. In addition, 825 strikes with reptiles were reported of which 57 percent occurred in May-July. Strikes reported for U.S.-registered aircraft in foreign countries were excluded.



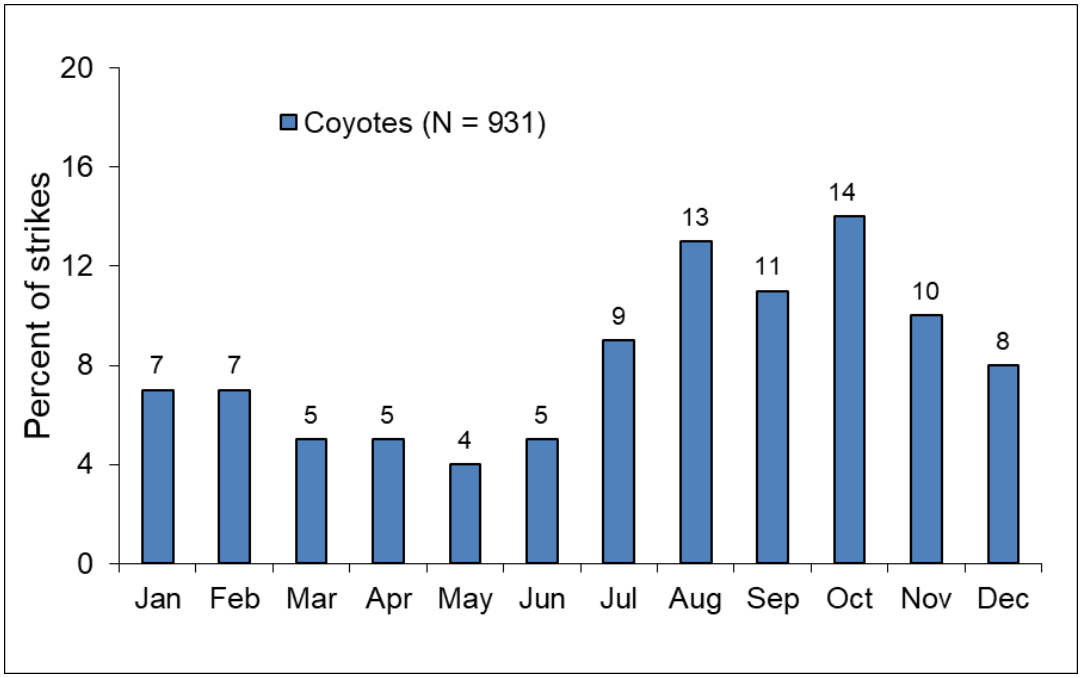


Figure 7. Percentage of reported deer (top graph) and coyote (bottom graph) strikes with civil aircraft by month, USA, 1990-2024. One deer and 1 coyote strike reported for U.S.-registered aircraft in foreign countries were excluded. Deer (1,332 white-tailed, 92 mule, 1 axis, 17 unidentified to species) and coyotes are the most frequently struck terrestrial mammals (Table 18). Biondi et al. (2011) provide a more detailed analysis of deer strikes with civil aircraft in the USA; Ball et al. (2021) summarize data on mammal strikes worldwide.

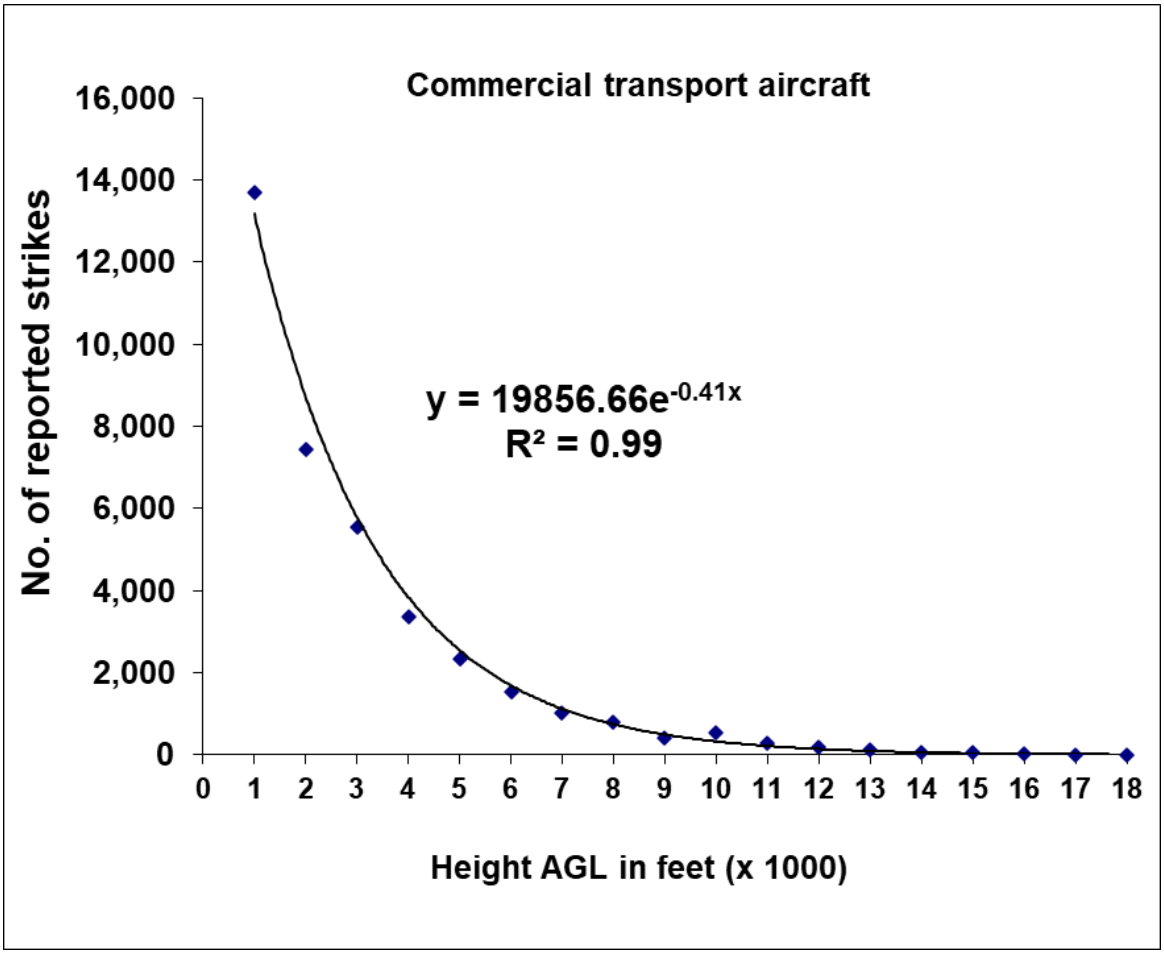
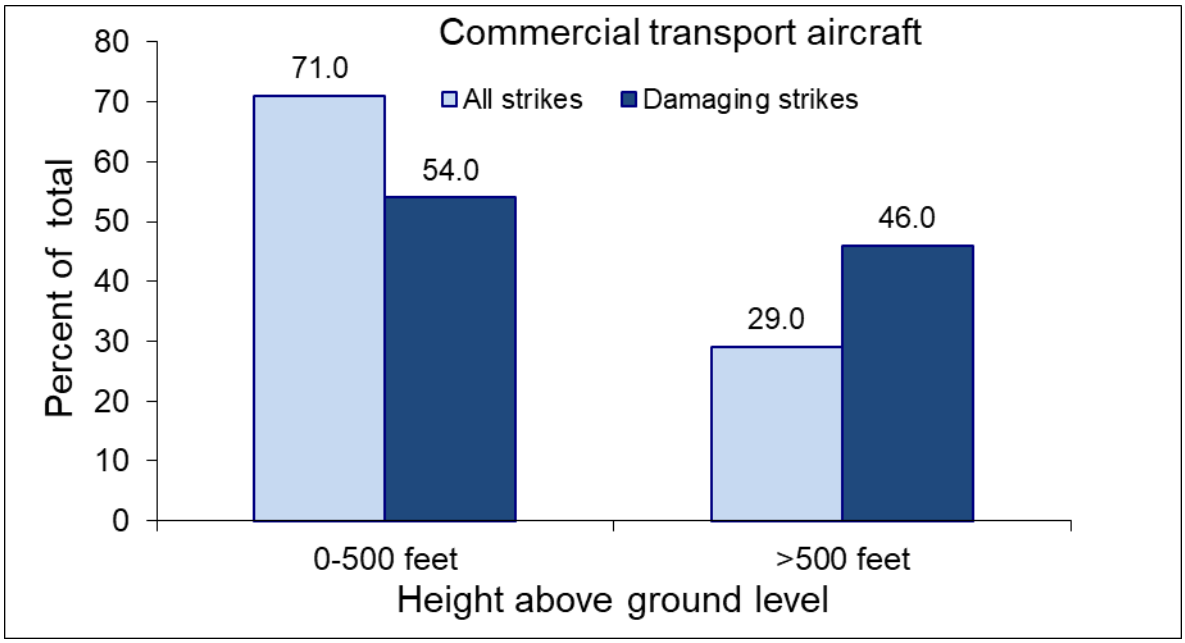


Figure 8. Number of reported bird strikes with commercial transport aircraft in USA by 1,000-foot height intervals above ground level from 501—1,500 feet (interval 1) to 17,501—18,500 feet (interval 18), 1990-2024. This graph excludes strikes at ≤500 feet and strikes with rotorcraft. Above 500 feet, the number of reported strikes declined consistently by 34 percent for each 1,000-foot gain in height. The exponential equation explained 99 percent of the variation in number of strikes by 1,000-foot intervals from 501 to 18,500 feet. See Table 11 for sample sizes.



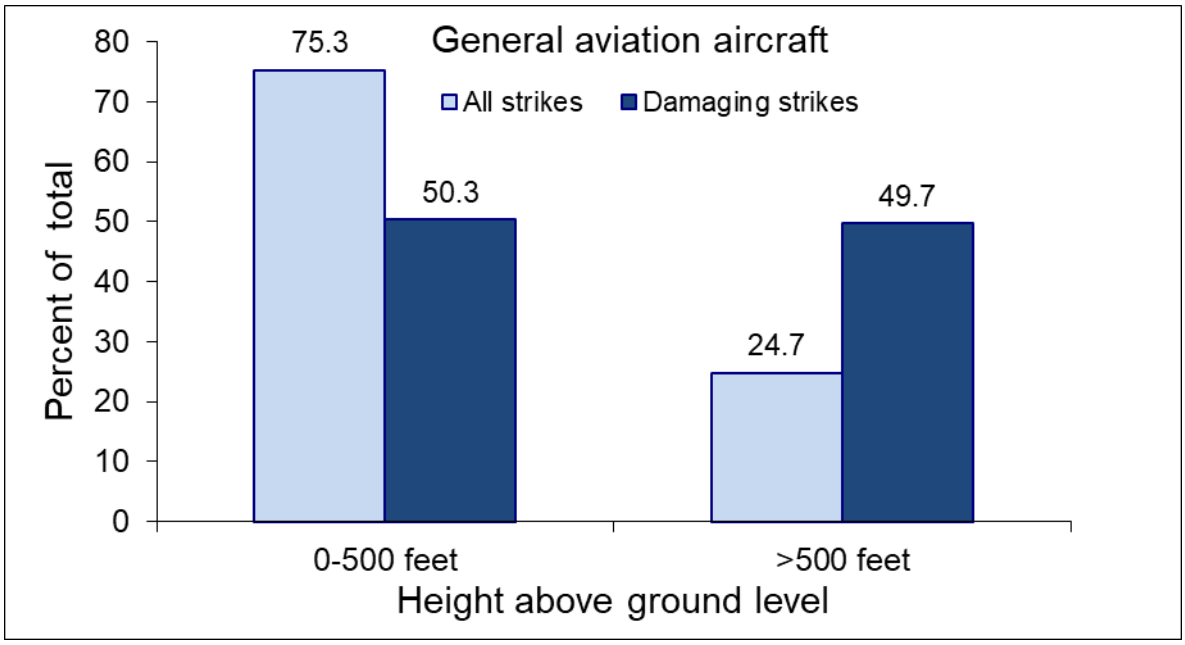
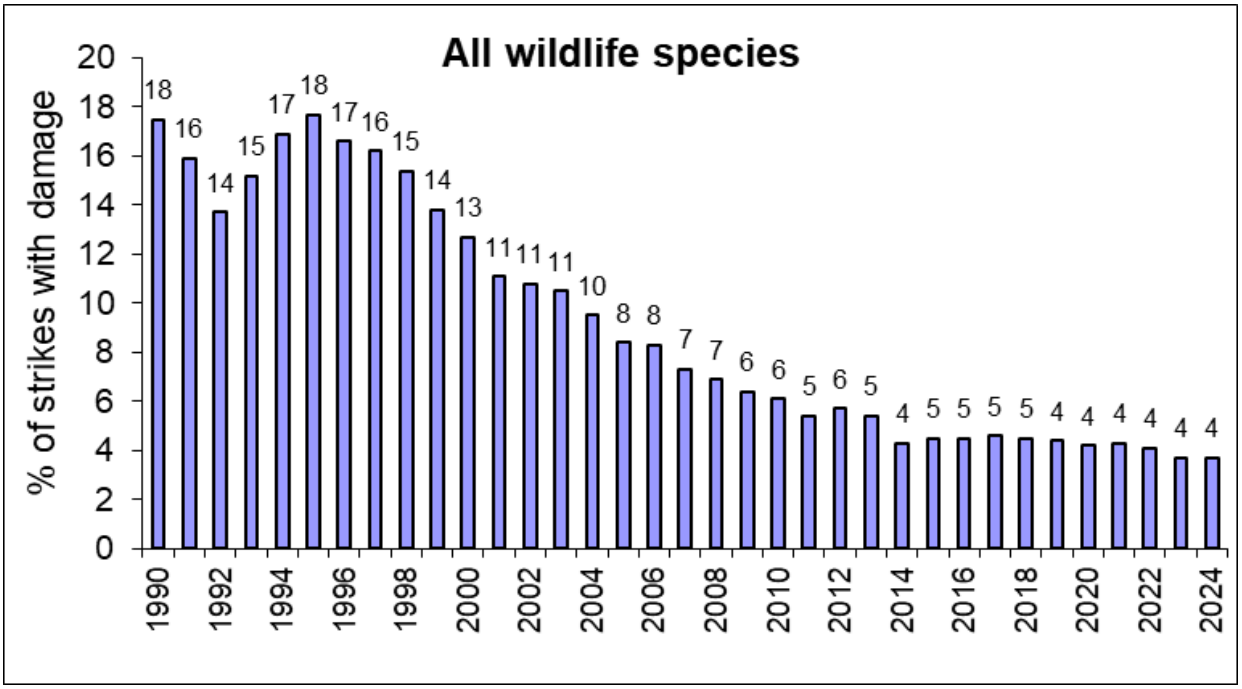


Figure 9. Percentages of total strikes and total damaging strikes occurring at 500 feet or less and above 500 feet for commercial transport (top graph) and general aviation (bottom graph) aircraft in USA, 1990-2024. See Tables 11 and 12 for sample sizes.



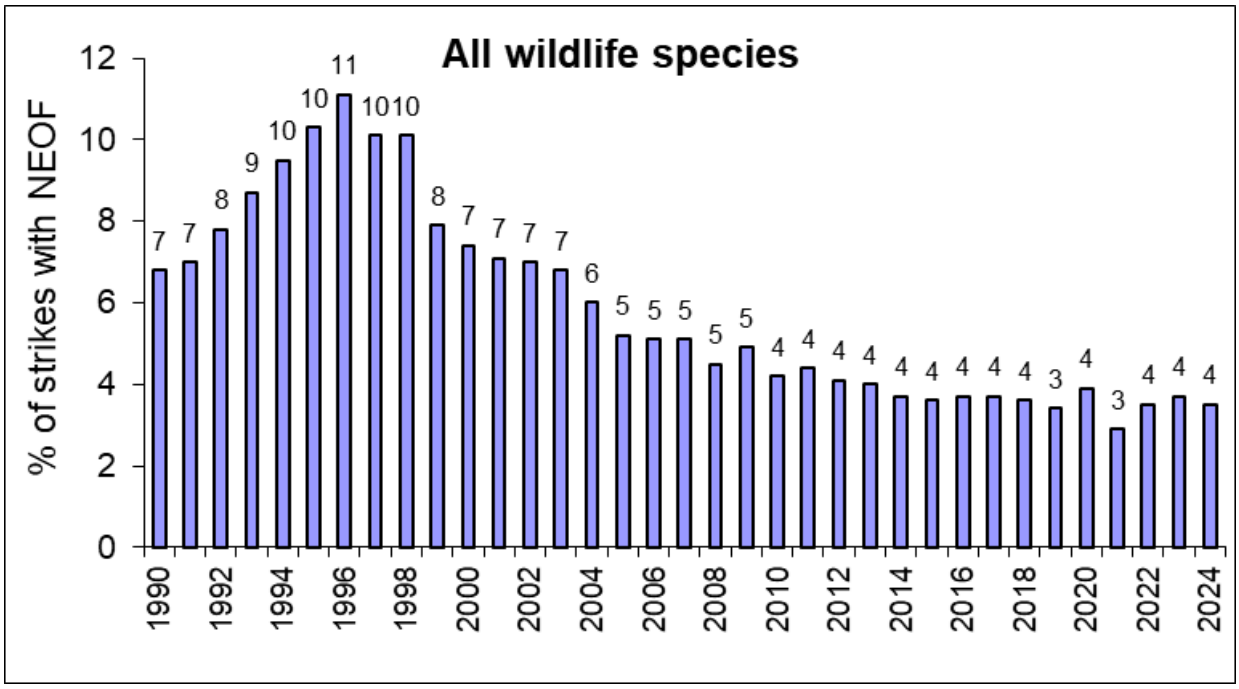


Figure 10. Percentage of reported strikes that indicated damage to the civil aircraft (top graph) or a negative effect-on-flight (NEOF, bottom graph), USA, 1990-2024. See Tables 1, 14, and 15 for sample sizes and classifications of damage and negative effects-on-flight.

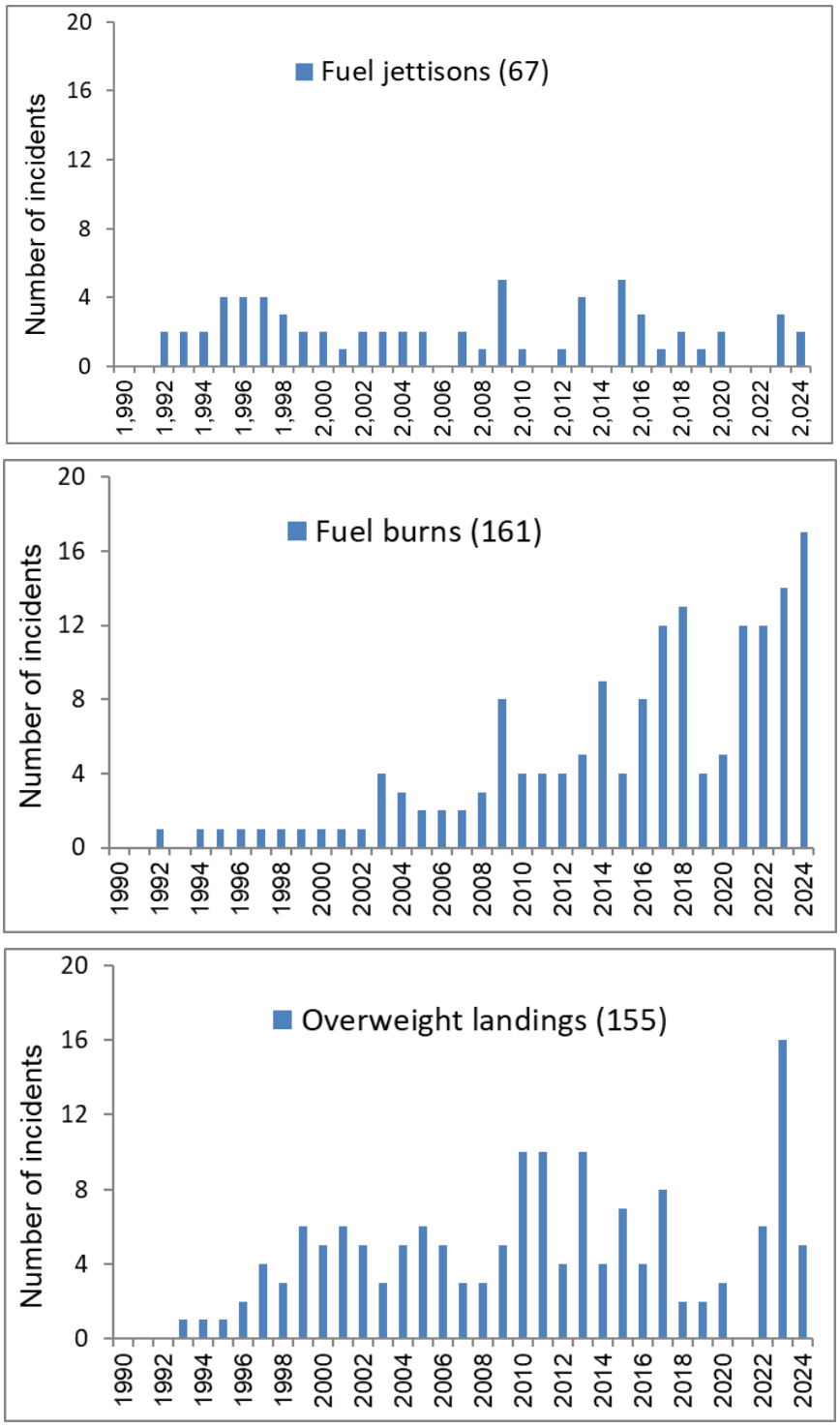


Figure 11. Number of reported incidents where pilot made an emergency or precautionary landing after striking wildlife during departure in which fuel was jettisoned or burned (circling pattern) to lighten aircraft weight or in which an overweight (greater than maximum landing weight) landing was made (no fuel jettison or burn), USA civil aircraft, 1990-2024. See Table 16 for details on aircraft involved and amount of fuel jettisoned.

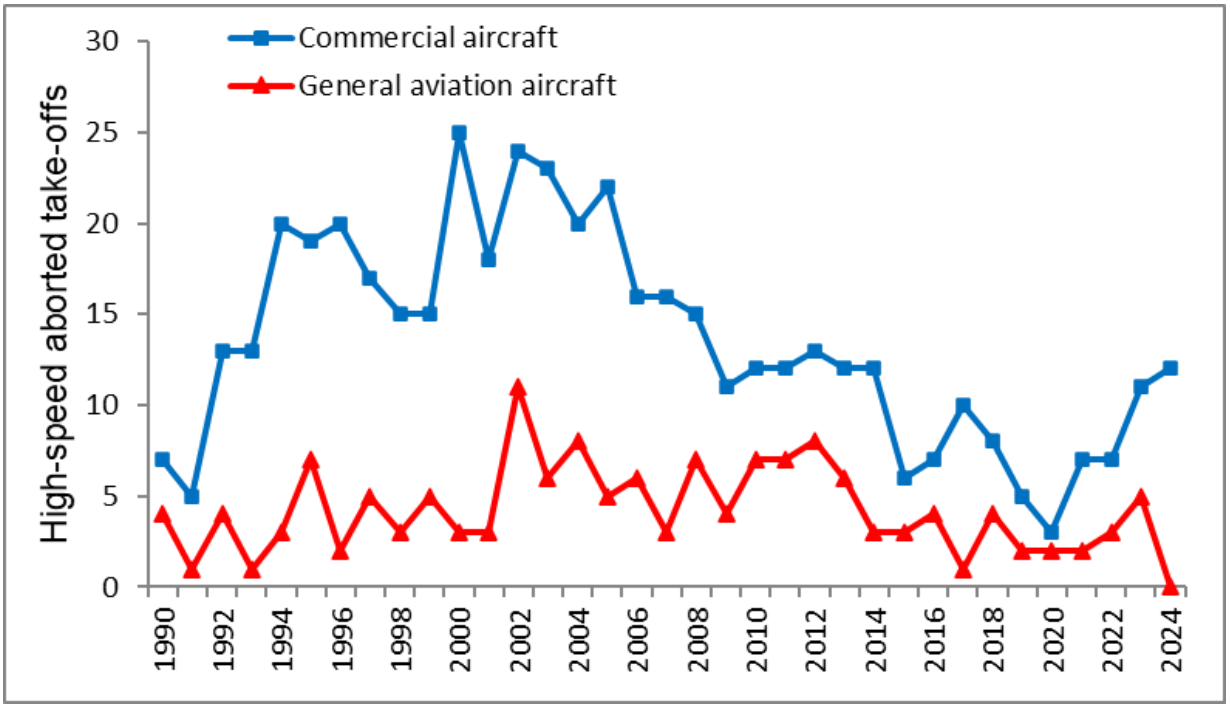


Figure 12. Number of reported incidents in which pilot made a high-speed aborted take-off (≥100 knots) after striking or observing wildlife during take-off run, USA civil aircraft, 1990-2024. See Table 17 for classification of aborted take-offs by indicated airspeed.

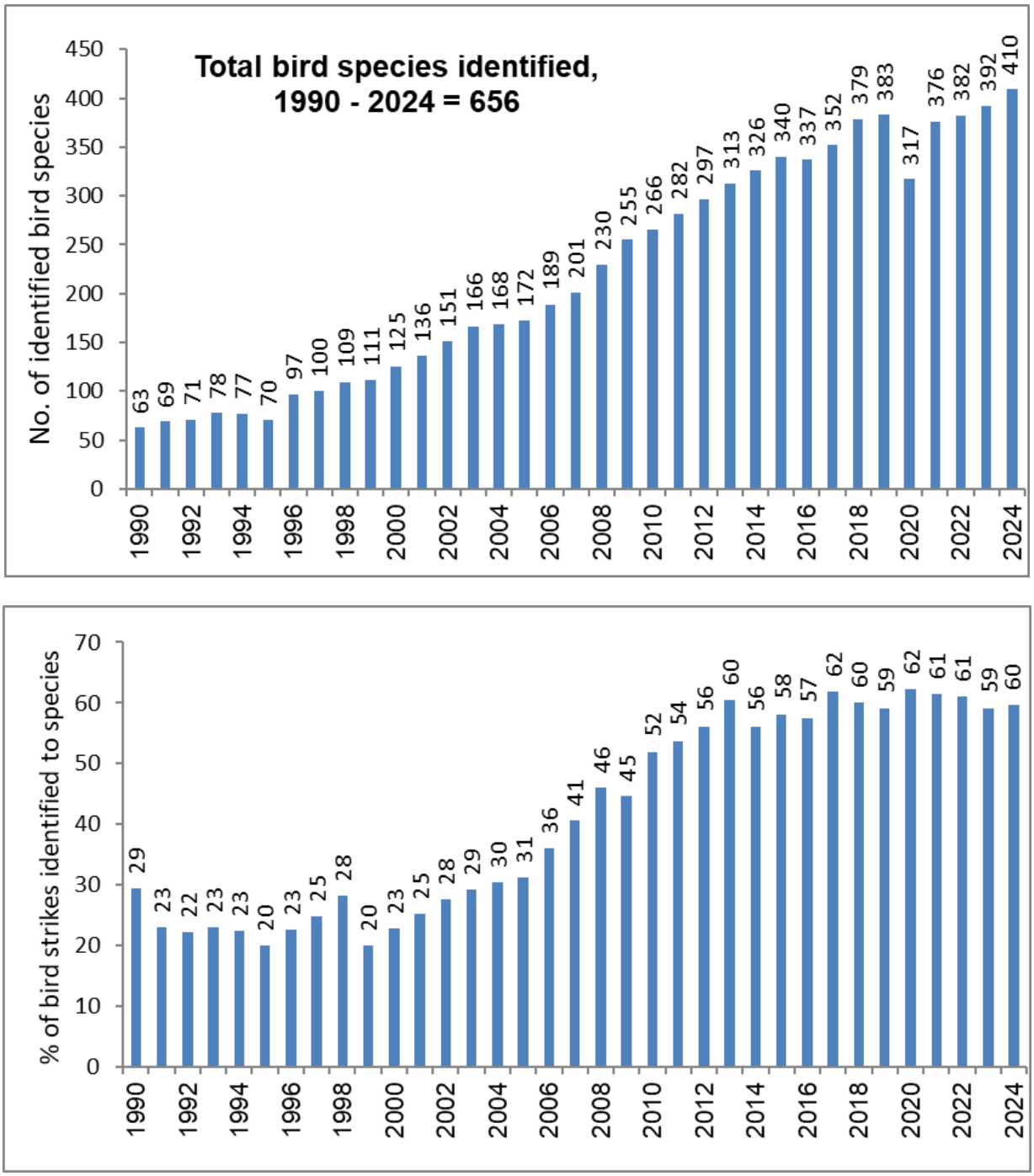


Figure 13. A record 410 bird species were identified as struck by civil aircraft in 2024 (top graph); the bird was identified to species in 60 percent of the strikes (bottom graph). From 1990 through 2024, 656 species of birds, 57 species of terrestrial mammals, 52 species of bats, and 45 species of reptiles (810 species total) have been identified. See Tables 1 and 18 and Appendix C for sample sizes and list of species.

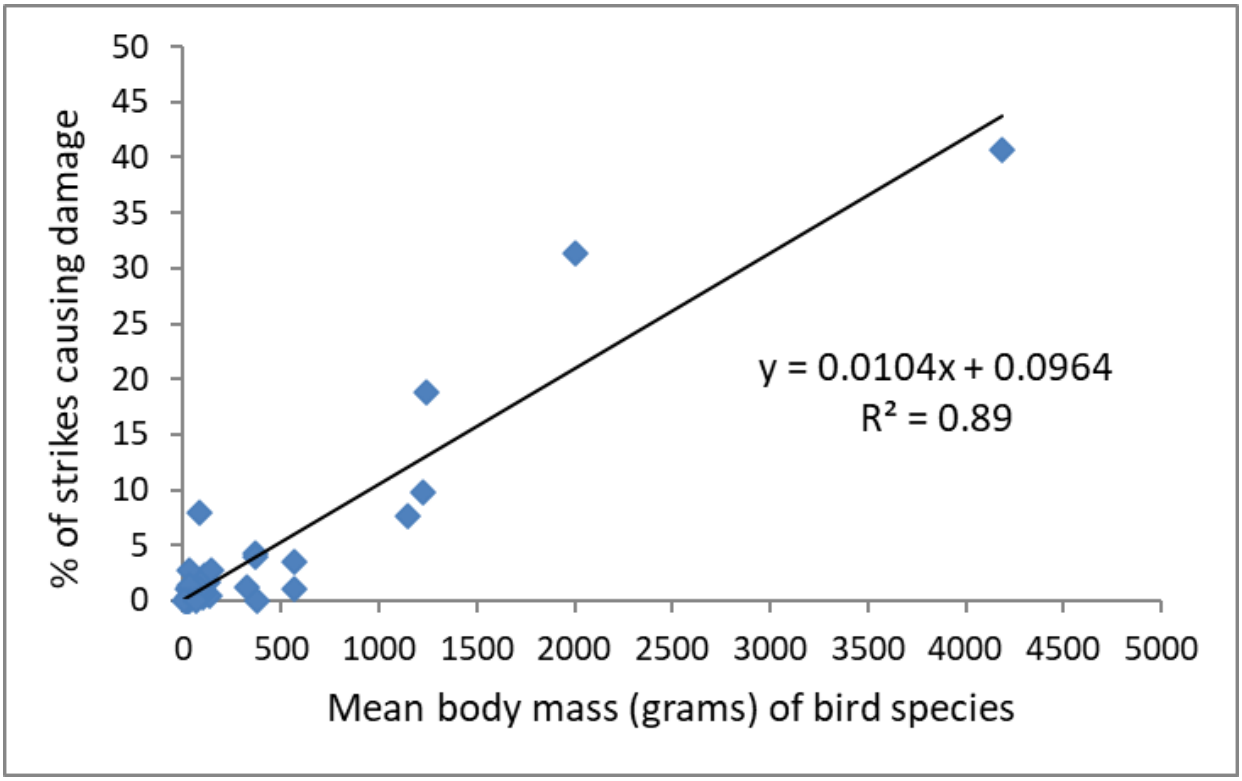


Figure 14. Relation between mean body mass (Dunning 2008) and likelihood of a strike causing damage to aircraft for the 33 species of birds most frequently identified as struck by civil aircraft in USA, 2024 (Table 20). The linear regression equation explained 89 percent of the variation in the likelihood of damage among the 33 species. For every 100-gram increase in body mass, there was a 1.04 percent increase in the likelihood of damage.

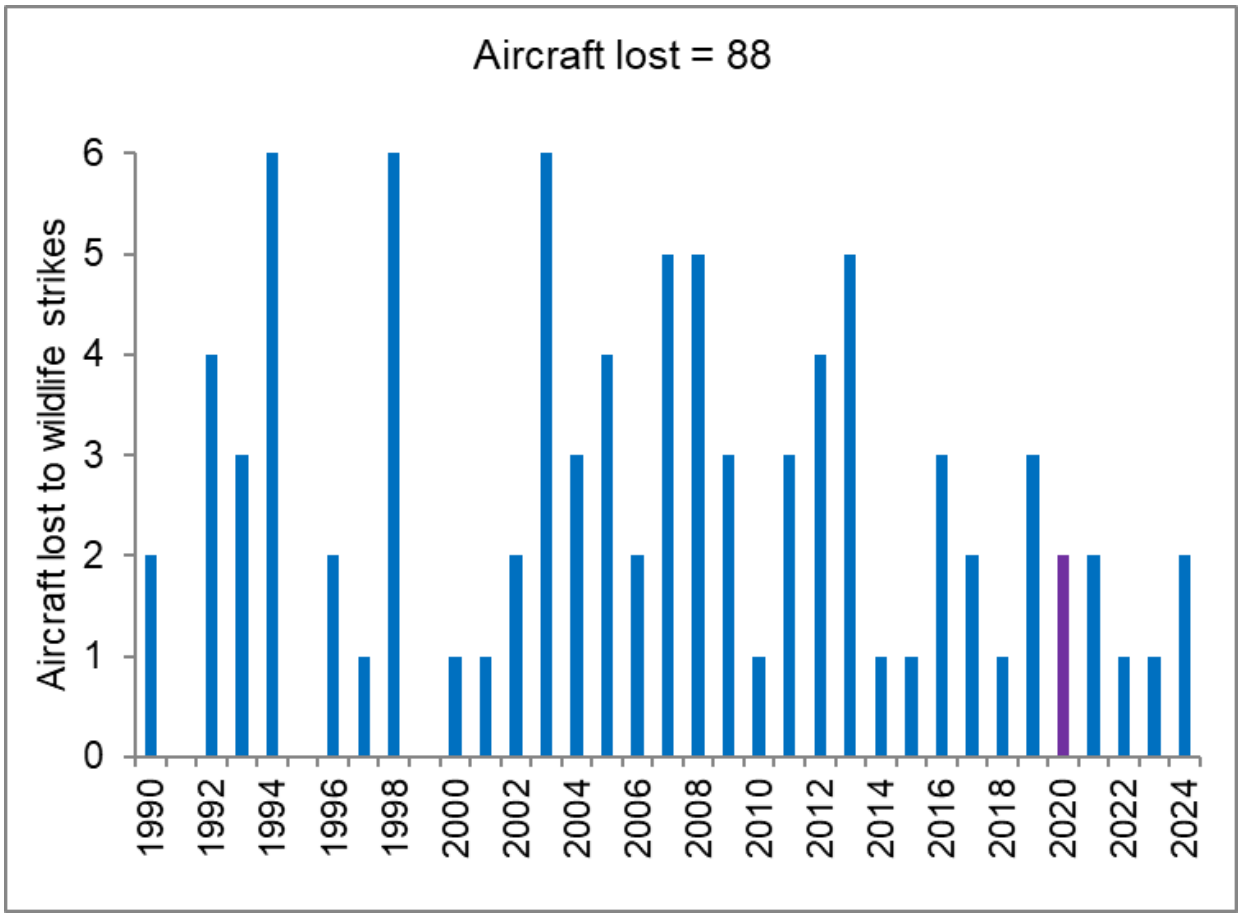


Figure 15. Number of civil aircraft destroyed or damaged beyond repair after striking wildlife, USA, 1990-2024. From 1990-2024, 88 aircraft have been lost (59 with maximum take-off mass ≤2,250 kg; 17, 2,251-5,700 kg; 10, 5,701-27,000 kg; 2, >27,000 kg). See Table 22 for wildlife species groups and types of aircraft and airports associated with these events. The graph includes 1 unmanned aerial vehicle (drone) destroyed in 2020 after being attacked by a bald eagle during a shoreline erosion survey on Lake Michigan.

APPENDIX A.

Selected Significant Wildlife Strikes to U.S. Civil Aircraft, 2024

The U.S. Department of Agriculture, through an interagency agreement with the Federal Aviation Administration, compiles a database of all reported wildlife strikes to U.S. civil aircraft and to foreign carriers experiencing strikes in the USA. From 1990 through 2024, 319,047 strike reports from 2,360 USA airports, 343 foreign airports in 113 countries, and en route events have been entered in the database (18,029 strikes from 809 USA airports and 257 strikes from 96 foreign airports in 56 countries in 2024), Tables 1, 8; Figure 5). The following 13 examples from the database in 2024 are presented to show the serious impact that strikes by birds or other wildlife can have on aircraft. These examples demonstrate the widespread and diverse nature of the problem. The examples are not intended to highlight or criticize individual airports because, as documented above, strikes have occurred on almost every airport in the USA. Some of the strike examples reported here occurred off airport property during approach, departure or en route. For more information on wildlife strikes or to report a strike, visit *www.birdstrike.org* and *https://wildlife.faa.gov*

Date	Aircraft	Airport/location	Phase of flight	Effect on flight	Damage	Wildlife species	Comments from report
01/11/2024	Learjet-36	Brooksville-Tampa Bay Regional Airport (FL)	Climb (375 feet AGL)	Precautionary landing, evasive maneuver, fuel jettison	Wing	Sandhill crane	Pilot noticed flock of cranes and attempted evasive maneuver. Advised Tower of bird strike and requested vectors to dump fuel, return to departure airport. Climbed to 30,000 feet over coast and dumped fuel to attain below maximum landing gross weight. Post-flight inspection revealed dent in leading edge of right wing. Three sandhill crane carcasses retrieved from runway.
01/20/2024	Bell-206	1.5 miles east of Hydro, Oklahoma (OK)	Enroute (550 feet AGL)	Impacted terrain	Windshield, tail, control servo	Cackling goose	Medical transport. NTSB Accident Number: CEN24FA094. Remarks based on preliminary NTSB report and Smithsonian Feather ID Lab report: One goose was imbedded into a control servo. At least 4 carcasses located in debris field. Photos of remains from debris field confirm Cackling goose. Three fatalities.

Appendix A. (page 2 of 5)

Date	Aircraft	Airport/location	Phase of flight	Effect on flight	Damage	Wildlife species	Comments from report
02/07/2024	B-737-800	La Aurora International Airport (Guatemala)	Approach (1,500 feet AGL)	None	Windshield	Turkey vulture	The captain's forward windscreen was shattered, but it retained its integrity.
03/03/2024	EC135	Near Dickson, TN	Enroute (1,900 feet AGL)	Precautionary landing	Windshield, rotor, and interior floor	Ring-necked duck	Medical transport helicopter substantially damaged while enroute over TN at 1,900 feet AGL and 120 knots. Two or more birds struck and damaged windshield, rotor and interior floor. ID by Smithsonian Feather ID Lab. Aircraft out of service for 200 hours; $125,000 in repairs costs. No injuries reported.
04/01/2024	CRJ900	Dallas/Fort Worth International Airport (TX)	Climb (14,000 feet AGL)	Precautionary landing	Nose	Northern shoveler	During climb out of KDFW, CRJ1900 struck bird on nose panel, which became dislodged and damaged frame around panel and fuselage. Pilot reports neither he nor copilot saw bird prior to strike. ID by Smithsonian Feather ID Lab.
05/01/2024	Bell 206	3 miles KGCN (AZ)	Enroute (150 feet AGL)	Precautionary landing	Windshield	Turkey vulture	Helicopter was starting tour flight. At 3 miles W of Grand Canyon National Airport (KGCN), enroute at 150 feet AGL at 100 knots, a bird penetrated windshield. Aircraft made a precautionary landing. Pilot suspects that rotors were also struck since only half of the bird was removed from the interior of the aircraft. ID by Smithsonian Feather ID Lab.

Appendix A. (page 3 of 6)

Date	Aircraft	Airport/location	Phase of flight	Effect on flight	Damage	Wildlife species	Comments from report
06/13/2024	Ayres Thrush	White, SD	Enroute (30 feet AGL)	Evasive maneuver, impacted terrain	Engine #1	Mallard	Aerial applicator was finishing his last pass at 30 feet AGL when a flock of ducks flew in front of him. He attempted to climb above the ducks, but aircraft struck some. A few seconds later, he felt the engine stop producing thrust and noted the N1, torque, and EGT gauges rolling back. By this time, he was at 80 ft AGL and running out of airspeed. Pilot pitched aircraft down to gain airspeed and put aircraft in a 3-point landing configuration without using flaps. The main landing gear sank into wet ground, and aircraft flipped on its back. Once aircraft stopped moving, pilot exited. Smithsonian Feather ID Lab identification: Mallard. NTSB CEN24LA229. Reported repair cost = $700,000; other costs = $200,000; pilot reported a minor injury.
07/06/2024	PA-28	St. Pete-Clearwater International Airport (FL)	Approach (1,000 feet AGL)	Evasive maneuver	Fuselage and electrical panel	Unknown bird	NTSB Accident Number: ERA24LA295 Student pilot reported that after completing multiple touch-and-go landings, they were on the downwind leg in the traffic pattern. While flying at 90 kts and at 1,000 ft AGL, he spotted a bird directly in front. The flight instructor took control of airplane and tried to avoid the bird. The bird entered a dive before it struck the top of windshield, resulting in substantial damage to the fuselage. Flight instructor declared an emergency and landed without further issue.

Appendix A. (page 4 of 5)

Date	Aircraft	Airport/location	Phase of flight	Effect on flight	Damage	Wildlife species	Comments from report
08/13/2024	Bell 407	Laughlin/Bullhead International Airport (AZ)	Approach (800 feet AGL)	Evasive maneuver	Windshield	Turkey vulture	A vulture struck windshield, fuselage and pitot tube of a medical transport helicopter at approximately 70 knots. The pilot attempted an evasive maneuver to avoid the bird, as the vulture made a climbing turn towards the aircraft. One bird was struck with only feathers found in the aircraft cabin. ID by Smithsonian Feather ID Lab.
09/02/2024	B-737-700	Chicago Midway International Airport (IL)	Climb (6,000 feet AGL)	Precautionary landing	Wing	American white pelican	The plane made a precautionary landing back at KMDW to access the strike. Maintenance replaced some slats on the right wing. ID by Smithsonian Feather ID Lab.
10/10/2024	Eurocopter BK117	4NM South of KPYM (MA)	Enroute (1,500 feet AGL)	Precautionary landing	Windshield	Ring-necked duck	Medical transport. Pilot observed 3-4 birds through Night Vision Goggles just before impact. Right lower chin bubble struck and shattered; bird landed at pilot's feet. Aircraft was stable, no other malfunctions evident. Aircraft was using a Pulse-light system. ID by Smithsonian Feather ID Lab.
11/14/2024	Eurocopter BK117	Denver, CO, 8.5 miles KAPA	Enroute (1,500 feet AGL)	None	Windshield	Western/Clark's grebe complex	Medical transport. Bird went through the left front wind screen and upper left passenger door. No injuries. ID by Smithsonian Feather ID Lab.

Appendix A. (page 5 of 5)

Date	Aircraft	Airport/location	Phase of flight	Effect on flight	Damage	Wildlife species	Comments from report
12/12/24	A-321	La Guardia Airport (NY)	Climb (400 feet AGL)	Precautionary landing	Engine #2	Canada goose	At 20:04 hours (night), an Airbus 321 with 200 people on board sustained a bird strike and #2 engine damage during initial climb at 150 knots. The flight crew pulled back throttle of engine to idle and diverted to JFK International Airport. First Officer observed at least 2 birds at time of impact. Aircraft was taken out of service; passengers were given hotel accommodations and re-departures the next morning. Wildlife remains from engine identified by Smithsonian Feather ID Lab as Canada goose. In addition, an injured goose was discovered the following morning at departure end of runway 31 at LGA.

APPENDIX B.

Reporting a Strike and Identifying Species of Wildlife Struck

Pilots, airport operations, aircraft maintenance personnel, and anyone else having knowledge of a strike should report the incident to the FAA Wildlife Strike Database (http://wildlife.faa.gov) using the electronic FAA Form 5200-7. Form 5200- 7 should be printed for each report that has remains submitted to the Smithsonian for identification.

It is important to include as much information as possible on FAA Form 5200-7. All reports are carefully screened to identify duplicate reports prior to entry in the database. Multiple reports of the same incident are combined and often provide a more complete record of the strike event than would be possible if just one report was filed.

The National Museum of Natural History, Smithsonian Institution, has the 3rd largest bird collection in the world with over 640,000 specimens. The collection has representatives of about 85% of the more than 10,000 known species in the world's avifauna.

The identification of the exact species struck (e.g., ring-billed gull, Canada goose, mallard, mourning dove, red-tailed hawk, red fox as opposed to gull, goose, duck, dove, hawk, or fox), is particularly important. This species information is critical for biologists developing wildlife risk management programs at airports and for engineers working on airworthiness standards because a problem that cannot be measured or defined cannot be solved. Bird strike remains that cannot be identified by airport personnel can often be identified by a local biologist trained in ornithology or by sending feathers, photographs and other remains to the Smithsonian Institution Feather Identification Lab:

Material sent via Courier Service (e.g., UPS, FedEx, DHL):	**Material sent via U.S. Postal Service:**
Feather Identification Lab Smithsonian Institution NMNH E600, MRC 116 10th & Constitution Ave. NW Washington, D.C. 20560-0116 (label package “safety investigation material”) Phone # 202-633-0801	Feather Identification Lab Smithsonian Institution, NMNH E600, MRC 116 P.O. Box 37012 Washington, D.C. 20013-7012

Whenever possible, send whole feathers as the diagnostic microscopic characteristics are often found in the downy barbules at the feather base. Wing feathers, as well as breast

and tail feathers, should be sent whenever possible (e.g., Dove et al. 2025*a*). Beaks and feet are also useful diagnostic materials. Even blood smears can provide material for DNA analysis (Dove et al. 2008). Do not send entire bird carcasses through the mail! However, photographs of the intact carcass or carcass remains (e.g., wing, head), which can be uploaded to the on-line 5200-7 when filing a strike report, can be useful supplemental documentation. Photographs should include a reference marker (e.g., ruler, coin) to gauge size of the carcass or body part.

Guidelines for Collecting Bird Strike Material

- Always include any feather material available.
- Include the printed report (FAA 5200-7) with the QR code in the upper right corner. This is necessary for tracking samples through the lab.
- Always secure remains in re-sealable plastic bag, put bird remains (samples) from different impact points in separate bags.

Feathers:

- Whole Bird - Pluck a variety of feathers (breast, back, wing, tail)
- Partial Bird - Collect a variety of feathers with color or pattern
- Feathers only - Send all material available. Do not cut feathers from the bird (downy part at the base of the feathers is needed). Do not use any sticky substance (no tape or glue).

Tissue/blood ("Snarge"):

- Dry material - Scrape or wipe off into a clean re-closeable bag or wipe area with pre-packaged alcohol wipe or spray with alcohol to loosen material then wipe with clean cloth/gauze. (Do not use water, bleach, or other cleansers; they destroy DNA.)
- Fresh material - Wipe area with alcohol wipe and/or clean cloth/gauze or apply fresh tissue/blood to an FTA® DNA collecting card.

Additional information on sending bird remains to the Smithsonian is available at https://www.faa.gov/airports/airport_safety/wildlife/smithsonian/.

Cases Processed by Feather Lab in FY 2024

The number of bird strike cases involving civil aircraft processed by the Smithsonian Feather Identification Lab in FY 2024 was 6,742 with 7,290 separate identifications (some cases involved remains from multiple impact points). This compares to 5,525 cases with 6,029 separate identifications in FY 2023, and 4,579 cases with 5,003 separate identifications in FY 2022 (Dove et al. 2025*b*). In addition, the Lab processed 3,091 cases involving 4,042 identifications for the U.S. Air Force and 1,157 cases involving 1,308 identifications for the U.S. Navy in FY 2024. DNA methods (Dove et al. 2008, Luttrell et al. 2020) were used exclusively in 48% of the identifications, whereas morphological methods (microscopy and whole feather comparisons) were the sole source for 25% of the identifications. Morphology and DNA methods were used in various combinations in 22% of identifications. Photographs alone were used for 5% of the identifications, and as supplementary evidence in many other cases.

Scientists at the Smithsonian Feather Lab use a combination of forensic methods, including mitochondrial DNA analysis, to determine the species of birds, bats, and other wildlife involved in strikes with civil and military aircraft. Photo, J. Tiller, Smithsonian.

Appendix C.

Scientific Names and Body Masses for Identified Wildlife Species Struck by Civil Aircraft in USA or by USA-registered Aircraft in Foreign Countries, 1990-2024.[1]

#	Common name	Scientific name	Body mass (grams)	
			Mean	Max
	Flying mammals (bats)			
1	African yellow bat	Scotophilus dinganii	25	25
2	Angolan free-tailed bat	Mops condylurus	23	
3	Antillean fruit-eating bat	Brachyphylla cavernarum	45	
4	Big brown bat	Eptesicus fuscus	14	
5	Big free-tailed bat	Nyctinomops macrotis	30	
6	Black mastiff bat	Molossus rufus	65	70
7	Brazilian free-tailed bat	Tadarida brasiliensis	15	
8	Broad-eared bat	Nyctinomops laticaudatus	11	14
9	Brown flower bat	Erophylla bombifrons	19	21
10	California myotis	Myotis californicus	4	5
11	Cape serotine	Laephotis capensis	7	10
12	Common pipistrelle	Pipestrellus pipistrellus	6	8
13	Cuban flower bat	Phyllonycteris poeyi	22	29
14	Eastern red bat	Lasiurus borealis	14	
15	Eastern small-footed myotis	Myotis leibii	7	
16	Egyptian free-tailed bat	Tadarida aegyptiaca	17	21
17	Evening bat	Nycticeius humeralis	14	
18	Florida bonneted bat	Eumops floridanus	40	55
19	Gray bat	Myotis grisescens	12	16
20	Gray sac-winged bat	Balantiopteryx plicata	7	
21	Grey-headed flying fox	Pteropus poliocephalus	700	1,000
22	Hoary bat	Lasiurus cinereus	35	
23	Indian flying fox	Pteropus giganteus	1,100	1,600
24	Indian pipistrelle	Pipistrellus coromandra	11	13
25	Indiana bat	Myotis sodalis	6	10
26	Jamaican fruit bat	Artibeus jamaicensis	50	60
27	Kelaart's pipistrelle	Pipistrellus ceylonicus	4	5
28	Kuhl's pipistrelle	Pipistrellus kuhlii	6	
29	Leschenault's rousette	Rousettus leschenaulti	100	100
30	Lesser bulldog bat	Noctilio albiventris	30	44
31	Little brown bat	Myotis lucifugus	8	
32	Little red flying fox	Pteropus scapulatus	400	
33	Long-eared myotis	Myotis evotis	8	
34	Long-legged myotis	Myotis volans	8	10
35	Mauritian tomb bat	Taphozous mauritianus	36	
36	Naked-rumped tomb bat	Taphozous nudiventris	34	
37	Northern yellow bat	Lasiurus intermedius	17	20
38	Pallas's mastiff bat	Molossus molossus	13	
39	Pocketed free-tailed bat	Nyctinomops femorosacca	14	
40	Seminole bat	Lasiurus seminolus	11	
41	Silver-haired bat	Lasionycteris noctivagans	9	
42	Sinaloan mastiff bat	Molossus sinaloae	24	28
43	Sooty mustached bat	Pteronotus quadridens	5	
44	Spotted bat	Euderma maculatum	18	20
45	Tri-colored bat	Perimyotis subflavus	5	

Appendix C. Continued (page 2 of 17)

#	Common name	Scientific name	Body mass (grams)	
			Mean	Max
46	Wagner's bonneted bat	Eumops glaucinus	40	47
47	Western mastiff bat	Eumops perotis	57	73
48	Western pipistrelle	Parastrellus hesperus	5	6
49	Western red bat	Lasiurus blossevillii	13	15
50	Western small-footed myotis	Myotis ciliolabrum	5	7
51	Western yellow bat	Lasiurus xanthinus	12	
52	Yuma myotis	Myotis yumanensis	6	7
	Terrestrial mammals			
1	American badger	Taxidea taxus	12,000	
2	American black bear	Ursus americanus	135,000	200,000
3	American mink	Mustela vison	1,000	1,300
4	American red squirrel	Tamiasciurus hudonsonicus	300	400
5	Antelope jackrabbit	Lepus alleni	4,000	5,900
6	Axis deer	Axis axis	90,000	110,000
7	Bearded seal	Erignathus barbatus	315,000	430,000
8	Black-tailed jackrabbit	Lepus californicus	2,268	
9	Black-tailed prairie dog	Cynomys ludovicianus	1,050	1,400
10	Brown bear	Ursus arctos	217,000	400,000
11	Brush rabbit	Sylvilagus bachmani	800	917
12	California ground squirrel	Otospermophilus beecheyi	500	750
13	Caribou	Rangifer arcticus	119,297	
14	Cattle	Bos taurus	753,430	
15	Collared peccary	Pecari tajacu	20,412	
16	Common gray fox	Urocyon cinereoargenteus	4,536	
17	Coyote	Canis latrans	15,876	
18	Coypu (nutria)	Myocaster coypus	6,000	17,000
19	Desert cottontail	Sylvilagus audubonii	1,247	
20	Domestic sheep	Ovis aries	100,000	160,000
21	Domestic/feral cat	Felis catus	4,309	
22	Domestic/feral dog	Canis familiaris	34,927	
23	Eastern cottontail	Sylvilagus floridanus	1,361	
24	Eastern gray squirrel	Sciurus carolinensis	500	600
25	Fox squirrel	Sciurus niger	800	1,000
26	Gunnison's prairie dog	Cynomys gunnisoni	816	1,350
27	Horse	Equus caballus	1,147,608	
28	Kit fox	Vulpes macrotis	2,000	2,700
29	Least weasel	Mustela nivalis	100	250
30	Long-tailed weasel	Mustela frenata	260	300
31	Marsh rabbit	Sylvilagus palustris	1,600	2,000
32	Moose	Alces alces	389,189	
33	Mountain cottontail	Sylvilagus nuttallii	900	1,000
34	Mule deer	Odocoileus hemionus	92,000	
35	Muskrat	Ondatr zibethicus	1,361	
36	Nine-banded armadillo	Dasypus novemcinctus	5,670	
37	North American beaver	Castor canadensis	20,000	
38	North American porcupine	Erethizon dorsatum	8,618	
39	Piute ground squirrel	Urocitellus mollis	500	
40	Pronghorn	Antilocapra americana	46,721	
41	Raccoon	Procyon lotor	10,660	

Appendix C. Continued (page 3 of 17)

#	Common name	Scientific name	Body mass (grams)	
			Mean	Max
42	Red fox	Vulpes fulva	5,670	
43	Richardson's ground squirrel	Urocitellus richardsonii	500	750
44	River otter	Lutra canadensis	7,938	
45	Small Indian mongoose	Herpestes javanicus	650	
46	Snowshoe hare	Lepus americanus	1,300	1,800
47	Striped skunk	Mephitis mephitis	4,536	
48	Swine (pigs)	Sus scrofa	199,584	
49	Thirteen-lined ground squirrel	Ictidomys tridecemlineatus	500	700
50	Virginia opossum	Didelphus virginianus	4,990	
51	Wapiti (elk)	Cervis elaphus	317,520	
52	White-nosed coati	Nasua narica	9,072	
53	White-tailed deer	Odocoileus virginianus	88,000	
54	White-tailed jackrabbit	Lepus townsendii	3,402	
55	White-tailed prairie dog	Cynomys leucurus	1,000	1,136
56	Woodchuck	Marmota monax	3,402	
57	Yellow-bellied marmot	Marmota flaviventris	5,000	
	Reptiles			
1	Alligator snapping turtle	Macrochelys temminckii	75,000	100,000
2	American alligator	Alligator mississippie	136,080	
3	California kingsnake	Lampropeltis californiae	1,000	1,500
4	Checkered garter snake	Thamnophis marcianus	60	122
5	Chicken turtle	Deirochelys reticularia	800	
6	Coastal plain cooter	Pseudemys floridana	3,000	3,500
7	Common box turtle	Terrapene carolina	350	
8	Common garter snake	Thamnophis sirtalis	150	
9	Common kingsnake	Lampropeltis getula	1,000	1,500
10	Common snapping turtle	Chelydra serpentina	9,979	
11	Corn snake	Pantherophis guttatus	900	
12	Diamondback terrapin	Malaclemys terrapin	455	
13	Diamondback water snake	Nerodia rhombifer	400	600
14	E. diamondback rattlesnake	Crotalus adamanteus	2,300	4,900
15	Eastern hognose snake	Heterodon platirhinos	100	120
16	Eastern mud turtle	Kinosternon subrubrum	207	291
17	Eastern pine snake	Pituophis melanoleucus	1,000	
18	Eastern racer	Coluber constrictor	556	667
19	Eastern rat snake	Pantherophis alleghaniensis	800	1,274
20	Florida red-bellied cooter	Pseudemys nelsoni	4,000	
21	Florida softshell turtle	Apalone ferox	6,650	43,000
22	Gopher snake	Pituophis catenifer	2,300	4,500
23	Gopher tortoise	Gopherus polyphemus	4,000	4,500
24	Green iguana	Iguana iguana	5,000	
25	Lined snake	Tropidoclonion lineatum	50	
26	Milk snake	Lampropeltis triangulum	225	1,000
27	Mohave rattlesnake	Crotalus scutulatus	4,000	9,000
28	Northern map turtle	Graptemys geographica	1,600	2,500
29	Northern water snake	Nerodia sipedon	1,361	1,814
30	Ornate box turtle	Terrapene ornata	310	431
31	Painted turtle	Chrysemys picta	350	
32	Plains garter snake	Thamnophis radix	300	400

Appendix C. Continued (page 4 of 17)

#	Common name	Scientific name	Body mass (grams)	
			Mean	Max
33	Pond slider	Trachemys scripta	1,000	
34	Prairie rattlesnake	Crotalus viridis	1,000	
35	River cooter	Pseudemys concinna	2,000	5,000
36	Spectacled caiman	Caiman crocodilus	20,000	40,000
37	Spiny softshell turtle	Apalone spinifera	4,000	10,000
38	Striped mud turtle	Kinosternon baurii	203	
39	Texas blind snake	Leptotyphlops dulcis	50	
40	Water moccasin	Agkistrodon piscivorus	580	4,600
41	W. diamondback rattlesnake	Crotalus atrox	1,500	6,700
42	Western fox snake	Pantherophis ramspotti	1,000	
43	Western hognose snake	Heterodon nasicus	350	500
44	Western rat snake	Pantherophis obsoletus	1,000	2,500
45	Western ribbon snake	Thamnophis proximus	150	
	Birds			
1	Acadian flycatcher	Empidonax virescens	13	14
2	African collared dove	Streptopelia roseogrisea	155	172
3	African silverbill	Euodice cantans	12	14
4	Alder flycatcher	Empidonax alnorum	13	15
5	Allen's hummingbird	Selasphorus sasin	3	4
6	Alpine swift	Tachymarptis melba	104	120
7	American avocet	Recurvirostra americana	307	382
8	American barn owl	Tyto furcata	566	
9	American bittern	Botaurus lentiginosus	706	1,072
10	American black duck	Anas rubripes	1,400	1,800
11	American coot	Fulica americana	724	848
12	American crow	Corvus brachyrhynchos	538	
13	American golden-plover	Pluvialis dominica	154	166
14	American goldfinch	Spinus tristis	13	17
15	American goshawk	Astur atricapillus	1,137	1,364
16	American kestrel	Falco sparverius	132	
17	American oystercatcher	Haematopus palliatus	638	720
18	American pipit	Anthus rubescens	22	26
19	American redstart	Setophaga ruticilla	8	10
20	American robin	Turdus migratorius	79	112
21	American tree sparrow	Spizelloides arborea	19	28
22	American white pelican	Pelecanus erythrorhynchos	6,329	8,000
23	American wigeon	Mareca americana	792	1,036
24	American woodcock	Scolopax minor	219	278
25	Anhinga	Anhinga anhinga	1,235	
26	Anna's hummingbird	Calypte anna	5	6
27	Antillean nighthawk	Chordeiles gundlachii	50	
28	Antillean palm swift	Tachornis phoenicobia	10	11
29	Arctic tern	Sterna paradisaea	110	127
30	Ash-throated flycatcher	Myiarchus cinerascens	28	38
31	Australian pelican	Pelecanus conspicillatus	5,505	6,800
32	Baird's sandpiper	Calidris bairdii	44	
33	Baird's sparrow	Centronyx bairdii	18	20
34	Bald eagle	Haliaeetus leucocephalus	5,350	6,400
35	Baltimore oriole	Icterus galbula	34	39

Appendix C. Continued (page 5 of 17)

#	Common name	Scientific name	Body mass (grams)	
			Mean	Max
36	Band-rumped storm-petrel	Hydrobates castro	45	54
37	Band-tailed pigeon	Patagioenas fasciata	398	515
38	Bank swallow	Riparia riparia	14	19
39	Bare-eyed pigeon	Patagioenas corensis	273	283
40	Barn swallow	Hirundo rustica	19	
41	Barred owl	Strix varia	801	1,051
42	Barrow's goldeneye	Bucephala islandica	1,130	1,314
43	Bar-tailed godwit	Limosa lapponica	332	400
44	Bay-breasted warbler	Setophaga castanea	12	14
45	Bell's sparrow	Artemisiospiza belli	15	17
46	Bell's vireo	Vireo bellii	9	10
47	Belted kingfisher	Megaceryle alcyon	148	215
48	Bewick's wren	Thryomanes bewickii	10	12
49	Bicknell's thrush	Catharus bicknelli	28	37
50	Black drongo	Dicrurus macrocercus	48	59
51	Black francolin	Francolinus francolinus	482	566
52	Black kite	Milvus migrans	870	920
53	Black noddy	Anous minutus	116	130
54	Black phoebe	Sayornis nigricans	20	22
55	Black redstart	Phoenicurus ochruros	17	20
56	Black skimmer	Rynchops niger	349	392
57	Black swift	Cypseloides niger	46	53
58	Black tern	Chlidonias niger	65	74
59	Black turnstone	Arenaria melanocephala	135	169
60	Black vulture	Coragyps atratus	2,159	
61	Black-and-white warbler	Mniotilta varia	11	13
62	Black-bellied plover	Pluvialis squatarola	250	283
63	Black-bellied whistling-duck	Dendrocygna autumnalis	796	950
64	Black-billed cuckoo	Coccyzus erythropthalmus	51	65
65	Black-billed magpie	Pica hudsonia	189	209
66	Blackburnian warbler	Setophaga fusca	10	
67	Black-capped chickadee	Poecile atricapillus	11	13
68	Black-chinned hummingbird	Archilochus alexandri	4	5
69	Black-crowned night heron	Nycticorax nycticorax	810	1,014
70	Black-crowned sparrow lark	Eremopterix nigriceps	14	16
71	Black-faced bunting	Emberiza spodocephala	20	24
72	Black-footed albatross	Phoebastria nigripes	3,400	4,300
73	Black-headed grosbeak	Pheucticus melanocephalus	48	
74	Black-headed gull	Chroicocephalus ridibundus	284	327
75	Black-legged kittiwake	Rissa tridactyla	421	525
76	Black-necked stilt	Himantopus mexicanus	170	202
77	Blackpoll warbler	Setophaga striata	12	13
78	Black-throated blue warbler	Setophaga caerulescens	11	12
79	Black-throated gray warbler	Setophaga nigrescens	9	10
80	Black-throated green warbler	Setophaga virens	9	10
81	Black-throated sparrow	Amphispiza bilineata	14	16
82	Blue grosbeak	Passerina caerulea	28	41
83	Blue jay	Cyanocitta cristata	88	101
84	Blue-and-white swallow	Pygochelidon cyanoleuca	10	11

Appendix C. Continued (page 6 of 17)

#	Common name	Scientific name	Body mass (grams)	
			Mean	Max
85	Blue-black grassquit	Volatinia jacarina	10	12
86	Blue-crowned parakeet	Thectocercus acuticaudatus	168	176
87	Blue-gray gnatcatcher	Polioptila caerulea	6	7
88	Blue-headed vireo	Vireo solitarius	15	17
89	Blue-tailed bee-eater	Merops philippinus	34	38
90	Blue-winged teal	Spatula discors	380	
91	Blue-winged warbler	Vermivora cyanoptera	9	10
92	Boat-tailed grackle	Quiscalus major	206	239
93	Bobolink	Dolichonyx oryzivorus	34	
94	Bohemian waxwing	Bombycilla garrulus	56	69
95	Bonaparte's gull	Chroicocephalus philadelphia	222	
96	Bonin petrel	Pterodroma hypoleuca	176	220
97	Brandt's cormorant	Urile penicillatus	2,570	2,682
98	Brant	Branta bernicla	1,370	1,790
99	Brewer's blackbird	Euphagus cyanocephalus	67	73
100	Brewer's sparrow	Spizella breweri	11	
101	Broad-tailed hummingbird	Selasphorus platycercus	4	
102	Broad-winged hawk	Buteo platypterus	490	
103	Bronze mannikin	Spermestes cucullata	9	12
104	Brown booby	Sula leucogaster	1,360	
105	Brown creeper	Certhia americana	8	10
106	Brown noddy	Anous stolidus	189	232
107	Brown pelican	Pelecanus occidentalis	3,702	
108	Brown thrasher	Toxostoma rufum	69	89
109	Brown-crested flycatcher	Myiarchus tyrannulus	44	54
110	Brown-headed cowbird	Molothrus ater	49	57
111	Brown-throated parakeet	Eupsittula pertinax	84	102
112	Budgerigar	Melopsittacus undulatus	29	
113	Buff-breasted sandpiper	Calidris subruficollis	69	78
114	Bufflehead	Bucephala albeola	473	551
115	Bullock's oriole	Icterus bullockii	38	43
116	Burrowing owl	Athene cunicularia	156	
117	Bushtit	Psaltriparus minimus	5	6
118	Cackling goose	Branta hutchinsii	2,180	
119	Cactus wren	Campylorhynchus brunneicapillus	39	47
120	California gull	Larus californicus	841	1,045
121	California quail	Callipepla californica	186	230
122	California towhee	Melozone crissalis	54	61
123	Calliope hummingbird	Selasphorus calliope	3	3
124	Canada goose	Branta canadensis	4,181	4,727
125	Canada jay	Perisoreus canadensis	76	82
126	Canada warbler	Cardellina canadensis	10	12
127	Canvasback	Aythya valisineria	1,252	1,600
128	Cape May warbler	Setophaga tigrina	10	13
129	Caribbean martin	Progne dominicensis	40	42
130	Carolina chickadee	Poecile carolinensis	10	
131	Carolina wren	Thryothorus ludovicianus	21	27
132	Carrion crow	Corvus corone	570	
133	Caspian tern	Hydroprogne caspia	655	782

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#	Common name	Scientific name	Body mass (grams)	
			Mean	Max
134	Cassin's finch	Haemorhous cassinii	27	38
135	Cassin's sparrow	Peucaea cassinii	19	24
136	Cassin's vireo	Vireo cassinii	15	21
137	Cave swallow	Petrochelidon fulva	24	
138	Cedar waxwing	Bombycilla cedrorum	33	40
139	Cerulean warbler	Setophaga cerulea	9	10
140	Chestnut munia	Lonchura atricapilla	13	14
141	Chestnut-collared longspur	Calcarius ornatus	20	22
142	Chestnut-sided warbler	Setophaga pensylvanica	10	11
143	Chihuahuan meadowlark	Sturnella lilianae	112	131
144	Chimney swift	Chaetura pelagica	24	30
145	Chipping sparrow	Spizella passerina	12	15
146	Chuck-will's-widow	Antrostomus carolinensis	109	188
147	Chukar	Alectoris chukar	541	580
148	Cinnamon teal	Spatula cyanoptera	383	470
149	Clapper rail	Rallus crepitans	290	314
150	Clark's grebe	Aechmophorus clarkii	1,341	1,685
151	Clark's nutcracker	Nucifraga columbiana	137	
152	Clay-colored sparrow	Spizella pallida	11	15
153	Cliff swallow	Petrochelidon pyrrhonota	22	27
154	Common chaffinch	Fringilla coelebs	22	29
155	Common cuckoo	Cuculus canorus	117	
156	Common eider	Somateria mollissima	2,218	2,895
157	Common gallinule	Gallinula galeata	339	493
158	Common goldeneye	Bucephala clangula	1,120	1,329
159	Common grackle	Quiscalus quiscula	120	142
160	Common ground dove	Columbina passerina	37	
161	Common gull	Larus canus	432	552
162	Common loon	Gavia immer	5,460	6,130
163	Common merganser	Mergus merganser	1,709	2,054
164	Common murre	Uria aalge	1,066	1,202
165	Common myna	Acridotheres tristis	127	140
166	Common nighthawk	Chordeiles minor	79	
167	Common pauraque	Nyctidromus albicollis	53	
168	Common poorwill	Phalaenoptilus nuttallii	50	
169	Common raven	Corvus corax	1,097	
170	Common ringed plover	Charadrius hiaticula	65	75
171	Common snipe	Gallinago gallinago	113	153
172	Common swift	Apus apus	38	43
173	Common tern	Sterna hirundo	120	145
174	Common waxbill	Estrilda astrild	9	11
175	Common wood-pigeon	Columba palumbus	490	614
176	Common yellowthroat	Geothlypis trichas	10	12
177	Connecticut warbler	Oporornis agilis	13	16
178	Cooper's hawk	Accipiter cooperii	529	588
179	Corn crake	Crex crex	169	202
180	Costa's hummingbird	Calypte costae	3	5
181	Couch's kingbird	Tyrannus couchii	39	
182	Crested caracara	Caracara plancus	1,220	1,355

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#	Common name	Scientific name	Body mass (grams)	
			Mean	Max
183	Curve-billed thrasher	Toxostoma curvirostre	81	94
184	Dark-billed cuckoo	Coccyzus melacoryphus	54	67
185	Dark-eyed junco	Junco hyemalis	19	24
186	Dickcissel	Spiza americana	28	
187	Double-crested cormorant	Nannopterum auritum	2,089	
188	Double-striped thick-knee	Hesperoburhinus bistriatus	787	
189	Downy woodpecker	Dryobates pubescens	28	29
190	Dunlin	Calidris alpina	60	
191	Dusky flycatcher	Empidonax oberholseri	10	11
192	Eared dove	Zenaida auriculata	136	155
193	Eared grebe	Podiceps nigricollis	422	521
194	Eastern bluebird	Sialia sialis	28	38
195	Eastern cattle egret	Ardea coromanda	372	512
196	Eastern kingbird	Tyrannus tyrannus	43	55
197	Eastern meadowlark	Sturnella magna	112	131
198	Eastern phoebe	Sayornis phoebe	20	23
199	Eastern screech-owl	Megascops asio	194	235
200	Eastern towhee	Pipilo erythrophthalmus	41	47
201	Eastern whip-poor-will	Antrostomus vociferus	57	
202	Eastern wood-pewee	Contopus virens	14	15
203	Egyptian goose	Alopochen aegyptiaca	1,873	2,100
204	Elegant tern	Thalasseus elegans	260	325
205	Emperor goose	Anser canagicus	2,370	
206	Eurasian buzzard	Buteo buteo	969	1,364
207	Eurasian collared dove	Streptopelia decaocto	152	184
208	Eurasian coot	Fulica atra	902	1,200
209	Eurasian curlew	Numenius arquata	869	1,050
210	Eurasian kestrel	Falco tinnunculus	201	260
211	Eurasian moorhen	Gallinula chloropus	415	493
212	Eurasian siskin	Spinus spinus	14	19
213	Eurasian skylark	Alauda arvensis	43	51
214	Eurasian wigeon	Mareca penelope	819	1,073
215	European goldfinch	Carduelis carduelis	16	20
216	European robin	Erithacus rubecula	18	22
217	European starling	Sturnus vulgaris	88	100
218	Evening grosbeak	Coccothraustes vespertinus	60	72
219	Ferruginous hawk	Buteo regalis	1,776	2,047
220	Field sparrow	Spizella pusilla	13	15
221	Fish crow	Corvus ossifragus	300	332
222	Flammulated owl	Psiloscops flammeolus	66	96
223	Fork-tailed storm-petrel	Hydrobates furcatus	54	68
224	Forster's tern	Sterna forsteri	149	173
225	Fox sparrow	Passerella iliaca	35	39
226	Franklin's gull	Leucophaeus pipixcan	280	335
227	Gadwall	Mareca strepera	968	1,250
228	Gambel's quail	Callipepla gambelii	170	207
229	Garden warbler	Sylvia borin	18	25
230	Glaucous gull	Larus hyperboreus	1,855	2,060
231	Glaucous-winged gull	Larus glaucescens	1,180	

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#	Common name	Scientific name	Body mass (grams)	
			Mean	Max
232	Glossy ibis	Plegadis falcinellus	663	768
233	Golden eagle	Aquila chrysaetos	4,627	5,280
234	Golden-crowned kinglet	Regulus satrapa	6	8
235	Golden-crowned sparrow	Zonotrichia atricapilla	32	
236	Golden-fronted woodpecker	Melanerpes aurifrons	85	99
237	Golden-winged warbler	Vermivora chrysoptera	10	11
238	Grasshopper sparrow	Ammodramus savannarum	18	
239	Gray catbird	Dumetella carolinensis	35	44
240	Gray flycatcher	Empidonax wrightii	12	14
241	Gray francolin	Ortygornis pondicerianus	274	
242	Gray heron	Ardea cinerea	1,443	2,073
243	Gray kingbird	Tyrannus dominicensis	47	69
244	Gray partridge	Perdix perdix	418	483
245	Gray vireo	Vireo vicinior	13	15
246	Gray-breasted martin	Progne chalybea	43	48
247	Gray-cheeked thrush	Catharus minimus	33	45
248	Gray-crowned rosy-finch	Leucosticte tephrocotis	25	
249	Gray-headed chickadee	Poecile cinctus	11	13
250	Gray-tailed tattler	Tringa brevipes	127	160
251	Great black-backed gull	Larus marinus	1,829	2,272
252	Great blue heron	Ardea herodias	2,480	
253	Great cormorant	Phalacrocorax carbo	3,240	
254	Great crested flycatcher	Myiarchus crinitus	32	40
255	Great crested grebe	Podiceps cristatus	738	813
256	Great egret	Ardea alba	935	
257	Great frigatebird	Fregata minor	1,662	
258	Great gray owl	Strix nebulosa	1,267	1,700
259	Great horned owl	Bubo virginianus	1,555	2,046
260	Great kiskadee	Pitangus sulphuratus	74	
261	Greater Antillean grackle	Quiscalus niger	94	100
262	Greater prairie chicken	Tympanuchus cupido	933	1,200
263	Greater roadrunner	Geococcyx californianus	376	538
264	Greater sage-grouse	Centrocercus urophasianus	3,190	
265	Greater scaup	Aythya marila	1,054	1,316
266	Greater spotted eagle	Clanga clanga	2,678	
267	Greater white-fronted goose	Anser albifrons	3,000	
268	Greater yellowlegs	Tringa melanoleuca	153	
269	Great-tailed grackle	Quiscalus mexicanus	222	253
270	Green heron	Butorides virescens	212	
271	Greenish warbler	Phylloscopus trochiloides	9	11
272	Green-tailed towhee	Pipilo chlorurus	30	37
273	Green-winged teal	Anas crecca	364	454
274	Gull-billed tern	Gelochelidon nilotica	170	184
275	Gyrfalcon	Falco rusticolus	1,752	2,000
276	Hairy woodpecker	Dryobates villosus	79	
277	Hammond's flycatcher	Empidonax hammondii	11	13
278	Harlequin duck	Histrionicus histrionicus	610	680
279	Harris's hawk	Parabuteo unicinctus	1,047	1,203
280	Harris's sparrow	Zonotrichia querula	37	

Appendix C. Continued (page 10 of 17)

#	Common name	Scientific name	Body mass (grams)	
			Mean	Max
281	Hawaiian duck	Anas wyvilliana	644	
282	Hawaiian goose	Branta sandvicensis	2,165	3,050
283	Hawaiian hawk	Buteo solitarius	606	
284	Hawaiian petrel	Pterodroma sandwichensis	434	500
285	Heermann's gull	Larus heermanni	500	643
286	Helmeted guineafowl	Numida meleagris	1,350	
287	Hermit thrush	Catharus guttatus	30	36
288	Hermit warbler	Setophaga occidentalis	10	13
289	Herring gull	Larus argentatus	1,147	1,775
290	Hooded crow	Corvus cornix	570	
291	Hooded merganser	Lophodytes cucullatus	680	879
292	Hooded oriole	Icterus cucullatus	24	33
293	Hooded warbler	Setophaga citrina	11	13
294	Horned grebe	Podiceps auritus	453	528
295	Horned lark	Eremophila alpestris	32	
296	Horned puffin	Fratercula corniculata	556	
297	House finch	Haemorhous mexicanus	21	26
298	House sparrow	Passer domesticus	28	35
299	Hudsonian godwit	Limosa haemastica	289	
300	Hume's short-toed lark	Calandrella acutirostris	21	23
301	Iceland gull	Larus glaucoides	1,021	1,100
302	Inca dove	Columbina inca	48	57
303	Indian silverbill	Euodice malabarica	12	14
304	Indigo bunting	Passerina cyanea	15	19
305	Island canary	Serinus canaria	24	30
306	Japanese white-eye	Zosterops japonicus	11	
307	Java sparrow	Lonchura oryzivora	25	28
308	Kentish plover	Anarhynchus alexandrinus	42	58
309	Kentucky warbler	Geothlypis formosa	14	17
310	Killdeer	Charadrius vociferus	101	121
311	King rail	Rallus elegans	415	
312	Kirtland's warbler	Setophaga kirtlandii	14	16
313	Ladder-backed woodpecker	Dryobates scalaris	34	41
314	Lanceolated warbler	Locustella lanceolata	11	11
315	Lapland longspur	Calcarius lapponicus	28	35
316	Lappet-faced vulture	Torgos tracheliotus	6,969	8,500
317	Lark bunting	Calamospiza melanocorys	38	52
318	Lark sparrow	Chondestes grammacus	29	33
319	Laughing gull	Leucophaeus atricilla	327	371
320	Lawrence's goldfinch	Spinus lawrencei	11	14
321	Lawrence's warbler	Vermivora chrysoptera/cyanoptera	10	11
322	Laysan albatross	Phoebastria immutabilis	3,310	4,100
323	Lazuli bunting	Passerina amoena	16	20
324	Least bittern	Botaurus exilis	86	
325	Least flycatcher	Empidonax minimus	10	12
326	Least sandpiper	Calidris minutilla	24	26
327	Least tern	Sternula antillarum	49	62
328	LeConte's sparrow	Ammospiza leconteii	13	16
329	Lesser black-backed gull	Larus fuscus	880	1,000

Appendix C. Continued (page 11 of 17)

#	Common name	Scientific name	Body mass (grams)	
			Mean	Max
330	Lesser goldfinch	Spinus psaltria	10	12
331	Lesser nighthawk	Chordeiles acutipennis	50	64
332	Lesser scaup	Aythya affinis	850	1,050
333	Lesser whitethroat	Sylvia curruca	12	18
334	Lesser yellowlegs	Tringa flavipes	78	96
335	Lilac-crowned parrot	Amazona finschi	302	312
336	Limpkin	Aramus guarauna	1,080	1,270
337	Lincoln's sparrow	Melospiza lincolnii	17	19
338	Little blue heron	Egretta caerulea	364	
339	Little owl	Athene noctua	164	193
340	Little swift	Apus affinis	25	30
341	Little tern	Sternula albifrons	57	63
342	Loggerhead kingbird	Tyrannus caudifasciatus	44	52
343	Loggerhead shrike	Lanius ludovicianus	48	59
344	Long-billed curlew	Numenius americanus	642	689
345	Long-billed dowitcher	Limnodromus scolopaceus	109	119
346	Long-billed thrasher	Toxostoma longirostre	68	
347	Long-eared owl	Asio otus	337	409
348	Long-tailed duck	Clangula hyemalis	932	
349	Long-tailed jaeger	Stercorarius longicaudus	307	444
350	Louisiana waterthrush	Parkesia motacilla	20	23
351	MacGillivray's warbler	Geothlypis tolmiei	10	13
352	Magnificent frigatebird	Fregata magnificens	1,704	
353	Magnolia warbler	Setophaga magnolia	8	10
354	Mallard	Anas platyrhynchos	1,246	1,580
355	Marbled godwit	Limosa fedoa	391	454
356	Marbled murrelet	Brachyramphus marmoratus	220	269
357	Mariana kingfisher	Todiramphus albicilla	83	102
358	Marsh wren	Cistothorus palustris	12	14
359	McKay's bunting	Plectrophenax hyperboreus	55	62
360	Meadow pipit	Anthus pratensis	18	23
361	Medium egret	Ardea intermedia	516	562
362	Merlin	Falco columbarius	218	281
363	Mississippi kite	Ictinia mississippiensis	311	339
364	Mitred parakeet	Psittacara mitratus	249	275
365	Monk parakeet	Myiopsitta monachus	120	
366	Morelet's seedeater	Sporophila morelleti	9	12
367	Mottled duck	Anas fulvigula	1,043	1,241
368	Mountain bluebird	Sialia currucoides	30	
369	Mountain chickadee	Poecile gambeli	12	15
370	Mourning dove	Zenaida macroura	123	
371	Mourning warbler	Geothlypis philadelphia	12	14
372	Mugimaki flycatcher	Ficedula mugimaki	12	14
373	Muscovy duck	Cairina moschata	2,858	
374	Mute swan	Cygnus olor	11,800	14,300
375	Nacunda nighthawk	Chordeiles nacunda	159	188
376	Nanday parakeet	Aratinga nenday	128	141
377	Nashville warbler	Leiothlypis ruficapilla	8	10
378	Nelson's sparrow	Ammospiza nelsoni	17	20

Appendix C. Continued (page 12 of 17)

#	Common name	Scientific name	Body mass (grams)	
			Mean	Max
379	Neotropic cormorant	Nannopterum brasilianum	1,393	1,550
380	Newell's shearwater	Puffinus newelli	323	358
381	Northern bobwhite	Colinus virginianus	178	
382	Northern cardinal	Cardinalis cardinalis	44	52
383	Northern flicker	Colaptes auratus	128	143
384	Northern fulmar	Fulmarus glacialis	649	773
385	Northern gannet	Morus bassanus	3,067	3,610
386	Northern harrier	Circus hudsonius	515	661
387	Northern hawk owl	Surnia ulula	340	454
388	Northern house wren	Troglodytes aedon	11	13
389	Northern lapwing	Vanellus vanellus	226	317
390	Northern mockingbird	Mimus polyglottos	49	56
391	Northern parula	Setophaga americana	9	10
392	Northern pintail	Anas acuta	1,006	1,245
393	Northern pygmy-owl	Glaucidium gnoma	73	87
394	N. rough-winged swallow	Stelgidopteryx serripennis	16	18
395	Northern saw-whet owl	Aegolius acadicus	131	
396	Northern shoveler	Spatula clypeata	636	908
397	Northern shrike	Lanius borealis	63	81
398	Northern waterthrush	Parkesia noveboracensis	16	20
399	Olivaceous elaenia	Elaenia mesoleuca	17	20
400	Olive sparrow	Arremonops rufivirgatus	23	30
401	Olive-backed pipit	Anthus hodgsoni	21	26
402	Olive-sided flycatcher	Contopus cooperi	32	42
403	Olive-throated parakeet	Eupsittula nana	77	84
404	Orange-crowned warbler	Leiothlypis celata	9	12
405	Orchard oriole	Icterus spurius	19	28
406	Oriental plover	Anarhynchus veredus	98	
407	Oriental turtle dove	Streptopelia orientalis	238	323
408	Osprey	Pandion haliaetus	1,568	1,900
409	Ovenbird	Seiurus aurocapilla	19	21
410	Pacific golden-plover	Pluvialis fulva	140	168
411	Pacific loon	Gavia pacifica	1,830	2,450
412	Pacific wren	Troglodytes pacificus	9	12
413	Painted bunting	Passerina ciris	13	19
414	Pallid swift	Apus pallidus	42	50
415	Palm warbler	Setophaga palmarum	10	13
416	Parasitic jaeger	Stercorarius parasiticus	478	604
417	Pearly-eyed thrasher	Margarops fuscatus	104	138
418	Pectoral sandpiper	Calidris melanotos	98	
419	Pelagic cormorant	Urile pelagicus	2,072	2,440
420	Peregrine falcon	Falco peregrinus	977	1,194
421	Philadelphia vireo	Vireo philadelphicus	12	13
422	Philippine collared dove	Streptopelia dusumieri	153	174
423	Philippine duck	Anas luzonica	891	977
424	Picazuro pigeon	Columba picazuro	279	402
425	Pied-billed grebe	Podilymbus podiceps	474	568
426	Pigeon guillemot	Cepphus columba	530	
427	Pileated woodpecker	Dryocopus pileatus	308	328

Appendix C. Continued (page 13 of 17)

#	Common name	Scientific name	Body mass (grams)	
			Mean	Max
428	Pine grosbeak	Pinicola enucleator	56	62
429	Pine siskin	Spinus pinus	13	15
430	Pine warbler	Setophaga pinus	12	17
431	Pin-tailed snipe	Gallinago stenura	113	180
432	Piping plover	Charadrius melodus	55	64
433	Prairie falcon	Falco mexicanus	908	1,133
434	Prairie warbler	Setophaga discolor	8	11
435	Prothonotary warbler	Protonotaria citrea	14	
436	Purple finch	Haemorhous purpureus	23	28
437	Purple gallinule	Porphyrio martinicus	257	
438	Purple heron	Ardea purpurea	1,112	1,150
439	Purple martin	Progne subis	54	
440	Purple sandpiper	Calidris maritima	68	85
441	Pygmy nuthatch	Sitta pygmaea	11	
442	Rainbow lorikeet	Trichoglossus moluccanus	133	169
443	Red avadavat	Amandava amandava	10	10
444	Red crossbill	Loxia curvirostra	41	48
445	Red knot	Calidris canutus	148	206
446	Red phalarope	Phalaropus fulicarius	62	
447	Red-bellied woodpecker	Melanerpes carolinus	73	
448	Red-breasted merganser	Mergus serrator	1,135	1,317
449	Red-breasted nuthatch	Sitta canadensis	10	12
450	Red-breasted sapsucker	Sphyrapicus ruber	58	
451	Red-crested cardinal	Paroaria coronata	40	44
452	Red-crowned amazon	Amazona viridigenalis	316	345
453	Reddish egret	Egretta rufescens	614	869
454	Red-eyed vireo	Vireo olivaceus	17	21
455	Red-footed booby	Sula sula	1,223	
456	Redhead	Aythya americana	1,118	1,320
457	Red-headed woodpecker	Melanerpes erythrocephalus	72	91
458	Red-legged kittiwake	Rissa brevirostris	377	489
459	Red-legged partridge	Alectoris rufa	540	547
460	Red-masked parakeet	Psittacara erythrogenys	151	
461	Red-naped sapsucker	Sphyrapicus nuchalis	45	55
462	Red-necked grebe	Podiceps grisegena	1,023	1,270
463	Red-necked phalarope	Phalaropus lobatus	39	
464	Red-necked stint	Calidris ruficollis	27	31
465	Redpoll	Acanthis flammea	13	15
466	Red-shouldered hawk	Buteo lineatus	670	774
467	Red-tailed hawk	Buteo jamaicensis	1,224	
468	Red-tailed tropicbird	Phaethon rubricauda	659	
469	Red-throated loon	Gavia stellata	1,486	1,923
470	Red-vented bulbul	Pycnonotus cafer	46	59
471	Red-wattled lapwing	Vanellus indicus	181	230
472	Redwing	Turdus iliacus	61	80
473	Red-winged blackbird	Agelaius phoeniceus	65	72
474	Ring-billed gull	Larus delawarensis	566	650
475	Ring-necked duck	Aythya collaris	730	1,180
476	Ring-necked pheasant	Phasianus colchicus	1,317	1,861

Appendix C. Continued (page 14 of 17)

#	Common name	Scientific name	Body mass (grams)	
			Mean	Max
477	Rock pigeon	Columba livia	369	
478	Rock ptarmigan	Lagopus muta	550	640
479	Rock sandpiper	Calidris ptilocnemis	106	130
480	Rock wren	Salpinctes obsoletus	17	
481	Rook	Corvus frugilegus	489	560
482	Roseate spoonbill	Platalea ajaja	1,490	1,800
483	Roseate tern	Sterna dougallii	112	128
484	Rose-breasted grosbeak	Pheucticus ludovicianus	42	51
485	Rose-ringed parakeet	Psittacula krameri	119	134
486	Ross's goose	Anser rossii	1,640	2,040
487	Rough-legged hawk	Buteo lagopus	1,065	1,660
488	Royal tern	Thalasseus maximus	470	
489	Ruby-crowned kinglet	Corthylio calendula	7	7
490	Ruby-throated hummingbird	Archilochus colubris	3	4
491	Ruddy duck	Oxyura jamaicensis	629	
492	Ruddy ground dove	Columbina talpacoti	47	57
493	Ruddy turnstone	Arenaria interpres	138	
494	Ruffed grouse	Bonasa umbellus	566	
495	Rufous hummingbird	Selasphorus rufus	4	5
496	Rufous-tailed robin	Larvivora sibilans	17	20
497	Rusty blackbird	Euphagus carolinus	64	80
498	Sabine's gull	Xema sabini	198	214
499	Saffron finch	Sicalis flaveola	20	23
500	Sage thrasher	Oreoscoptes montanus	44	50
501	Sagebrush sparrow	Artemisiospiza nevadensis	19	22
502	Sanderling	Calidris alba	51	
503	Sandhill crane	Antigone canadensis	4,800	
504	Sandwich tern	Thalasseus sandvicensis	208	238
505	Savannah sparrow	Passerculus sandwichensis	21	
506	Say's phoebe	Sayornis saya	21	24
507	Scaled quail	Callipepla squamata	191	234
508	Scaly-breasted munia	Lonchura punctulata	14	15
509	Scaly-naped pigeon	Patagioenas squamosa	312	388
510	Scarlet tanager	Piranga olivacea	28	34
511	Scissor-tailed flycatcher	Tyrannus forficatus	39	
512	Seaside sparrow	Ammospiza maritima	24	29
513	Sedge wren	Cistothorus stellaris	8	9
514	Semipalmated plover	Charadrius semipalmatus	47	57
515	Semipalmated sandpiper	Calidris pusilla	28	
516	Sharp-shinned hawk	Accipiter striatus	174	208
517	Sharp-tailed grouse	Tympanuchus phasianellus	953	1,090
518	Sharp-tailed sandpiper	Calidris acuminata	74	92
519	Short-billed dowitcher	Limnodromus griseus	116	154
520	Short-billed gull	Larus brachyrhynchus	409	459
521	Short-eared owl	Asio flammeus	378	475
522	Short-tailed hawk	Buteo brachyurus	480	710
523	Siberian sand-plover	Anaryhnchus mongolus	64	71
524	Smith's longspur	Calcarius pictus	28	32
525	Snow bunting	Plectrophenax nivalis	42	56

Appendix C. Continued (page 15 of 17)

#	Common name	Scientific name	Body mass (grams)	
			Mean	Max
526	Snow goose	Anser caerulescens	2,744	
527	Snowy egret	Egretta thula	371	
528	Snowy owl	Bubo scandiacus	2,279	2,951
529	Snowy plover	Anarhynchus nivosus	42	58
530	Solitary sandpiper	Tringa solitaria	48	65
531	Song sparrow	Melospiza melodia	21	23
532	Song thrush	Turdus philomelos	69	89
533	Sooty tern	Onychoprion fuscatus	175	224
534	Sora	Porzana carolina	75	126
535	South American snipe	Gallinago paraguaiae	113	145
536	Southern lapwing	Vanellus chilensis	327	426
537	Speckled pigeon	Columba guinea	352	371
538	Spotted dove	Streptopelia chinensis	159	194
539	Spotted flycatcher	Muscicapa striata	16	21
540	Spotted sandpiper	Actitis macularius	40	60
541	Spotted thick-knee	Burhinus capensis	423	450
542	Spotted towhee	Pipilo maculatus	39	46
543	Sprague's pipit	Anthus spragueii	26	30
544	Spruce grouse	Falcipennis canadensis	492	513
545	Spur-winged lapwing	Vanellus spinosus	192	
546	Stilt sandpiper	Calidris himantopus	61	68
547	Sulphur-bellied flycatcher	Myiodynastes luteiventris	47	57
548	Summer tanager	Piranga rubra	30	34
549	Surf scoter	Melanitta perspicillata	1,148	
550	Surfbird	Calidris virgata	216	251
551	Swainson's hawk	Buteo swainsoni	1,109	1,367
552	Swainson's thrush	Catharus ustulatus	30	36
553	Swainson's warbler	Limnothlypis swainsonii	19	20
554	Swallow-tailed kite	Elanoides forficatus	442	510
555	Swamp sparrow	Melospiza georgiana	16	19
556	Tennessee warbler	Leiothlypis peregrina	9	14
557	Thick-billed kingbird	Tyrannus crassirostris	56	59
558	Thick-billed longspur	Rhynchophanes mccownii	27	
559	Townsend's solitaire	Myadestes townsendi	33	39
560	Townsend's warbler	Setophaga townsendi	9	11
561	Tree pipit	Anthus trivialis	25	29
562	Tree swallow	Tachycineta bicolor	21	26
563	Tricolored blackbird	Agelaius tricolor	68	79
564	Tricolored heron	Egretta tricolor	415	
565	Tropical kingbird	Tyrannus melancholicus	37	43
566	Tropical mockingbird	Mimus gilvus	58	66
567	Trumpeter swan	Cygnus buccinator	11,900	14,500
568	Tufted titmouse	Baeolophus bicolor	22	26
569	Tundra swan	Cygnus columbianus	7,200	
570	Turkey vulture	Cathartes aura	2,006	
571	Upland sandpiper	Bartramia longicauda	164	218
572	Varied thrush	Ixoreus naevius	80	100
573	Vaux's swift	Chaetura vauxi	17	21
574	Veery	Catharus fuscescens	32	37

Appendix C. Continued (page 16 of 17)

#	Common name	Scientific name	Body mass (grams)	
			Mean	Max
575	Vega gull	Larus vegae	1,147	1,385
576	Vesper sparrow	Pooecetes gramineus	27	
577	Violet-green swallow	Tachycineta thalassina	14	16
578	Virginia rail	Rallus limicola	84	124
579	Virginia's warbler	Leiothlypis virginiae	8	11
580	Warbling vireo	Vireo gilvus	14	18
581	Wedge-tailed eagle	Aquila audax	3,800	4,750
582	Wedge-tailed shearwater	Ardenna pacifica	388	510
583	Western barn owl	Tyto alba	370	
584	Western bluebird	Sialia mexicana	27	32
585	Western cattle egret	Ardea ibis	372	512
586	Western flycatcher	Empidonax difficilis	11	14
587	Western grebe	Aechmophorus occidentalis	1,429	1,826
588	Western gull	Larus occidentalis	1,136	
589	Western house-martin	Delichon urbicum	15	20
590	Western kingbird	Tyrannus verticalis	40	44
591	Western marsh harrier	Circus aeruginosus	814	1,030
592	Western meadowlark	Sturnella neglecta	112	
593	Western sandpiper	Calidris mauri	29	
594	Western screech-owl	Megascops kennicottii	236	305
595	Western tanager	Piranga ludoviciana	28	35
596	Western wood-pewee	Contopus sordidulus	13	15
597	Whimbrel	Numenius phaeopus	404	459
598	Whiskered tern	Chlidonias hybrida	90	110
599	White ibis	Eudocimus albus	1,036	1,261
600	White stork	Ciconia ciconia	3,571	4,400
601	White tern	Gygis alba	111	139
602	White-bellied sea-eagle	Haliaeetus leucogaster	3,300	3,900
603	White-breasted nuthatch	Sitta carolinensis	21	23
604	White-crested elaenia	Elaenia albiceps	15	18
605	White-crowned pigeon	Patagioenas leucocephala	253	
606	White-crowned sparrow	Zonotrichia leucophrys	29	39
607	White-eyed vireo	Vireo griseus	11	14
608	White-faced ibis	Plegadis chihi	697	807
609	White-rumped sandpiper	Calidris fuscicollis	49	
610	White-tailed hawk	Geranoaetus albicaudatus	928	
611	White-tailed kite	Elanus leucurus	346	
612	White-tailed tropicbird	Phaethon lepturus	367	
613	White-throated sparrow	Zonotrichia albicollis	24	30
614	White-throated swift	Aeronautes saxatalis	32	36
615	White-tufted grebe	Rollandia rolland	424	450
616	White-winged crossbill	Loxia leucoptera	26	
617	White-winged dove	Zenaida asiatica	153	187
618	White-winged scoter	Melanitta deglandi	1,917	2,128
619	White-winged swallow	Tachycineta albiventer	18	21
620	White-winged tern	Chlidonias leucopterus	54	66
621	Whooping crane	Grus americana	5,826	6,356
622	Wild turkey	Meleagris gallopavo	7,800	10,400
623	Willet	Tringa semipalmata	283	327

Appendix C. Continued (page 17 of 17)

#	Common name	Scientific name	Body mass (grams)	
			Mean	Max
624	Willow flycatcher	Empidonax traillii	14	16
625	Willow ptarmigan	Lagopus lagopus	613	
626	Wilson's phalarope	Phalaropus tricolor	68	85
627	Wilson's plover	Anarhynchus wilsonia	55	80
628	Wilson's snipe	Gallinago delicata	128	156
629	Wilson's warbler	Cardellina pusilla	7	7
630	Winter wren	Troglodytes hiemalis	9	12
631	Wood duck	Aix sponsa	681	907
632	Wood sandpiper	Tringa glareola	73	130
633	Wood stork	Mycteria americana	2,702	2,780
634	Wood thrush	Hylocichla mustelina	53	76
635	Worm-eating warbler	Helmitheros vermivorum	15	17
636	Wrentit	Chamaea fasciata	15	18
637	Yellow bittern	Botaurus sinensis	94	120
638	Yellow rail	Coturnicops noveboracensis	61	70
639	Yellow warbler	Setophaga petechia	10	12
640	Yellow-bellied flycatcher	Empidonax flaviventris	12	16
641	Yellow-bellied sapsucker	Sphyrapicus varius	50	62
642	Yellow-billed cuckoo	Coccyzus americanus	64	85
643	Yellow-billed magpie	Pica nuttalli	174	189
644	Yellow-breasted chat	Icteria virens	25	28
645	Yellow-browed warbler	Phylloscopus inornatus	7	8
646	Yellow-chevroned parakeet	Brotogeris chiriri	62	68
647	Yellow-crowned night heron	Nyctanassa violacea	716	
648	Yellow-fronted canary	Crithagra mozambica	13	16
649	Yellow-headed blackbird	Xanthocephalus xanthocephalus	80	86
650	Yellow-headed caracara	Milvago chimachima	329	
651	Yellow-legged gull	Larus michahellis	1,275	1,500
652	Yellow-rumped warbler	Setophaga coronata	12	15
653	Yellow-throated vireo	Vireo flavifrons	18	21
654	Yellow-throated warbler	Setophaga dominica	10	11
655	Zebra dove	Geopelia striata	57	62
656	Zenaida dove	Zenaida aurita	156	205

[1] Body masses for birds from Dunning (2008). Body masses for mammals and reptiles from miscellaneous sources.