



U. S. DEPARTMENT
OF TRANSPORTATION
FEDERAL AVIATION
ADMINISTRATION

WILDLIFE STRIKES TO CIVIL AIRCRAFT IN THE UNITED STATES 1990–2004



U.S. Department of
Agriculture
Animal and Plant
Health Inspection
Service
Wildlife Services



FEDERAL AVIATION ADMINISTRATION
NATIONAL WILDLIFE STRIKE DATABASE
SERIAL REPORT NUMBER 11

REPORT PREPARED BY
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REPORT OF THE ASSOCIATE ADMINISTRATOR FOR AIRPORTS
OFFICE OF AIRPORT SAFETY AND STANDARDS
AIRPORT SAFETY AND CERTIFICATION
WASHINGTON, DC

MAY 2005

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The Federal Aviation Administration produced this report in cooperation with the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services.

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COVER

An MD-80 departing a major Midwestern USA airport struck a flock of double-crested cormorants while climbing through 3,000 feet AGL on 16 September 2004. At least one bird was ingested into the #1 engine, causing an uncontained engine failure and fire. Debris fell from the engine onto a suburban neighborhood. The aircraft made an emergency landing.

The double-crested cormorant population on the U.S. and Canadian Great Lakes increased from about 100 nesting pairs in 1972 to over 120,000 nesting pairs in 2005.

Anyone with quality photographs of aircraft damage resulting from wildlife strikes or of wildlife at airports is encouraged to submit them to one of the authors for consideration in future wildlife strike publications.

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ACKNOWLEDGMENTS

The database files and support programs used to enter and organize strike data initially were established by **E. LeBoeuf** and **J. Rapol**, Federal Aviation Administration (FAA), Office of Airport Safety and Standards, Washington, DC, and were subsequently updated by **A. M. Dickey** and **A. Newman**, Embry-Riddle Aeronautical University, Prescott, AZ. We greatly appreciate the assistance provided by these above-acknowledged professionals. **S. Agrawal** and **M. Hoven**, FAA William J. Hughes Technical Center, Atlantic City, NJ, also provided critical support and advice. Finally, we acknowledge and thank all of the people who took the time and effort to report wildlife strikes—pilots, mechanics, control tower personnel, airport operations personnel, airline flight safety officers, U.S. Department of Agriculture Wildlife Services biologists, and many others. Sponsorship and funds for the ongoing maintenance and analysis of the FAA Wildlife Strike Database are provided by the FAA, Office of Airport Safety and Standards, Washington, DC, and Airports Division, Airport Technology Branch, FAA William J. Hughes Technical Center, Atlantic City, NJ.

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PREFACE



The pilot of this Britten-Norman Islander was temporarily blinded when a herring gull penetrated the windshield at 800 feet AGL during a flight over Lake Erie in Ohio, July 2004. A passenger took over the controls until the pilot recovered, assessed his injuries, and landed at destination airport. He was then flown to a hospital where he received stitches for facial cuts.

The civil and military aviation communities widely recognize that the threat to human health and safety from aircraft collisions with wildlife (wildlife strikes) is increasing (Dolbeer 2000, MacKinnon et al. 2001). Globally, wildlife strikes have killed more than 194 people and destroyed over 163 aircraft since 1988 (Richardson and West 2000; Thorpe 2003; 2005; Dolbeer, unpublished data). Several factors contribute to this increasing threat:

1. Commercial air carriers are replacing their older three- and four-engine aircraft fleets with more efficient and quieter, two-engine aircraft. In 1969, 75 percent of the 2,100 USA passenger aircraft had three or four engines. In 1998, the USA passenger fleet

had grown to about 5,400 aircraft, and only 30 percent had three or four engines. It is estimated that by 2008 the fleet will contain about 7,000 aircraft, and only 10 percent will have three or four engines (Cleary and Dolbeer 1999). This reduction in engine redundancy increases the probability of life-threatening situations resulting from aircraft collisions with wildlife, especially with flocks of birds. In addition, previous research has indicated that birds are less able to detect and avoid modern jet aircraft with quieter engines (Chapter 3, International Civil Aviation Organization 1993) than older aircraft with noisier (Chapter 2) engines (Burger 1983, Kelly et al. 1999). Noisier (Chapter 2) aircraft engines will be phased out by 2005.

2. Many populations of wildlife species commonly involved in strikes have increased markedly in the last few decades. For example, from 1980 to 2003, the resident (non-migratory) Canada goose population in the USA and Canada increased at a mean rate of 9.1 percent per year; the red-tailed hawk population increased at a mean annual rate of 2.0 percent; the wild turkey population increased at a mean annual rate of 12.7 percent; and the turkey vulture population increased at a mean annual rate of 2.2 percent (Sauer et al. 2004). Thirteen of the 14 bird species in North America with mean body masses greater than 8 pounds have shown significant population increases over the past three decades (Dolbeer and Eschenfelder 2003). The white-tailed deer population increased from a low of about 350,000 in 1900 to about 24 million by 1994 (Jacobson and Kroll 1994).
3. Air traffic has increased substantially since 1980. Passenger enplanements in the USA increased from about 310 million in 1980 to 686 million in 2004 (2.1 percent increase per year), and commercial air traffic increased from about 17.8 million aircraft movements in 1980 to 29 million in 2004 (2.1 percent per year, Federal Aviation Administration 2005). USA commercial air traffic is predicted to continue growing at a rate of about 2 percent per year to 33 million movements by 2010.

As a result of these factors, experts within the Federal Aviation Administration (FAA), U.S. Department of Agriculture (USDA), and U.S. Air Force expect the risk, frequency, and potential severity of wildlife-aircraft collisions to escalate over the next decade.

The FAA has initiated several programs to address this important safety issue. Among the various programs is the collection and analysis of data from wildlife strikes. The FAA began collecting wildlife strike data in 1965. However, except for cursory examinations of the strike reports to determine general trends, the data were never submitted to rigorous analysis. 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 national wildlife strike problem for civil aviation. This project involves having specialists from the USDA/WS (1) edit all strike reports (FAA Form 5200-7, *Bird/Other Wildlife Strike Report*) received by the FAA since 1990 to ensure consistent, error-free data; (2) enter all edited strike reports in the FAA National Wildlife Strike Database; (3) supplement FAA-reported strikes with additional, non-duplicated strike reports from other sources; (4) provide the FAA with an updated computer file each month containing all edited strike reports; and (5) assist the

FAA with the production of annual 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, and seasonal patterns). The information obtained from these analyses provides the foundation for refinements in the development, implementation, and justification of integrated research and management efforts to reduce wildlife strikes.

The first annual report on wildlife strikes to civil aircraft in the USA, covering 1994, was completed in November 1995 (Dolbeer et al. 1995). Since then we have published subsequent reports covering the years 1993–1995, 1992–1996, 1991–1997, 1990–1998, 1990–1999, 1990–2000, 1990–2001, 1990–2002, and 1990–2003 (Cleary et al. 1996, 1997, 1998, 1999, 2000, 2002a, 2002b, 2003, 2004). This is the eleventh report in the series and covers the 15-year period 1990–2004.

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WILDLIFE STRIKES TO CIVIL AIRCRAFT IN THE UNITED STATES, 1990–2004



This Canada goose nest, discovered beneath the approach lights of a Midwestern USA airport in April 2004, was destroyed by the airport wildlife biologist. The airport had the necessary federal and state permits in place to immediately remove nests of waterfowl on the airport. The non-migratory Canada goose population in the USA increased from 1 million to over 3.5 million birds between 1990 and 2004.

INTRODUCTION

This report presents a summary analysis of data from the FAA's National Wildlife Strike Database for the 15-year period 1990 through 2004. Unless noted, all totals are for the 15-year period, and percentages are of the total known. Because of the large amount of data, Tables 2 through 16 and Table 18 present 15-year totals only and do not display data for individual years.

In addition to the summary analysis for 1990 through 2004, a sample of significant wildlife strikes to civil aircraft in the USA during 2004 is presented at the end of the report. These strike examples demonstrate the widespread and diverse nature of the problem.

RESULTS

NUMBER OF REPORTED STRIKES

For the 15-year period covered by this report, 59,196 strikes were reported to the FAA. Birds were involved in 97.5 percent of the reported strikes, terrestrial mammals in 2.2 percent, bats in

0.2 percent, and reptiles in 0.1 percent (Table 1).

The number of strikes annually reported tripled from 1990 (1,739) to 2000 (6,002). From 2000 to 2003, reported strikes plateaued at about 5,795 to 6,183 per year. In 2004, a record 6,511 strikes were reported (Table 1, Figure 1). We suggest the steady increase in reports from 1990 to 2000 was the result of several factors: an increased

awareness of the wildlife strike issue, an increase in aircraft operations, an increase in populations of hazardous wildlife species, and an increase in the number of strikes (Dolbeer 2000, Dolbeer and Eschenfelder 2002). The plateau in reported strikes from 2000 to 2003 might be related to a slight (<6 percent) decline in air traffic after the events of September, 11, 2001 and to more aggressive wildlife hazard management programs at airports (e.g., Wenning et al. 2004). The reason for the increase in 2004 is unknown.

METHODS OF REPORTING STRIKES

Most (65 percent) of the 59,196 strike reports were filed using the paper (57 percent) or electronic/web (8 percent) versions of FAA Form 5200-7, *Bird/Other Wildlife Strike Report*. Since the online version became available in April 2001, use of the electronic reporting system has climbed dramatically. Almost 32 percent of the strike reports filed in 2004 were done using this system (Table 2).

SOURCE OF REPORTS

Airline personnel and pilots filed 29 percent and 26 percent of these 59,196 reports, respectively (Table 3). About 84 percent of the reported strikes involved commercial aircraft; the remainder involved business, private, and miscellaneous aircraft (Table 4). Reports were received from all 50 states, from some USA territories, and from foreign countries when USA-registered aircraft were involved (Table 5). California, Florida, and Texas had the most bird strike reports (4,897, 3,972, and 3,779, respectively). Fourteen other states each had over 1,000 bird strikes reported. New York, Texas, Virginia, Michigan, Illinois, and New Jersey each had 70 or more mammal strikes. In all, strikes were reported at 1,442 airports (1,258 airports in the USA and 184 foreign airports where USA-based aircraft were involved).

TIMING OF OCCURRENCE OF STRIKES

Most bird strikes (51 percent) occurred between July and October (Table 6); 63 percent occurred during the day (Table 7); 58 percent occurred during the landing (descent, approach, or landing roll) phase of flight; and 39 percent occurred during takeoff and climb (Table 8). About 61 percent of the bird strikes occurred when the aircraft was at a height of 100 feet or less above ground level (AGL), 74 percent occurred at 500 feet or less AGL, and 93 percent occurred at or below 3,000 feet AGL (Table 9).

Most terrestrial mammal strikes (58 percent) occurred between July and November with 20 percent of deer strikes concentrated in November (Table 6). Most terrestrial mammal strikes (64 percent) occurred at night (Table 7), 54 percent occurred during the landing roll, and 34 percent occurred during the takeoff run. About 8 percent of the reported terrestrial mammal strikes occurred while the aircraft was in the air, e.g., when the aircraft struck deer with the landing gear (Table 8).

AIRCRAFT COMPONENTS DAMAGED

The aircraft components most commonly reported as struck by birds were the nose/radome, windshield, engine, wing/rotor, and fuselage (Table 10). Aircraft engines were the component most frequently reported as being damaged by bird strikes (32 percent of all damaged components). There were 7,926 strike events in which a total of 8,350 engines were reported as struck (7,521 events with one engine struck, 391 with two engines struck, 9 with three engines struck, and 5 with four engines struck). In 2,714 damaging bird-strike events involving engines, a total of 2,805 engines were damaged (2,624 events with one engine damaged, 89 with two engines damaged, and 1 with three engines damaged).

Aircraft components most commonly reported as struck by terrestrial mammals were the landing gear, propeller, and wing/rotor. These same components ranked highest for the parts most often reported as damaged by mammals (Table 10).

REPORTED DAMAGE AND EFFECT-ON-FLIGHT

Of the 57,702 bird strikes reported, 47,900 provided some indication as to the nature and extent of any damage. Of these 47,900 reports, 40,584 (85 percent) indicated the strike did not damage the aircraft; 3,986 (8 percent) indicated the aircraft suffered minor damage; 1,992 (4 percent) indicated the aircraft suffered substantial damage; 1,326 (3 percent) reported an uncertain level of damage; and 12 reports (less than 1 percent) indicated the aircraft was destroyed as a result of the strike (Table 11). In addition, the reports indicated that 109 bird strikes resulted in 134 human injuries and 6 strikes resulted in 8 fatalities. Waterfowl (geese and ducks) were involved in 33 (40 percent) of the 82 strikes where injury or death occurred and the type of bird involved was identified (Table 12). These 33 strikes with waterfowl were responsible for 36 (35 percent) of the 104 injuries or deaths where the type of bird was identified.

Of the 1,297 terrestrial mammal strikes reported, 946 reports provided some indication as to the nature and extent of any damage. Of these 946 reports, 343 (36 percent) indicated the strike did not damage the aircraft; 276 (29 percent) indicated the aircraft suffered minor damage; 263 (28 percent) indicated the aircraft suffered substantial damage; 45 (5 percent) reported an uncertain level of damage; and 19 (2 percent) indicated the aircraft was destroyed as a result of the strike (Table 11). Not surprisingly, a much higher percentage of terrestrial mammal strikes (64 percent) resulted in aircraft damage than did bird strikes (15 percent). Reports were received of 21 terrestrial mammal strikes that resulted in 29 human injuries and 1 fatality. Deer were responsible for 17 (81 percent) of the mammal strikes that resulted in injury or death and for 24 (80 percent) of the 30 injuries or deaths (Table 12).

In 14 percent and 56 percent of the bird and terrestrial mammal strike reports, respectively, an adverse effect-on-flight was reported (Table 13). Three percent of bird

strikes resulted in an aborted takeoff compared to 19 percent of terrestrial mammal strikes.

FUEL DUMPS AND SPILLS DUE TO WILDLIFE STRIKES

Wildlife strikes not only cause damage to the aircraft but can result in potential environmental damage and additional economic loss when aviation fuel is released. For the 15-year period, there were 31 bird-strike events during take-off run or climb in which the report indicated fuel was subsequently dumped to lighten the aircraft for a precautionary or emergency landing (Table 14). The mean quantity of fuel dumped per event was 11,579 gallons. There were 44 wildlife strike events in which a resulting fuel spill was reported from a ruptured tank or line. The mean quantity of fuel released per event was 149 gallons.

WILDLIFE SPECIES INVOLVED IN STRIKES

Table 15 shows the number of reported strikes, strikes causing damage, strikes having a negative effect-on-flight, strikes involving more than one animal, the reported aircraft down time, and the reported costs by identified wildlife species for the 15-year period 1990 through 2004.

Only 24,447 (42 percent) of the 57,702 bird strike reports provided information on the type of bird (e.g., gull or hawk). Furthermore, only 13,317 (54 percent) of these 24,447 reports provided identification to species level (e.g., ring-billed gull or red-tailed hawk; Table 15). Thus, birds were identified to species level in only 23 percent of the 57,702 reported strikes. In all, 309 identified species of birds were struck; 141 identified species were reported as causing damage.

Gulls (24 percent), doves/pigeons (14 percent), raptors (13 percent), blackbirds/starlings (10 percent), and waterfowl (10 percent) were the most frequently struck bird groups (Table 16). Gulls were involved in 2.4 times more strikes than waterfowl (5,801 and 2,416, respectively). Waterfowl, however, were involved in more damaging strikes (1,104 or 32 percent of all damaging strikes in which the bird type was identified) than were gulls (963 or 28 percent of all damaging strikes in which the bird type was identified). Gulls were responsible for the greatest number of bird strikes (770 or 30 percent) that had a negative effect-on-flight.

The most frequently struck terrestrial mammals were Artiodactyls—primarily deer (53 percent)—and Carnivores—primarily coyotes (28 percent) (Table 16). Artiodactyls were responsible for 94 percent of the mammal strikes that resulted in damage and 84 percent of the mammal strikes that had a negative effect-on-flight. In all, 32 identified species of terrestrial mammals and 6 identified species of bats were reported struck; 17 identified species of terrestrial mammals and 1 identified species of bat caused damage.

WILDLIFE STRIKES WITH CIVIL AIRCRAFT REPORTED TO FAA

Reporting of wildlife strikes with civil aircraft is voluntary but strongly encouraged by the FAA (Advisory Circular 150/5200-32A, *Reporting Wildlife Aircraft Strikes* [22 December 2004]). An initial analysis of independent strike data from an eastern USA airport in 1994 indicated that less than 20 percent of strikes were actually reported to the FAA for inclusion in the national database (Dolbeer et al. 1995).

To obtain an improved estimate of the percent of strikes that are unreported, we obtained 14 sets of wildlife strike data maintained by three airlines and three airports for various years (1991–2004). Only 489 (10.7 percent) of the 4,561 strikes recorded in these databases had been reported to the FAA for inclusion in the National Wildlife Strike Database (Table 17). The National Wildlife Strike Database contained an additional 591 strike reports for the relevant time periods unknown to the airlines or airports, making a total of 5,152 known strike events in the combined databases. If we assume that these 5,152 known strike events in the combined databases represented all strikes that occurred for those airlines and airports during those time periods, then the National Wildlife Strike Database contained 1,080 (21.0 percent) of the total strikes. Because it is highly probable that additional strike events occurred that were not recorded in either the national or local databases, the percent of strikes reported to the FAA probably fell somewhere between 10.7 and 21.0 percent.

ECONOMIC LOSSES DUE TO WILDLIFE STRIKES

For the 15-year period 1990–2004, reported losses from bird strikes totaled 277,565 hours of aircraft downtime and \$181.6 million in monetary losses. Reported losses from terrestrial mammal strikes totaled 255,455 hours of aircraft downtime and \$29.9 million in monetary losses. Bat strikes resulted in 72 hours of aircraft downtime and \$3.1 million in losses (Table 15).

The reported losses can be used to calculate estimated downtime and monetary loss caused by all wildlife strikes. Of the 10,464 reports that indicated the strike had an adverse effect on the aircraft and/or flight, 2,947 provided an estimate of the aircraft down time ($\Sigma = 533,092$ hours, avg. = 180.9 hours down time/incident). Of the 1,997 reports providing a damage cost estimate for the incident, 1,856 gave an estimate of the direct aircraft damage cost ($\Sigma = \$186.99$ million, avg. = \$100,748 damage/incident) and 675 gave an estimate of other monetary losses ($\Sigma = \$27.53$ million, avg. = \$40,791 lost/incident, Table 18). Other monetary losses include such expenses as lost revenue and the cost of putting passengers up in hotel, re-scheduling aircraft, and flight cancellations.

As discussed above, analysis of strike reports from USA airports and airlines indicated that less than 20 percent of all strikes were reported to the FAA (Table 17 and Dolbeer et al. 1995). Additionally, many reports received by the FAA were filed before aircraft damage had been fully assessed or failed to provide an estimate of costs and down time. As a result, the information on the number of strikes and associated costs

compiled from the voluntary reporting program is believed to severely underestimate the magnitude of the problem.

Assuming (1) all 10,464 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) these reports cover all of the damaging strikes that occurred, then at a minimum, wildlife strikes cost the USA civil aviation industry 126,268 hours per year of aircraft downtime and \$99.12 million in monetary losses (\$70.50 million per year in direct costs and \$28.62 million per year in associated costs, Table 18).

Further, assuming a 20-percent reporting rate, the annual cost of wildlife strikes to the USA civil aviation industry is estimated to be in excess of 631,341 hours of aircraft downtime and \$495.58 million in monetary losses (\$352.49 million per year in direct costs and \$143.09 million per year in associated costs, Table 18).

CONCLUSIONS

An analysis of 15 years of strike data reveals the magnitude and severity of the wildlife-aircraft strike problem for civil aviation in the USA. Management actions to reduce wildlife strikes are being implemented at many airports, but much work remains to be done to reduce wildlife strikes.

To address the problem, airport managers need to be aware of the wildlife hazards on their airports (Dolbeer et al. 2000). They must take appropriate actions, under the guidance of professional biologists trained in wildlife damage management, to minimize the problems. The aviation community must also widen its view of airport wildlife management to consider habitats and land uses in proximity to the airport. Wetlands, dredge spoil containment areas, waste-disposal facilities, and wildlife refuges can attract hazardous wildlife. Such land uses are often incompatible with aviation safety and should either be prohibited near airports or designed and operated in a manner that minimizes the attraction of hazardous wildlife.

The manual *Wildlife Hazard Management at Airports* (Cleary and Dolbeer 1999) provides guidance to airport personnel in developing and implementing wildlife hazard management plans. Copies of this manual (stock number 050-007-012837) can be ordered from the Superintendent of Documents, P.O. Box 321954, Pittsburgh, PA 15720-7954. Portable Document Format (PDF) versions are available online in English, Spanish, and French at <http://wildlife-mitigation.tc.faa.gov>.

Finally, there is a need for increased and more detailed reporting of wildlife strikes. For example, our analyses indicated less than 20 percent of all wildlife strikes involving USA civil aircraft are reported. Further, only about 42 percent of all reported bird strikes for 1990 through 2004, provided information on the type of bird struck, and only about 23 percent of the reports identified the birds struck to species level. In addition, only 19 percent of strike reports indicating an adverse effect on the aircraft or flight provided an estimate of economic losses resulting from the strike.

REPORTING A STRIKE

Pilots, airport operations, aircraft maintenance personnel, and anyone else having knowledge of a strike should report the incident to the FAA. It is important to include as much information as possible on FAA Form 5200-7. All reports are carefully screened to identify duplicate reports before they are entered into the database. Reports of the same incident filed by different people are combined and often provide a more complete record of the strike event than would be possible if just one report were filed.

The identification of the exact species of wildlife struck (e.g., ring-billed gull, Canada goose, American wigeon, mourning dove, or red-tailed hawk as opposed to gull, goose, duck, dove, or hawk) is particularly important. Bird strike remains that cannot be identified by airport personnel can often be identified by a local biologist or by sending feather and other remains in a sealed plastic bag (with FAA Form 5200-7) to:

Material sent via Express Mail Service:	Material sent via U.S. Postal Service:
Feather Identification Laboratory Smithsonian Institution NHB, E610, MRC 116 10 th & Constitution Ave. NW Washington, DC 20560-0116 (Identify as "safety investigation material")	Feather Identification Laboratory Smithsonian Institution, Division of Birds PO Box 37012 NHB, E610, MRC 116 Washington, DC 20013-7012 (Not recommended for priority cases)

Please send whole feathers whenever possible as diagnostic characteristics are often found in the downy barbules at the feather base. Wings, as well as breast and tail feathers, should be sent whenever possible. Beaks, feet, bones, and talons are also useful diagnostic materials. Do not send entire bird carcasses through the mail.

Strikes can also be reported online (<http://wildlife-mitigation.tc.faa.gov>) or by filling out and mailing FAA Form 5200-7. A pre-addressed and postage paid FAA Form 5200-7 can be accessed and printed from the above website.

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TABLES

Table 1. Number of reported wildlife strikes to civil aircraft by wildlife group, USA, 1990–2004 (See Figure 1).

Year	Number of reported strikes-all aircraft					Commercial aircraft only ¹		
	Birds	Bats	Terrestrial mammals	Reptiles	Total	Total	Movements (x 1 million) ²	Strikes/10,000 movements
1990	1,723	4	16	0	1,743	1,319	25.20	0.523
1991	2,128	3	36	0	2,167	1,650	24.92	0.662
1992	2,263	2	56	1	2,322	1,711	25.32	0.676
1993	2,287	6	53	0	2,346	1,671	25.70	0.650
1994	2,346	2	73	1	2,422	1,787	26.74	0.668
1995	2,501	5	69	8	2,583	1,877	27.23	0.689
1996	2,692	1	91	3	2,787	1,937	27.75	0.698
1997	3,354	1	92	15	3,462	2,460	27.92	0.881
1998	3,661	3	105	7	3,776	2,524	28.17	0.896
1999	5,003	7	89	1	5,100	3,853	28.95	1.331
2000	5,863	16	120	3	6,002	4,476	29.71	1.507
2001 ³	5,641	8	138	8	5,795	4,159	29.37	1.416
2002	6,032	19	117	15	6,183	4,386	27.80	1.578
2003	5,848	20	124	5	5,997	4,279	28.11	1.522
2004	6,360	27	118	6	6,511	4,669	29.10	1.604
Total	57,702	124	1,297	73	59,196	42,758	411.99	1.038

¹ See Table 4.

² Departures and arrivals by air carrier, commuter, and air taxi service (FAA 2005).

³ The decline in reported strikes in 2001 was likely related in part to the decrease in air travel after 11 September. There was a 9 percent increase in the number of reported strikes for January–August 2001 compared to the same months in 2000; there was a 24 percent decline in reported strikes for September–December 2001 compared to the same months in 2000.

Table 2. Source of information for reported wildlife strikes to civil aircraft, USA, 1990–2004.

Source	15-year total	% of total known
FAA Form 5200-7 ¹ (Paper)	33,563	57
FAA Form 5200-7E (Electronic) ²	5,020	8
Airline report	8,291	14
Multiple ³	5,320	9
Airport report	3,263	6
Other ⁴	1,192	2
Engine manufacturer	823	1
Aircraft Incident Report	717	1
Preliminary Aircraft Incident Report	709	1
Aviation Safety Reporting System	168	<1
Aircraft Incident Preliminary Notice	61	<1
National Transportation Safety Board	58	<1
U.S. Air Force BASH program	11	<1
Total	59,196	100

¹ Bird/Other Wildlife Strike Report

² Electronic (web) filing of reports (<http://wildlife-mitigation.tc.faa.gov>) began in April 2001. In 2001, 0.4 percent of reports were filed electronically compared to 20 percent in 2002, 28 percent in 2003, and 32 percent in 2004.

³ More than one report was filed for the same strike.

⁴ Various sources, such as news media and Commercial Incident Reports.

Table 3. Person filing report of wildlife strike to civil aircraft, USA, 1990–2004.

Person filing report	15-year total	% of total known
Airline Operations	13,448	29
Pilot	11,764	26
Tower	7,202	16
Carcass Found ¹	6,980	15
Airport Operations	4,725	10
Other	1,653	4
Total known	45,772	100
Unknown	13,424	
Total	59,196	

¹ Airport operations personnel found wildlife remains within 200 feet of a runway centerline that appeared to have been struck by aircraft and no strike was reported by pilot, tower, or airline.

Table 4. Number of reported wildlife strikes to civil aircraft by type of operator, USA, 1990–2004.

Type of operator	15-year total	% of total known
Commercial	42,758	84
Business	6,172	12
Private	1,652	3
Government/Police	308	<1
Total known	50,890	100
Unknown	8,306	
Total	59,196	

Table 5. Number of reported bird, mammal, and reptile strikes to civil aircraft by USA state, including the District of Columbia (DC), Puerto Rico (PR), USA-possessed Pacific Islands (PI), and the U.S. Virgin Islands (VI), 1990–2004.

State	Reported strikes (15-year total)				State	Reported strikes (15-year total)			
	Birds	Mammals	Reptiles	Total		Birds	Mammals	Reptiles	Total
AK	433	17	0	450	NC	1,081	24	0	1,105
AL	530	12	0	542	ND	155	4	0	159
AR	238	13	0	251	NE	567	16	0	583
AZ	825	60	0	885	NH	339	11	0	350
CA	4,897	64	0	4,961	NJ	1,584	70	7	1,661
CO	1,576	68	0	1,644	NM	110	5	0	115
CT	604	16	0	620	NV	275	3	0	278
DC	623	4	0	627	NY	3,183	99	13	3,295
DE	48	1	0	49	OH	1,816	58	0	1,874
FL	3,972	54	42	4,068	OK	534	24	2	560
GA	954	20	0	974	OR	915	8	0	923
HI	1,244	4	0	1,248	PA	2,112	66	0	2,178
IA	365	13	0	378	PI	112	0	0	112
ID	120	5	0	125	PR	103	2	5	110
IL	2,794	74	1	2,869	RI	252	8	0	260
IN	635	14	0	649	SC	270	14	0	284
KS	160	6	0	166	SD	90	7	0	97
KY	1,379	14	0	1,393	TN	1,586	16	0	1,602
LA	1,016	19	2	1,037	TX	3,779	80	0	3,859
MA	780	17	0	797	UT	647	12	0	659
MD	648	46	0	694	VA	1,638	78	0	1,716
ME	170	7	0	177	VI	75	0	0	75
MI	1,386	77	0	1,463	VT	54	1	0	55
MN	497	19	0	516	WA	885	12	0	897
MO	1,208	29	0	1,237	WI	488	46	0	534
MS	196	6	0	202	WV	138	45	0	183
MT	73	6	0	79	WY	49	6	0	55
					Total known¹	50,208	1,400	72	51,680
					Foreign²	1,133	11	0	1,144
					Unknown	6,361	10	1	6,372
					Total	57,702	1,421³	73	59,196

¹ Strikes were reported at 1,258 airports in the USA.

² Strikes to USA air carriers were reported at 184 foreign airports.

³ Mammal strikes consisted of 1,297 strikes involving terrestrial species and 124 strikes involving bats.

Table 6. Number of reported bird and terrestrial mammal strikes to civil aircraft by month, USA, 1990–2004¹.

Month	All birds		Terrestrial mammals		Deer only ²	
	15-year total	% of total known	15-year total	% of total known	15-year total	% of total known
Jan	2,225	4	64	5	28	4
Feb	2,008	3	56	4	24	4
Mar	3,072	5	80	6	36	5
Apr	3,999	7	79	6	40	6
May	5,323	9	66	5	30	4
Jun	4,383	8	110	8	47	7
Jul	6,451	11	128	10	56	8
Aug	7,740	13	145	11	63	9
Sep	7,790	14	142	11	75	11
Oct	7,526	13	172	13	90	13
Nov	4,548	8	175	13	133	20
Dec	2,637	5	80	6	51	8
Total	57,702	100	1,297	100	673	100

¹ In addition, 73 strikes with reptiles were reported of which 19 (26 percent) occurred in June; 124 strikes with bats were reported of which 29 percent occurred in August.

² Deer strikes were comprised of 616 white-tailed deer, 29 mule deer, 8 deer not identified to species, 9 wapiti (elk), 7 pronghorns, 3 moose, and 1 caribou. Other wild ungulates reported struck (but not included in this column of table) were 1 swine and 1 collared peccary.

Table 7. Reported time of occurrence of wildlife strikes to civil aircraft, USA, 1990–2004¹.

Time of day	Birds		Terrestrial mammals	
	15-year total	% of total known	15-year total	% of total known
Dawn	1,763	4	26	3
Day	24,991	63	208	24
Dusk	2,163	5	84	10
Night	10,597	27	565	64
Total known	39,514	100	883	100
Unknown	18,188		414	
Total¹	57,702		1,297	

¹ In addition, 73 strikes with reptiles were reported: time not reported = 61, day = 6, night = 3, dusk = 2, and dawn = 1. Also, 124 strikes with bats were reported: time not reported = 85, night = 31, dusk = 5, day = 2, and dawn = 1.

Table 8. Reported phase of flight at time of wildlife strikes to civil aircraft, USA, 1990–2004¹.

Phase of flight	Birds		Terrestrial mammals	
	15-year total	% of total known	15-year total	% of total known
Parked	26	<1	1	<1
Taxi	178	<1	25	3
Takeoff run	8,698	20	342	34
Climb	8,170	19	22	2
En route	1,231	3	0	0
Descent	1,621	4	0	0
Approach	16,846	38	64	6
Landing roll	7,241	16	543	54
Total known	44,011	100	997	100
Unknown	13,691		300	
Total¹	57,702		1,297	

¹In addition, 73 strikes with reptiles were reported: phase of flight not reported = 53, takeoff run = 8, taxi = 5, approach = 4, and landing roll = 3. Also, 124 strikes with bats were reported: phase of flight not reported = 82, approach = 28, climb = 5, descent = 4, landing roll = 3, en route = 1, and takeoff run = 1.

Table 9. Number of reported bird strikes to civil aircraft by height (feet) above ground level (AGL), USA, 1990–2004.

Height of strike (feet AGL)	All reported strikes			Strikes with damage		
	15-year total	% of total known	% cumulative total	15-year total	% of total known	% cumulative total
0	16,189	42	42	1,498	27	27
1-100	7,372	19	61	930	17	44
101-200	1,917	5	66	259	5	49
201-300	1,233	3	69	166	3	52
301-400	756	2	71	122	2	54
401-500	1,339	3	74	206	4	58
501-600	380	1	75	76	1	59
601-700	300	1	76	59	1	60
701-800	634	2	78	139	3	63
801-900	201	1	79	62	1	64
901-1,000	1,117	3	82	244	4	68
1,001-2,000	2,842	7	89	695	13	81
2,001-3,000	1,699	4	93	405	7	89
3,001-4,000	874	2	95	171	3	92
4,001-5,000	654	2	96	119	2	94
5,001-10,000	1,187	3	99	253	5	98
10,001-20,000	255	<1	99	82	1	99
20,001-30,000	11	<1	99	7	<1	100
>30,000	1	<1	100	1	<1	100
Total known	38,961	100		5,494	100	
Unknown ht.	18,741			1,822		
Total	57,702			7,316		

Table 10. Civil aircraft components reported as being struck and damaged by wildlife, USA, 1990–2004.

Aircraft component	Birds (15-year total)				Terrestrial mammals (15-year total)			
	Number struck	% of total	Number damaged	% of total	Number struck	% of total	Number damaged	% of total
Radome/nose	13,796	26	1,315	15	70	5	73	7
Windshield	9,167	18	516	6	6	<1	12	1
Engine(s) ¹	7,926	15	2,714	32	97	7	95	9
Wing/rotor	7,014	13	1,929	23	152	12	155	14
Fuselage	6,610	13	304	4	88	7	99	9
Landing gear	2,524	5	270	3	506	39	262	24
Propeller	1,563	3	164	2	179	14	171	16
Tail	788	2	344	4	37	3	48	4
Light	436	<1	343	4	19	1	27	2
Other	2,376	5	673	8	153	12	153	14
Total²	52,200	100	8,572	100	1,307	100	1,095	100

¹ For birds, there were 7,926 strike events in which a total of 8,350 engines were reported as struck (7,521 events with one engine struck, 391 with two engines struck, 9 with three engines struck, and 5 with four engines struck). In 2,714 bird-strike events, a total of 2,805 engines were damaged (2,624 events with one engine damaged, 89 with two engines damaged, and 1 with three engines damaged). For terrestrial mammals, there were 97 strike events in which a total of 103 engines were reported as struck (91 with one engine struck and 6 with two engines struck). In 95 terrestrial mammal-strike events, a total of 106 engines were reported as damaged (some engines were damaged without being struck when the landing gear collapsed).

² In addition, there were 124 and 73 reported bat and reptile strikes, respectively. For bats, 39 indicated the part struck and 4 indicated the strike damaged an aircraft component: Radome/nose (7 struck, 0 damaged), Windshield (13 struck, 0 damage), Engine (4 struck, 2 damaged), Propeller (1 struck, 0 damaged), Wing/rotor (7 struck, 2 damaged), Fuselage (4 struck, 0 damaged), Tail (2 struck, 0 damaged), Other (1 struck, 0 damage). For reptiles, 16 indicated the part struck and 5 indicated the strike damaged an aircraft component: Windshield (1 struck, 1 damaged), Wing/rotor (1 struck, 1 damaged), Fuselage (1 struck, 1 damaged), Landing gear (11 struck, 0 damaged), Tail (1 struck, 1 damaged), Other (1 struck, 1 damaged).

Table 11. Number of civil aircraft with reported damage resulting from wildlife strikes, USA, 1990–2004.

Damage category ²	Reported strikes					
	Birds		Terrestrial mammals		Total ¹	
	15-year total	% of total known	15-year total	% of total known	15-year total	% of total known
None	40,584	85	343	36	40,983	84
Damage	7,316	15	603	64	7,924	16
Minor	3,986	8	276	29	4,264	9
Uncertain	1,326	3	45	5	1,371	3
Substantial	1,992	4	263	28	2,258	5
Destroyed	12	<1	19	2	31	<1
Total known	47,900	100	946	100	48,907	100
Unknown	9,802		351		10,289	
Total	57,702		1,297		59,196	

¹ Included in totals are 124 and 73 strikes involving bats and reptiles, respectively. For bats, 44 reports indicated no damage, 76 failed to report if damage occurred, 2 reported minor damage, and 2 reported substantial damage. For reptiles, 12 reports indicated no damage, 60 failed to report if damage occurred, and 1 reported substantial damage.

² The damage codes and descriptions follow the *International Civil Aviation Organization Bird Strike Information System (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.

Table 12. Wildlife species involved in strikes with civil aircraft causing human injury or fatality, USA, 1990–2004 (page 1 of 2).

Wildlife group	Species or species group	Injuries		Fatalities	
		No. of strikes causing injuries	No. of injuries	No. of strikes causing fatalities	No. of fatalities
Birds	Unknown bird	27	30	5	7
	Ducks	12	14		
	Canada goose	12	13		
	Turkey vulture	7	9		
	Gulls	7	8		
	Vultures	7	7		
	Ring-billed gull	1	7		
	Geese	5	5		
	American kestrel	1	5		
	Red-tailed hawk	3	4		
	Spotted dove	1	4		
	Hawks	2	3		
	Black vulture	2	2		
	Herring gull	2	2		
	Mallard	2	2		
	Osprey	2	2		
	Rock dove	2	2		
	Sharp-tailed grouse	1	2		
	American coot	1	1		
	Double-crested cormorant	1	1		
	Doves	1	1		
	Egret	1	1		
	Golden eagle	1	1		
	Great frigatebird	1	1		
	Horned grebe	1	1		
	Lesser scaup	1	1		
	Owls	1	1		
	Red-tailed tropicbird	1	1		
	Sandhill crane	1	1		
	Snow goose	1	1		
Western grebe	1	1			
Brown pelican	0	0	1	1	
Total birds		109	134	6	8

Table 12. Continued (page 2 of 2).

Wildlife group	Species or species group	Injuries		Fatalities	
		No. of strikes causing injuries	No. of injuries	No. of strikes causing fatalities	No. of fatalities
Mammals	White-tailed deer	15	21	1	1
	Cattle	2	3		
	Domestic dog	1	2		
	Mule deer	1	2		
	Horse	1	1		
Total mammals		20	29	1	1
All species	Total	129	163	7	9

Table 13. Reported effect-on-flight of wildlife strikes to civil aircraft, USA, 1990–2004.

Effect-on-flight ²	Reported strikes					
	Birds		Terrestrial mammals		Total ¹	
	15-year total	% of total known	15-year total	% of total known	15-year total	% of total known
None	29,825	86	328	44	30,199	85
Negative effect	4,699	14	425	56	5,133	15
Precautionary landing	2,452	7	63	8	2,518	7
Aborted takeoff	1,177	3	141	19	1,318	4
Engine shutdown	267	1	23	3	290	1
Other	803	3	198	26	1,007	3
Total known	34,524	100	753	100	35,332	100
Unknown	23,178		554		23,864	
Total	57,702		1,297		59,196	

¹ Included in totals are 124 and 73 strikes involving bats and reptiles, respectively. For bats, 32 reports indicated no effect-on-flight, 90 failed to report if an effect-on-flight occurred, and 2 reported a precautionary landing. For reptiles, 14 reports indicated no effect-on-flight, 52 failed to report if an effect-on-flight occurred, 1 reported a precautionary landing, and 6 reported “other”.

² Effect-on-flight: None = flight continued as scheduled, although delays and other cost caused by inspections or repairs may have been incurred after landing; Aborted takeoff = pilot aborted the takeoff; Precautionary landing = pilot landed at other-than-destination airport after strike; Engine shut down = pilot shut down the engine or the engine stopped running because of strike; Other = miscellaneous effects, such as reduced speed because of shattered windshield, emergency landing at destination airport, or crash landing; Unknown = report did not give sufficient information to determine an effect-on-flight (Dolbeer et al. 2000).

Table 14. Reported wildlife strikes to civil aircraft in which a resulting fuel dump or fuel spill was noted, USA, 1990–2004

Type of fuel release after wildlife strike	Number of incidents	Gallons of fuel released		
		n ¹	Mean	Range (min-max)
Fuel dump to lighten load for landing	31 ²	13	11,579	522-40,300
Fuel spill from tank or fuel line rupture	44 ³	3	149	24-223

¹ Number of reports that provided data on amount of fuel dumped or spilled (when data were provided as lbs of fuel released, we converted to gallons using a mean of 6.7 lbs of fuel/gallon).

² Aircraft were B-747 (12), B-727 (4), DC-10 (5), B-767 (2), B-737 (2); and DA-2000, L-1011, Learjet 24, Learjet 31, Learjet 35, and Unknown (1 each). Wildlife species responsible were Unknown bird species (14), gulls (8), ducks (2), rock doves (2); and great blue heron, great egret, mourning dove, red-tailed hawk, and vulture (1 each).

³ Aircraft were Cessna—various models (17), BE-1900 (8), Piper—various models (7); and A-320, B-727, BA-41, BE-90, Dash-8, DC-8, Learjet 36, MD-80, Rockwell Commander, RV-6A, Socata TB20, and Unknown (1 each). Wildlife species responsible were Deer (12), geese (10), unknown bird species (7), gulls (5), vultures (3), ducks (2); and bald eagle, cattle, grackle, osprey, and pelican (1 each).

Table 15. Total reported strikes, strikes causing damage, strikes having a negative effect-on-flight (EOF), strikes involving more than one animal, aircraft downtime, and costs by identified wildlife species for civil aircraft, USA, 1990–2004 (page 1 of 14).

Wildlife group or species	15-year totals					
	Number of reported strikes				Reported economic losses ¹	
	Total	With damage	With neg. EOF	With multiple animals ²	Aircraft down time (hrs)	Reported costs (\$)
Birds						
Loons	11	8	5		2,807	284,200
Loons	3	3	2		557	251,200
Common loon	8	5	3		2,250	33,000
Grebes	27	4	4	2	82	117,772
Grebes	6					
Eared grebe	5	1		1	10	100,000
Western grebe	7	2	2	1		
Pied-billed grebe	4	0	1			
Horned grebe	4	1	1		72	17,772
Red-necked grebe	1					
Albatrosses/shearwaters	22	3	3		50	30,000
Laysan albatross	14	3	3		50	30,000
Black-footed albatross	1					
Bonin petrel	1					
Wedge-tailed shearwater	3					
Townsend's shearwater	2					
Fork-tailed storm-petrel	1					
Tropicbirds	4	2	2		10	10,800
Tropicbirds	1	1	1		10	5,200
White-tailed tropicbird	1					
Red-tailed tropicbird	2	1	1			5,600
Pelicans	35	17	12	2	117	36,000
Pelicans	2	1			80	
Australian pelican	1	1	1			
Brown pelican	31	15	11	2	37	36,000
American white pelican	1					
Cormorants	37	17	11	10	78	2,147,370
Cormorants	1					
Great cormorant	2	1		2		
Double-crested cormorant	33	16	11	8	78	2,147,370
Pelagic cormorant	1					
Anhinga	10	3	3	2	92	3,800

Table 15. Continued (page 2 of 14)

Wildlife group or species	15-year totals					
	Number of reported strikes				Reported economic losses ¹	
	Total	With damage	With neg. EOF	With multiple animals ²	Aircraft down time (hrs)	Reported costs (\$)
Frigatebirds	9	3	1		3	4,900
Frigatebirds	1					
Great frigatebird	6	2	1		3	4,900
Magnificent frigatebird	2	1				
Hérons/bitterns	241	43	30	10	2,487	2,678,792
Hérons	39	12	8	3	98	3,000
Great blue heron	137	27	20	3	1,799	2,636,592
Black-crowned night heron	13	2		2	14	31,000
Little blue heron	2					
Green heron	3					
Yellow-crowned night heron	2					
American bittern	2	2	2		576	8,200
Yellow bittern	43			2		
Egrets	353	41	50	99	3,632	5,306,240
Egrets	233	29	35	71	3,451	3,465,140
Cattle egret	87	8	12	24	61	300
Great egret	21	2	3	3	96	1,840,800
Snowy egret	12	2		1	24	
Storks/ibises	19	4	4	4	1	
White stork	1	1				
Wood stork	3					
Ibises	8	1	2	1		
Glossy ibis	1			1		
White ibis	3	1	1			
White-faced ibis	2	1		2		
Roseate spoonbill	1		1		1	
Waterfowl	2,416	1,104	518	905	76,960	1,641,267
Ducks, geese, swans	121	61	27	50	715	758,775
Ducks	560	196	88	189	4,114	3,560,292
American wigeon	14	8	4	5	238	867,089
Northern pintail	24	16	8	12	1,198	95,889
Green-winged teal	10	3	2	2	54	235,250
Blue-winged teal	6	4	1	3	97	600,000
European wigeon	1			1		
Mallard	307	81	44	68	3,780	4,006,959
Common eider	2	2	1	1		
Ring-necked duck	5	3	2	2	72	9,568
Greater scaup	1	1	1			

Table 15. Continued (page 3 of 14)

Wildlife group or species	15-year totals					
	Number of reported strikes				Reported economic losses ¹	
	Total	With damage	With neg. EOF	With multiple animals ²	Aircraft down time (hrs)	Reported costs (\$)
Wood duck	12	4	2	2	54	38,000
Muscovy duck	1	1			120	443,332
Red-breasted merganser	1	1		1		
Hooded merganser	1	1		1		
Common merganser	1	1	1		72	2,500
Northern shoveler	12	7	2	6	624	1,043,300
Gadwall	11	1	1	2		
Canvasback	4	2		1		
American black duck	12	3	1	6		
Mottled duck	3	1	1		24	
Lesser scaup	7	5	2	3	984	101,000
Ruddy duck	7	2				8,446
Redhead	1	1		1		
Bufflehead	2					
Geese	307	175	79	108	16,977	2,113,246
Snow goose	55	41	18	30	3,097	9,476,726
Canada goose	898	468	226	398	44,164	37,031,067
Brant	13	6	3	6	40	1,271
Greater white-fronted goose	4	3	1	2	200	653,767
Emperor goose	1					
Swans	2	1				
Mute swan	4			1		
Tundra swan	5	4	2	3	336	144,790
Trumpeter swan	1	1	1	1		450,000
Raptors	3,077	587	379	114	53,685	3,536,591
Hawks, eagles, vultures	27	14	6	1	255	9,050
Vultures	192	116	57	22	15,013	752,675
Black vulture	21	13	12	3	4,609	365,987
Turkey vulture	202	115	72	10	14,791	2,145,848
Osprey	93	22	11	2	2,085	219,803
White-tailed kite	3	2				
Black kite	2	1	1			
Eagles	6	3	2	1		
Bald eagle	65	24	17	7	4,468	156,974
Golden eagle	2	1	1		72	1,000
Hawks	746	156	101	21	8,585	917,118
Red-tailed hawk	545	98	72	7	2,907	4,035,293
Rough-legged hawk	7					

Table 15. Continued (page 4 of 14)

Wildlife group or species	15-year totals					
	Number of reported strikes				Reported economic losses ¹	
	Total	With damage	With neg. EOF	With multiple animals ²	Aircraft down time (hrs)	Reported costs (\$)
Red-shouldered hawk	10	1			39	900
Swainson's hawk	12		1			
Sharp-shinned hawk	5					
Cooper's hawk	8					
Ferruginous hawk	2					
Broad-winged hawk	5					
Harris' hawk	1					
Common buzzard	1				24	
Northern harrier	39	1	1	1		200,000
Lappet-faced vulture	1	1	1		240	4,000,000
Falcons	27	2	3	1	80	30,000
Peregrine falcon	76	6	2	3	30	235,500
Gyr Falcon	1					
Merlin	20		2		3	130
American kestrel	957	11	17	35	484	466,313
Eurasian kestrel	1					
Grouse/pheasants/turkeys	114	30	24	21	534	497,287
Grouse	5	2		2	2	
Greater sage grouse	3	2	2	1		226,077
Sharp-tailed grouse	1	1	1		24	500
Ptarmigans	6	4	1	2	57	57,500
Black francolin	1					
Quails	7		2	3		
Northern bobwhite	6	2	3	1	73	800
Ring-necked pheasant	48	10	8	5	15	2,000
Gray partridge	3	2	1	2	24	120
Chukar	1					
Grey francolin	1					
Guineafowl	1	1		1		
Wild turkey	31	6	6	4	339	210,290
Cranes	63	21	18	17	2,209	364,760
Cranes	16	4	5	2	34	250,300
Sandhill crane	47	17	13	15	2,175	114,460
Rails/gallinules	35	8	3	4	123	612,476
Rails	1	1		1		
Sora	1					
Common moorhen	2	1	1		24	990
American coot	26	6	2	3	99	611,486

Table 15. Continued (page 5 of 14)

Wildlife group or species	15-year totals					
	Number of reported strikes				Reported economic losses ¹	
	Total	With damage	With neg. EOF	With multiple animals ²	Aircraft down time (hrs)	Reported costs (\$)
Purple gallinule	2					
Virginia rail	1					
Clapper rail	2					
Shorebirds	1,216	47	67	256	650	2,611,256
Shorebirds	14			6		
American oystercatcher	15			2		
Plovers	31	2	2	6	24	
European golden-plover	3					
American golden-plover	19		1	5		
Black-bellied plover	25	2	2	3	12	38,622
Snowy plover	1			1		
Killdeer	565	21	28	91	215	2,325,153
Pacific golden-plover	255	1	4	48	15	1,200
Semipalmated plover	11			5		
Northern lapwing	1	1	1	1	25	
Southern lapwing	1	1	1			8,000
Sandpipers	111	8	16	45	166	106,560
Upland sandpiper	48	4	5	6	12	1,000
Spotted sandpiper	3			1		
Willet	3			1		
Common snipe	17	2	1	2		12,615
American woodcock	11	1	2	2		
Dunlin	10	1		3		300
Baird's sandpiper	3			1		
Western sandpiper	14	1		8	60	94,311
Pectoral sandpiper	1					
Sanderling	4		1	4		
Buff-breasted sandpiper	6			2		
Ruddy turnstone	3					
Least sandpiper	15		1	5	1	
Semipalmated sandpiper	7			2		
Lesser yellowlegs	2			1		
Short-billed dowitcher	2					
Hudsonian godwit	1	1	1	1	96	23,495
Solitary sandpiper	1					
Greater yellowlegs	1					
Whimbrel	5	1	1	1	24	
Long-billed curlew	3					

Table 15. Continued (page 6 of 14)

Wildlife group or species	15-year totals					
	Number of reported strikes				Reported economic losses ¹	
	Total	With damage	With neg. EOF	With multiple animals ²	Aircraft down time (hrs)	Reported costs (\$)
American avocet	3			2		
Black-necked stilt	1			1		
Gulls	5,801	963	770	1,500	40,350	3,119,630
Gulls	4,568	811	638	1,263	32,666	18,131,692
Herring gull	394	55	53	58	475	1,380,745
Mew gull	14	2	1	2		1,000
Ring-billed gull	490	50	43	115	2,017	1,750,891
Glaucous-winged gull	25	9	3	5	201	146,445
Great black-backed gull	49	6	4	2	27	250,000
Franklin's gull	15	3	3	8	18	139,000
Laughing gull	170	12	12	31	715	529,000
Bonaparte's gull	14	2	2	4		65,000
Western gull	38	7	4	6	92	540,857
California gull	20	5	6	4	4,139	185,000
Heermann's gull	1			1		
Thayer's gull	1					
Yellow-legged gull	2	1	1	1		
Terns	77	4	1	21	4	
Terns	35	2		12		
Caspian tern	12			1		
Common tern	7					
Gull-billed tern	1					
Fairy tern	1					
Arctic tern	3	1		2		
Roseate tern	1					
Forster's tern	4		1	1	4	
Least tern	4			2		
Black noddy	3			2		
Brown noddy	3					
Royal tern	1					
Black skimmer	2	1		1		
Pigeons/doves	3,330	255	285	980	15,339	6,395,112
Pigeons, doves	11	1	1	8	24	400
Pigeons	21	3	3	10	26	46,050
Doves	527	32	54	173	278	282,360
Rock dove	1,075	138	119	412	13,307	3,688,707
Racing pigeon	13	3	2	6	72	
Mourning dove	1,549	74	102	356	1,534	2,106,190

Table 15. Continued (page 7 of 14)

Wildlife group or species	15-year totals					
	Number of reported strikes				Reported economic losses ¹	
	Total	With damage	With neg. EOF	With multiple animals ²	Aircraft down time (hrs)	Reported costs (\$)
Spotted dove	33	3	2	4	96	271,405
Zebra dove	70	1	2	11	2	
Inca dove	14					
Philippine turtle dove	4					
White-winged dove	8					
Common ground-dove	5					
Parrots	6			1		
Budgerigar	1					
Parrots	4			1		
Black-hooded parakeet	1					
Cuckoos	4	1		1		
Cuckoos	1			1		
Yellow-billed cuckoo	3	1				
Owls	606	55	28	6	1,202	2,800,683
Owls	205	23	12	3	956	296,875
Barn owl	235	14	7	2	97	748,750
Snowy owl	33	3	2		18	27,500
Short-eared owl	52	2	2		11	
Long-eared owl	7	2	1			
Northern saw-whet owl	3					
Burrowing owl	25	1				
Barred owl	3	1	1			
Eastern screech owl	2	1			24	7,558
Great horned owl	41	8	3	1	96	1,720,000
Nightjars	84	2		5		
Common nighthawk	73	1		5		
Nightjars	2	1				
Whip-poor-will	2					
Common poorwill	3					
Lesser nighthawk	3					
Chuck-will's-widow	1					
Swifts	59	2		6		
Swifts	7	1		3		
Chimney swift	44	1		3		
Vaux's swift	1					
White-throated swift	7					
Anna's hummingbird	1					

Table 15. Continued (page 8 of 14)

Wildlife group or species	15-year totals					
	Number of reported strikes				Reported economic losses ¹	
	Total	With damage	With neg. EOF	With multiple animals ²	Aircraft down time (hrs)	Reported costs (\$)
Belted kingfisher	6					
Woodpeckers	26	2	2	1		
Northern flicker	15	2				
Yellow-bellied sapsucker	3		1	1		
Hairy woodpecker	1					
Woodpeckers	7		1			
Flycatchers	38	1	3	3		9,800
Tyrant flycatchers	2					
Eastern wood-pewee	1					
Great crested flycatcher	1					
Eastern kingbird	4	1	1			9,800
Scissor-tailed flycatcher	15		2	1		
Acadian flycatcher	1					
Western kingbird	11			2		
Ash-throated flycatcher	1					
Western wood-pewee	1					
Sulphur-bellied flycatcher	1					
Larks	321	6	7	83	7	250
Eurasian skylark	4					
Horned lark	317	6	7	83	7	250
Swallows	891	13	27	274	136	40,532
Swallows	340	4	21	124	23	
Purple martin	47	2		12	1	
Bank swallow	41	1		24	1	
Barn swallow	288	3	2	56	99	27,282
Cliff swallow	88	3	2	20	9	13,250
Tree swallow	77		2	38	3	
Violet-green swallow	7					
N. rough-winged swallow	3					
Starlings	1,348	61	88	557	1,105	2,491,474
European starling	1,319	60	87	550	1,103	2,491,474
Myna	2			1		
Common myna	27	1	1	6	2	
Crows/jays/magpies	405	41	40	65	5,881	1,423,558
Crows	191	17	18	31	209	129,500
American crow	176	18	17	27	5,561	1,265,013
Carrion crow	1					

Table 15. Continued (page 9 of 14)

Wildlife group or species	15-year totals					
	Number of reported strikes				Reported economic losses ¹	
	Total	With damage	With neg. EOF	With multiple animals ²	Aircraft down time (hrs)	Reported costs (\$)
Northwestern crow	1			1		
Blue jay	6					
Ravens	3	1	1	1	2	90
Common raven	14	3	2	1	108	28,400
Yellow-billed magpie	8			2		
American magpie	5	2	2	2	1	555
Chickadees	9	1		2		
Chickadees	3			1		
Black-capped chickadee	6	1		1		
Wrens	34	1	1	7		
Wrens	33	1	1	7		
Rock wren	1					
Mimics	44	1	2			
Brown thrasher	5					120
Northern mockingbird	32	1	2			
Gray catbird	7					
Thrushes	203	13	12	23	50	77,430
Thrushes	10	3	1	2	7	25,500
Western bluebird	2				3	
Swainson's thrush	6	1		1		
American robin	178	9	10	20	40	51,930
Hermit thrush	2					
Eastern bluebird	2					
Gray-cheeked thrush	1					
Varied thrush	2		1			
Vireos	3			1		
Yellow-throated vireo	1					
Warbling vireo	1			1		
Cassin's vireo	1					
Warblers	33					
Wood warblers	18					
Canada warbler	1					
Yellow-breasted chat	3					
Black and white warbler	2					
Ovenbird	1					
Wilson's warbler	1					
Common yellowthroat	1					
American redstart	1					

Table 15. Continued (page 10 of 14)

Wildlife group or species	15-year totals					
	Number of reported strikes				Reported economic losses ¹	
	Total	With damage	With neg. EOF	With multiple animals ²	Aircraft down time (hrs)	Reported costs (\$)
Northern waterthrush	1					
Nashville warbler	3					
Townsend's warbler	1					
Meadowlarks	413	7	14	57	190	203,452
Meadowlarks	55	1	3	5	10	
Eastern meadowlark	230	2	4	25	4	
Western meadowlark	128	4	7	27	176	203,452
Blackbirds/orioles	1,104	81	84	333	1,451	1,016,175
Brown-headed cowbird	24	1	1	12	1	
Bobolink	3		1			
Blackbirds	925	67	68	292	580	862,425
Red-winged blackbird	48	1	4	11	6	750
Yellow-headed blackbird	5	1	1	1		
Brewer's blackbird	8					
Orioles	5					
Baltimore oriole	3			1		
Grackles	45	5	2	10	722	108,000
Common grackle	27	4	5	5	121	45,000
Boat-tailed grackle	4	1	1		20	
Great-tailed grackle	4			1		
Scarlet tanager	2	1				
Western tanager	1		1		1	
Finches	68		5	13	50	5,000
Finches	36		4	10	2	
Lapland longspur	2			1		
Dark-eyed junco	5		1	1	48	5,000
Rose-breasted grosbeak	1					
Pine siskin	1					
Purple finch	1					
American goldfinch	9					
House finch	8					
Smith's longspur	1					
Red avadavat	1					
Red-crested cardinal	2			1		
Northern cardinal	1					
Buntings	89	3	11	53	15	
Snow bunting	72	2	11	51	15	
Indigo bunting	1					

Table 15. Continued (page 11 of 14)

Wildlife group or species	15-year totals					
	Number of reported strikes				Reported economic losses ¹	
	Total	With damage	With neg. EOF	With multiple animals ²	Aircraft down time (hrs)	Reported costs (\$)
Lazuli bunting	1					
Lark bunting	15	1		2		
Sparrows	1,626	33	64	439	41	8,150
Sparrows	1,556	31	64	434	41	3,050
Savannah sparrow	34	1		2		1,000
Fox sparrow	4	1				4,100
White-throated sparrow	7					
Golden crowned sparrow	1					
Field sparrow	1					
Lark sparrow	1					
White-crowned sparrow	2					
Grasshopper sparrow	2					
Java sparrow	1					
Vesper sparrow	2					
Chipping sparrow	1					
Lincoln's sparrow	1					
Song sparrow	12			3		
Sage sparrow	1					
Towhees	4					
Rufous-sided towhee	3					
Green-tailed towhee	1					
Mannikins	63		1	34	3	2,000
Mannikins	19			9		
Nutmeg manikin	18			11	1	
Chestnut manikin	26		1	14	2	2,000
Misc. Perching birds	60	5	2	8	49	33,600
Perching birds	17	5	2	2	49	33,600
House sparrow	22			2		
Red-vented bulbul	1			1		
Wrentit	1					
American pipit	5					
Cedar waxwing	10			2		
Loggerhead shrike	2					
Japanese white-eye	1					
Warbling silverbill	1			1		

Table 15. Continued (page 12 of 14)

Wildlife group or species	15-year totals					
	Number of reported strikes				Reported economic losses ¹	
	Total	With damage	With neg. EOF	With multiple animals ²	Aircraft down time (hrs)	Reported costs (\$)
Total known birds	24,447	3,493	2,581	5,919	209,393	127,510,477
Unknown birds	33,255	3,823	2,118	3,695	68,172	54,084,872
Total birds	57,702	7,316	4,699	9,614	277,565	181,595,349
<u>Flying mammals (bats)</u>						
Old world fruit bats	3	1	2	1	72	3,069,400
Red bat	7	1		1		
Hoary bat	1					
Eastern small-footed myotis	1					
Little brown bat	8					
Free-tailed bat	5			1		
Brazilian free-tailed bat	10					
Total known bats	35	4	2	3	72	3,076,015
Unknown bats	89	2		11		6,615
Total bats	124	4	2	14	72	3,076,015
<u>Terrestrial mammals</u>						
Marsupials (opossum)	34					
Xenarthras (armadilo)	14	1	1		8	700
Lagomorphs	104	3	4	1	6	24,384
Black-tailed jackrabbit	46	2	1			24,384
White-tailed jackrabbit	1					
Rabbits	24			1		
Eastern cottontail rabbit	33	1	3		6	
Rodents	83	2	2			
Prairie dog	4		1			
Woodchuck	58	2	1			
Woodrats	2					
Muskrat	7					
Black rat	2					
Norway rat	3					
North American porcupine	7					
Carnivores	364	29	56	2	11,849	696,764
Canids	3		1			
Coyote	174	15	34		9,675	660,828
Domestic dog	21	6	12			

Table 15. Continued (page 13 of 14)

Wildlife group or species	15-year totals					
	Number of reported strikes				Reported economic losses ¹	
	Total	With damage	With neg. EOF	With multiple animals ²	Aircraft down time (hrs)	Reported costs (\$)
Fox	45	4	1		10	750
Red fox	26		3			
Common gray fox	3	1	1		2	186
Raccoon	33	2	3	1	2,160	35,000
White-nosed coati	1					
Ringtail	1					
Skunks	6		1		2	
Striped skunk	40			1		
River otter	1	1				
Badger	2					
House cat	8					
Artiodactyls (deer/cattle)	683	559	353	69	242,584	29,104,717
Deer	8	8	4		696	197,000
White-tailed deer	616	500	312	58	175,135	22,583,718
Mule deer	29	24	17	4	3,528	484,695
Wapiti (elk)	9	9	5	2	11,560	5,496,204
Moose	3	2	3			
Caribou	1	1	1			
Cattle	8	8	6	2	46,535	187,000
Pronghorn	7	6	5	2	5,130	156,100
Swine (pigs)	1					
Collared peccary	1	1		1		
Perissodactyls (horse)	3	3	3		1,008	23,849
Total known terr. mammals	1,285	597	419	72	255,455	29,850,414
Unknown terr. mammals	12	6	6	1		
Total terrestrial mammals	1,297	603	425	73	255,455	29,850,414
Reptiles						
Turtles	55		2	1		
Turtles	36		2	1		
Florida soft shell turtle	4					
Box turtle	4					
Common snapping turtle	2					
Diamondback terrapin	8					
Painted turtle	1					

Table 15. Continued (page 14 of 14)

Wildlife group or species	15-year totals					
	Number of reported strikes				Reported economic losses ¹	
	Total	With damage	With neg. EOF	With multiple animals ²	Aircraft down time (hrs)	Reported costs (\$)
American alligator	12	1	2			
Green iguana	6		3			
Total reptiles	73	1	7	1		
Total known (all species)	25,840	4,095	3,009	5,995	464,920	160,436,906
Total unknown	33,356	3,831	2,124	3,707	68,172	54,091,487
Total	59,196	7,924	5,133	9,702	533,092	214,521,778

¹ These reported economic losses by species and species groups are minimal estimates because only about 20 percent of strikes involving civil aircraft are reported and only about 44 percent of reported strikes identify the wildlife species or species group responsible. Furthermore, less than 25 percent of reported strikes indicating damage also provided an estimate of the cost of damage or the downtime (see Table 18). Finally, even when cost estimates were provided, many reports were filed before aircraft damage had been fully assessed. See Table 18 for a more detailed projection of actual economic losses.

² More than 1 animal was struck by the aircraft.

Table 16. Number of reported strikes, strikes with damage, and strikes having a negative effect-on-flight (EOF) for the five most commonly struck bird groups and two most commonly struck terrestrial mammal groups, civil aircraft, USA, 1990–2004.

Species group ¹	Reported strikes		Strikes with damage		Strikes with EOF	
	15-year total	% of total known	15-year total	% of total known	15-year total	% of total known
Birds						
Gulls	5,801	24	963	28	770	30
Doves/pigeons	3,330	14	255	7	285	11
Raptors	3,077	13	587	17	379	15
Blackbirds/starlings	2,452	10	142	4	170	7
Waterfowl	2,416	10	1,104	32	518	20
All other known	7,371	30	442	13	459	18
Total known birds	24,447	100	3,493	100	2,581	100
Unknown birds	33,255		3,823		2,118	
Total birds	57,702		7,316		4,699	
Terrestrial mammals						
Artiodactyls	683	53	559	94	353	84
Carnivores	364	28	29	5	56	13
All other known	238	19	9	2	10	2
Total known mam.	1,285	100	597	100	419	100
Unknown mam.	12		6		6	
Total mammals	1,297		603		425	

¹ See Table 15 for listing of species within each species group.

Table 17. Estimates of the percent of wildlife strikes with civil aircraft in USA reported to the Federal Aviation Administration for inclusion in the National Wildlife Strike Database, based on a comparison of strike reports found in independent databases with strike reports in the

Source of non-FAA strike database ¹	Year	Number of strike reports:					Percent of strikes in FAA database in relation to:	
		In Source data-base (A)	In both Source & FAA database (B)	In FAA but not Source database (C)	In FAA data-base (B+C)	Total known for Source (A+C) ²	Source data-base (B/A)	Total known for source (B+C)/(A+C)
Airline 1	1991	147	25	43	68	190	17.0	35.8
Airport 1	1992	50	3	11	14	61	6.0	23.0
Airline 1	1992	112	19	47	66	159	17.0	41.5
Airline 1	1993	141	30	65	95	206	21.3	46.1
Airline 1	1994	162	35	81	116	243	21.6	47.7
Airline 1	1995	150	32	79	111	229	21.3	48.5
Airline 1	1996	188	34	77	111	265	18.1	41.9
Airport 2	1998	39	4	5	9	44	10.3	20.5
Airport 3	1998	54	2	41	43	95	3.7	45.3
Airline 1	1999	1,299	92	34	126	1,333	7.1	9.5
Airline 2	1999	113	26	46	72	159	23.0	45.3
Airline 1	2003	928	76	16	92	944	8.2	9.7
Airline 1	2004	1093	90	16	106	1,109	8.2	9.6
Airline 3	2004	85	21	30	51	115	24.7	44.3
TOTAL		4,561	489	591	1,080	5,152	10.7³	21.0⁴

¹ U.S.-based airlines and airports that provided the FAA database manager with internally maintained, independent wildlife strike databases for given years that could be compared with strikes reported to the FAA and entered the National Wildlife Strike Database.

² The total number of non-duplicating wildlife strike events that occurred for the airline or at the airport based on combined Source and FAA databases. The number of additional wildlife strike events not recorded in either database is unknown.

³ Overall, 10.7 percent of the 4,561 strikes recorded in the airline or airport databases had been reported to the FAA for inclusion in the National Wildlife Strike Database.

⁴ Overall, 21.0 percent of the 5,152 known strikes for the airline or at the airport, based on the combined Source and FAA databases, had been reported to the FAA for inclusion in the National Wildlife Strike Database. The number of additional wildlife strike events not recorded in either database is unknown.

Table 18. Number of reported wildlife strikes indicating damage or a negative effect-on-flight (EOF) and reported losses in hours of downtime and U.S. dollars, for civil aircraft, USA, 1990–2004.

	Number of reports				Reported time (hours) aircraft out of service (No. of reports)	Cost in millions of dollars (No. of reports)		
	Total reports	Reports indicating adverse effect	Reports indicating aircraft damage	Reports indicating negative EOF		Direct cost	Other cost	Total cost
15-yr total	59,196	10,464	7,924	5,133	533,092 (2,947)	186.988 (1,856)	27.534 (675)	214.522 (1,997)
15-yr avg.	3,946	698	528	342	35,539 (196)	12.466 (124)	1.836 (45)	14.302 (133)
Mean losses per incident reported					180.9	0.101	0.041	0.142
Estimated annual losses								
Minimum¹					126,268	70.498	28.618	99.116
Maximum²					631,341	352.490	143.090	495.580

¹ Minimum values are based on the assumption that all 10,464 reported strikes indicating an adverse effect (negative EOF and/or damage) to aircraft (mean of 698/year) incurred similar amounts of damage and/or downtime and that these reports are all of the adverse-effect strikes that occurred.

² Maximum values are based on the assumption that the 10,464 reported strikes indicating an adverse effect represent only 20 percent of the total strikes that occurred.

Figures

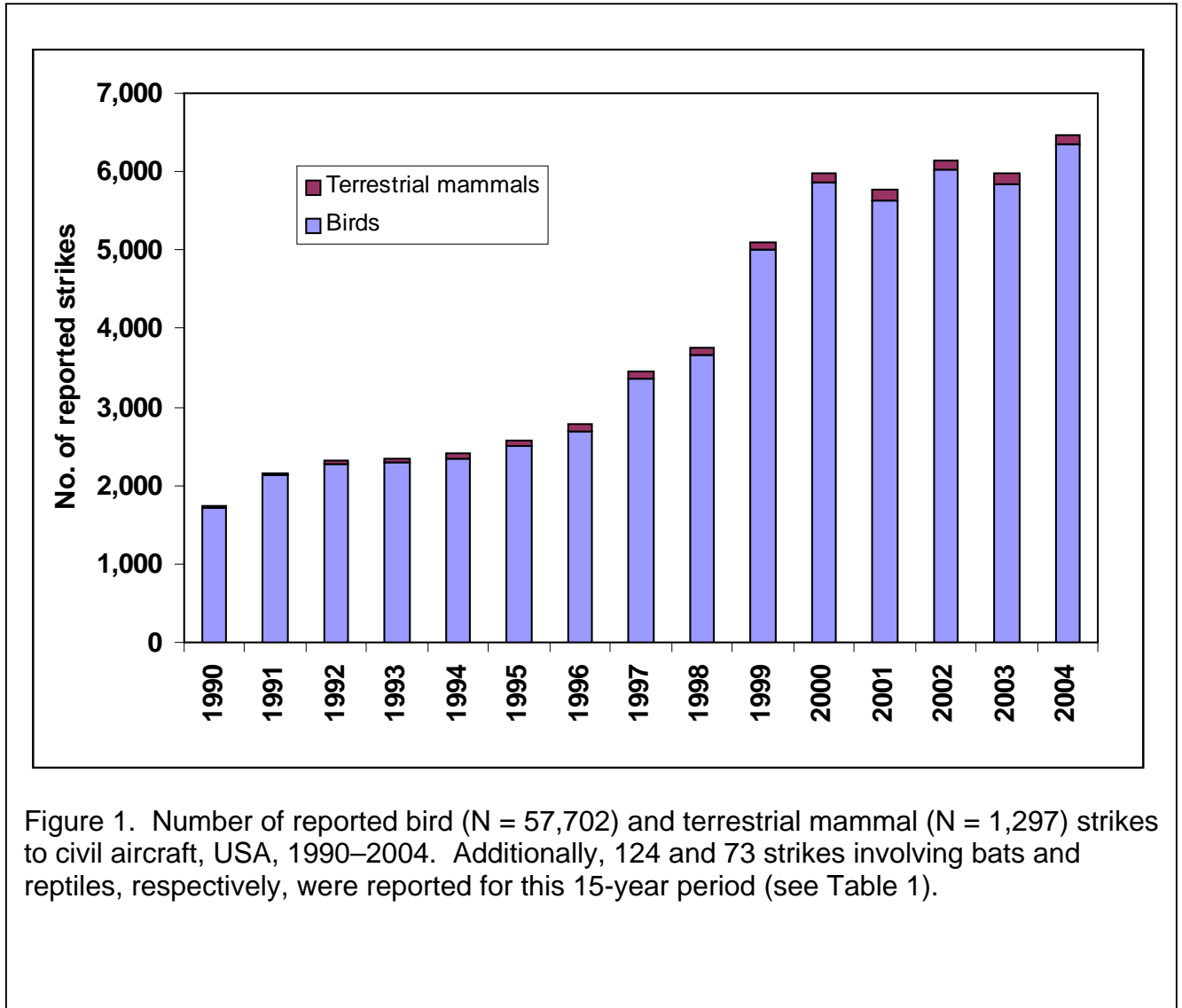


Figure 1. Number of reported bird (N = 57,702) and terrestrial mammal (N = 1,297) strikes to civil aircraft, USA, 1990–2004. Additionally, 124 and 73 strikes involving bats and reptiles, respectively, were reported for this 15-year period (see Table 1).

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SELECTED SIGNIFICANT STRIKES TO CIVIL AIRCRAFT IN THE UNITED STATES, 2004

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. We compiled 59,196 strike reports from 1,258 USA airports and 184 foreign airports for 1990 through 2004 (6,511 strikes in 2004), but estimate that this represents only about 20 percent of the strikes that have occurred. The following database examples from 2004 illustrate the serious impact that strikes by birds or other wildlife can have on aircraft and the widespread and diverse nature of the problem. The examples are not intended to highlight or criticize individual airports because strikes have occurred on almost every airport in the USA. Many of the strike examples reported here occurred off airport property during approach or departure. For more information on wildlife strikes or to report a strike, visit www.birdstrike.org and <http://wildlife-mitigation.tc.faa.gov>.

Date: 22 January 2004

Aircraft: Augusta Westland Helicopter
Airport: Palm Beach Intl. (FL)
Phase of Flight: Approach (500' AGL)
Effect on Flight: Precautionary landing
Damage: Windshield
Wildlife Species: Osprey
Comments from Report: An osprey crashed into the windshield, forcing the pilot to land at Palm Beach Intl. Airport. The windshield shattered and caused minor injuries to the pilot, the only person on board. Most of the windshield departed the aircraft. Interior was quite a mess. Time out of service was 3 weeks. Cost was \$16,000.

Date: 29 January 2004

Aircraft: Diamond DA 20
Airport: Baltimore (MD)
Phase of Flight: En Route (2,000' AGL)
Effect on Flight: Precautionary landing
Damage: Tail, horizontal stabilizer, prop, wing
Wildlife Species: Tundra swan
Comments from Report: Aircraft encountered about 10 swans. The pilot tried to avoid them but hit one. It cracked the prop, bounced off right wing and entire swan lodged in the tail. Pilot returned to Baltimore-Washington International. Bird ID by Smithsonian, Division of Birds. Cost was \$15,000.

Date: 8 February 2004

Aircraft: Eurocopter BO 105
Airport: Baton Rouge (LA)
Phase of Flight: En Route (700' AGL)
Effect on Flight: Precautionary landing
Damage: Windshield
Wildlife Species: American bittern
Comments from Report: Approximately 3 miles south of Baton Rouge Metropolitan Airport, a helicopter hit an American bittern which broke out the copilot's windshield. The body came into the cockpit on short final, before that it was wedged into the windshield. Time out of service was about 3 days. Cost of repairs was \$5,000.

Date: 17 February 2004

Aircraft: B-757-200
Airport: Portland Intl. (OR)
Phase of Flight: Takeoff run
Effect on Flight: Engine shut down, precautionary landing
Damage: Engine
Wildlife Species: Mallard
Comments from Report: The aircraft hit 5 mallards and returned with one engine out. At least 1 bird was ingested and parts of 5 birds were collected from the runway. Engine was not repairable and had to be replaced. Time out of service was 3 days. Cost was \$2.5 million.

Date: 19 March 2004

Aircraft: Helicopter
Airport: Oklahoma
Phase of Flight: En Route (3,000' AGL)
Effect on Flight: Precautionary landing
Damage: Windshield
Wildlife Species: Duck
Comments from Report: Duck crashed through the windshield of a medical center helicopter. Paramedic suffered only bruises to chest and arms. A safe landing was made and the patient was taken by ambulance to a hospital along with the helicopter crew.

Date: 26 March 2004

Aircraft: RV-6
Airport: Adams Field (AR)
Phase of Flight: Approach (2,500' AGL)
Effect on Flight: Precautionary landing
Damage: Windshield
Wildlife Species: Lesser scaup
Comments from Report: Duck crashed through the windshield at night, momentarily blinding pilot who was covered with duck blood. Pilot increased speed for landing due to increased drag from hole in windshield. Time out of service was about 3 weeks. Cost to repair was \$1,000.

Date: 30 March 2004

Aircraft: B-747
Airport: Louisville Intl. (KY)
Phase of Flight: Climb
Effect on Flight: Precautionary landing
Damage: Engines
Wildlife Species: European starling
Comments from Report: Just after takeoff, about 60-100 starlings were struck and ingested into the #3 and #4 engines. The engines lost power but were not shut down. An emergency was declared and the aircraft returned to the airport safely. Several blades had to be replaced.

Date: 15 April 2004

Aircraft: A-319
Airport: Portland Intl. (OR)
Phase of Flight: Climb (800' AGL)
Effect on Flight: Engine shut down, precautionary landing
Damage: Engine
Wildlife Species: Great blue heron
Comments from Report: Heron was ingested causing extensive damage to the right engine. Pilot shut the engine down as a precaution and made an emergency landing. Runway was closed 38 minutes for cleaning. Flight was cancelled. Engine and nose cowl were replaced. Time out of service was 3 days. Damage totaled \$388,000.

Date:	14 June 2004
Aircraft:	B-737-300
Airport:	Greater Pittsburgh Intl. (PA)
Phase of Flight:	Landing roll
Effect on Flight:	Ran off runway
Damage:	Landing gear
Wildlife Species:	Great horned owl
Comments from Report:	The aircraft struck an owl with the front main gear, severing a cable. The steering failed, the aircraft ran off the runway and became stuck in mud. Passengers were bused to the terminal. They replaced 2 nose wheels, 2 main wheels, and brakes. Time out of service was 24 hours. Cost was estimated at \$20,000.

Date:	14 July 2004
Aircraft:	B-737-500
Airport:	San Diego Intl. (CA)
Phase of Flight:	Takeoff run
Effect on Flight:	Precautionary landing
Damage:	Engine
Wildlife Species:	Barn owl
Comments from Report:	The #1 engine ingested a barn owl on takeoff run. Engine vibration went to full scale and a precautionary landing was made. Four pairs of fan blades were replaced. Time out of service was 8 hours. Repair cost was \$16,000; other costs totaled \$54,000.

Date:	2 August 2004
Aircraft:	B-747-400
Airport:	Bangkok Intl. (Thailand)
Phase of Flight:	Takeoff run
Effect on Flight:	Aborted takeoff
Damage:	Landing gear
Wildlife Species:	Spotted dove
Comments from Report:	The #2 engine ingested a dove causing an aborted takeoff. Pilot ordered an evacuation for safety because a tire had blown and the brake caught fire. Four passengers received minor injuries. The engine was not damaged. Time out of service was 4 days. Repair cost was \$47,310; hotel costs estimated at \$36,100. Medical bills and meals were not included in costs (U.S. carrier).

Date:	20 August 2004
Aircraft:	BE-58
Airport:	Groveton-Trinity County (TX)
Phase of Flight:	Landing roll
Effect on Flight:	Avoidance maneuver, ran off runway
Damage:	Aircraft destroyed
Wildlife Species:	White-tailed deer
Comments from Report:	Not a strike, but effected the flight. Pilot saw 3 deer on the left side of the runway at touchdown. When the pilot tried to avoid the deer, the aircraft left the runway, hit trees in a ravine and was consumed by fire. Tall grass on both sides of the runway hid the deer. The airport was not fenced. Published airport information remarked that deer were on and in vicinity of the airport. NTSB investigated.

Date:	31 August 2004
Aircraft:	B-737-800
Airport:	Chicago O'Hare Intl. (IL)
Phase of Flight:	Climb (4,800' AGL)
Effect on Flight:	Precautionary landing
Damage:	Engine
Wildlife Species:	Double-crested cormorant
Comments from Report:	One engine ingested a large bird about 5 miles from the airport. A precautionary landing was made due to engine vibrations. Fluid was leaking from the aircraft. Six fan blades were replaced. Bird ID by Smithsonian, Division of Birds. Approximate time out of service was 6 hours. Cost of repairs was estimated at \$61,000; other costs \$7,000.

Date:	16 September 2004
Aircraft:	B-747-400
Airport:	Gander Intl. (Newfoundland, Canada)
Phase of Flight:	Takeoff run
Effect on Flight:	Engine shut down, precautionary landing
Damage:	Engine & fan case
Wildlife Species:	Ring-billed gulls
Comments from Report:	Immediately after takeoff rotation, flight crew reported a loud bang followed by aircraft yaw to left. Flight engineer advised captain of engine failure. Fuel was dumped and the aircraft made a 3-engine landing at the airport. Extensive fan blade damage. Bird ID by Smithsonian, Division of Birds (U.S. carrier).

Date:	16 September 2004
Aircraft:	MD-80
Airport:	Chicago O'Hare Intl. (IL)
Phase of Flight:	Climb (3,000' AGL)
Effect on Flight:	Engine shut down, precautionary landing
Damage:	Engine
Wildlife Species:	Double-crested cormorant
Comments from Report:	The aircraft struck a flock of cormorants. Several birds were ingested causing an engine failure and fire. Debris fell from the engine onto a neighborhood in suburban Chicago. Aircraft made an emergency landing. Bird ID by Smithsonian, Division of Birds. Estimated cost of damage was \$179,000; other costs \$6,885.

Date:	16 September 2004
Aircraft:	A-300
Airport:	San Antonio Intl. (TX)
Phase of Flight:	Climb (1,200' AGL)
Effect on Flight:	Precautionary landing
Damage:	Radome, bulkhead
Wildlife Species:	Unknown birds
Comments from Report:	Aircraft had major damage due to a large bird strike. Major damage to radome and forward pressure bulkhead. Flight cancelled. Time out of service was 17 days. Cost of repairs was \$142,000. Other costs totaled \$300,000. One flight was cancelled.

Date: 13 October 2004

Aircraft: Rockwell AC 690
Airport: Winder Barrow (GA)
Phase of Flight: Climb (50' AGL)
Effect on Flight: Engine shut down
Damage: Engine, propeller, wing, fuselage, landing gear, tail
Wildlife Species: Canada geese
Comments from Report: The aircraft struck at least 17 geese on climb. The #1 engine failed due to ingestion. Aircraft diverted to another airport and landed safely. 14 carcasses found on departure runway. Remains of 3 other geese found on engine inlet. Time out of service was over 6 days. Cost of repairs was \$600,000 and other costs totaled \$2,000. Bird ID by Smithsonian, Division of Birds.

Date: 19 October 2004

Aircraft: Canadair Regional Jet
Airport: Bishop Intl. (MI)
Phase of Flight: Takeoff run
Effect on Flight: Aborted takeoff
Damage: Wing, landing gear
Wildlife Species: White-tailed deer
Comments from Report: The aircraft struck 2 deer on takeoff run. The landing gear door and left inboard flap were damaged. Passengers had to be put up over night as this was the last flight of the day. Time out of service was 2 days. Cost of repairs was estimated at \$100,000.

Date: 24 October 2004

Aircraft: B-767
Airport: Chicago O'Hare Intl. (IL)
Phase of Flight: Takeoff run
Effect on Flight: Engine shut down, precautionary landing
Damage: Engine
Wildlife Species: Passerines
Comments from Report: The aircraft struck a flock of birds on takeoff run. A compressor stall caused the engine to flame out. Local residents reported seeing flames coming from the plane. Approximately 11,000 gallons of fuel were dumped over Lake Michigan before returning to land. (Conflicting information about fuel dump on strike reports) Feathers were sent to the Smithsonian, Division of Birds, for identification. Could only identify species as passerines. Time out of service was about 4 days. Cost of fuel lost was \$15,000.

Date: 02 November 2004

Aircraft: MD-80
Airport: Chicago O'Hare Intl. (IL)
Phase of Flight: Climb (200' AGL)
Effect on Flight: Precautionary landing
Damage: Engine
Wildlife Species: Ring-billed gulls
Comments from Report: The aircraft made an emergency landing after ingesting a bird in the #2 engine. Oil and fuel were leaking from the engine. Smears of remains from two impact areas were sent to the Smithsonian, Division of Birds, for identification. Feathers could only be identified as gull. DNA sample provided a positive ID to species.

Date:	04 November 2004
Aircraft:	C-310
Airport:	Sundance Airpark (OK)
Phase of Flight:	Landing roll
Effect on Flight:	Props hit runway
Damage:	Landing gear, props, engines and nose
Wildlife Species:	White-tailed deer
Comments from Report:	The aircraft hit a deer upon landing. Deer hit left prop, then went into lower nose cone where it took out the front landing gear causing the plane to drop onto its nose. Both props hit the runway. Initial estimates are \$50,000 to \$70,000. Three deer were removed from the private airport.

Date:	07 November 2004
Aircraft:	EMB-145
Airport:	Kalamazoo/Battle Creek Intl. (MI)
Phase of Flight:	Climb
Effect on Flight:	Engine shut down, precautionary landing
Damage:	Engine, wing
Wildlife Species:	Trumpeter swans
Comments from Report:	Multiple bird strike. Pilot shut the right engine down and made an emergency landing. Leading edge of wing was dented. Engine was replaced. Bird ID by Smithsonian, Division of Birds. Cost of repairs was estimated at \$450,000.

Date:	19 November 2004
Aircraft:	B-757
Airport:	San Francisco Intl. (CA)
Phase of Flight:	Approach (100' AGL)
Effect on Flight:	Engine shut down
Damage:	Engine
Wildlife Species:	Brown pelican
Comments from Report:	Bird flew into left engine. Numerous fan blades damaged beyond repair. Pilot shut the engine down. Landing was normal. All fan blades were replaced. Bird ID by Smithsonian, Division of Birds. Time out of service was 4 days. Cost of repairs was \$216,000.

Date:	08 December 2004
Aircraft:	MD-80
Airport:	Sacramento Intl. (CA)
Phase of Flight:	Climb (5,500' AGL)
Effect on Flight:	Precautionary landing
Damage:	Radome, wing
Wildlife Species:	Northern pintail
Comments from Report:	Passengers reported seeing a flock of geese at time of strike. Radome was dented over 1/3 of surface and wing was punctured and dented. Bird ID by Smithsonian, Division of Birds. Cost of repairs estimated at \$200,000.