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Wildlife Strikes to Civil Aircraft in the United States 1990-2005

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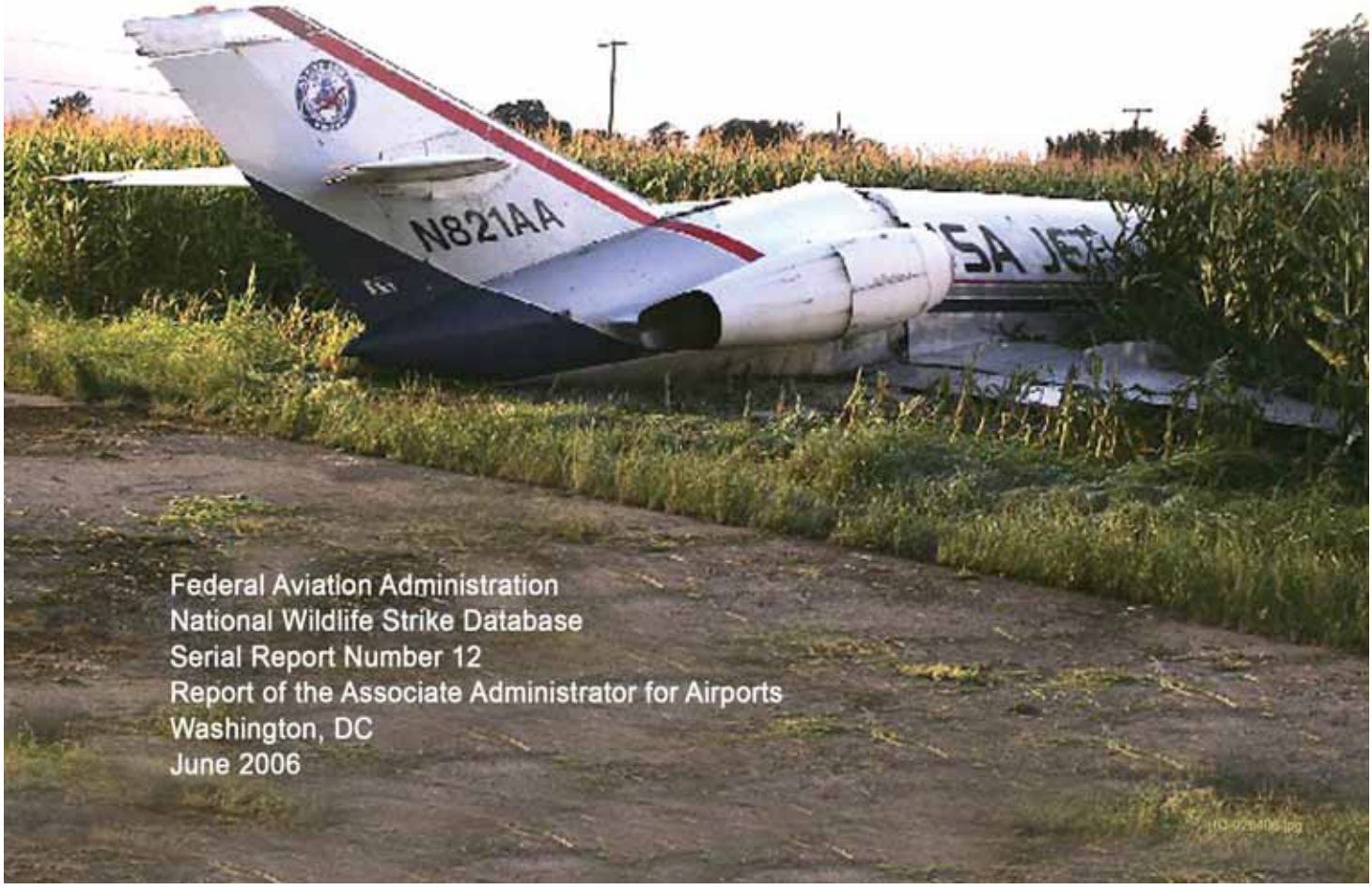
1990-2005



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COVER

At sunset on 1 September 2005, a Falcon 20 departing a regional airport in Ohio hit a flock of mourning doves (mean body mass = 120 grams) just after rotation (15 feet AGL), causing the #1 engine to flame out. As the gear was retracted, the aircraft hit a second flock which caused the #2 engine to lose power. The aircraft slid through a ditch and airport perimeter fence, and across a road, coming to a stop in a corn field. The aircraft sustained major structural damage beyond economical repairs. The copilot sustained minor injuries.

The mourning dove population in the USA annually reaches its maximum level of over 400 million birds in September following the spring-summer nesting season (Dolton and Rau 2005). The mourning doves involved in the strike described above had been feeding in harvested wheat fields near the airport.

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, New Jersey, 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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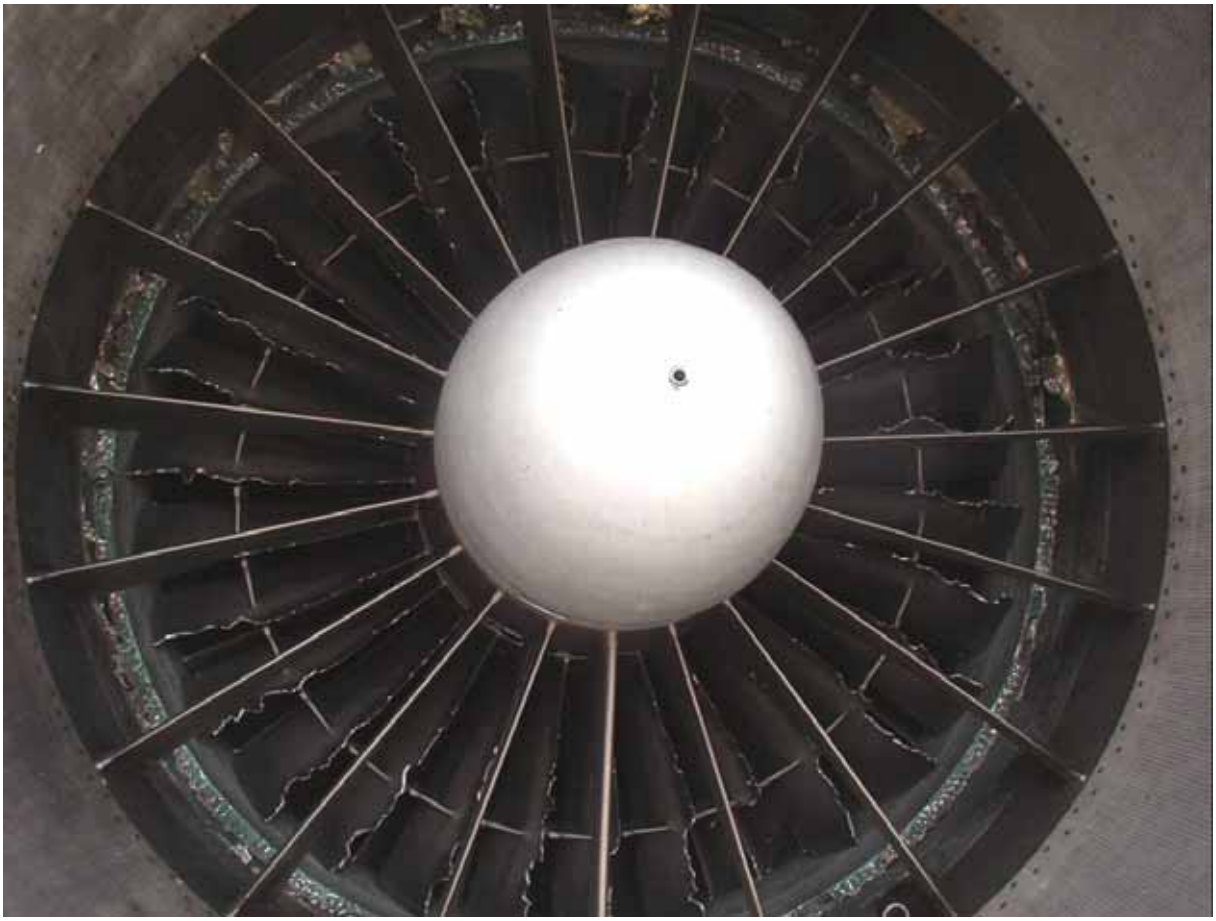
PREFACE



A DC-9-30 departing an airport in Missouri on 10 June 2005 ingested an American kestrel into the #1 engine at 10 ft AGL. The aircraft returned to airport with extensive engine damage. The American kestrel is the smallest falcon in North America, weighing about 120 grams. Kestrels hunt for mice, grasshoppers and other small prey at airports.

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.

Commercial air carriers are replacing their older three- or 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 2005). 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).

Many populations of wildlife species commonly involved in strikes have increased markedly in the last few decades. For example, from 1980 to 2005, the resident (non-migratory) Canada goose population in the USA and Canada increased at a mean rate of 7.9 percent per year. Other species showing significant mean annual rates of increase included red-tailed hawks (1.9 percent), wild turkeys (12.7 percent), turkey vultures (2.2 percent), double-crested cormorants (4.9 percent), and sandhill cranes (4.3 percent) (Sauer et al. 2006). 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 at least 17 million by 1997 (McCabe and McCabe 1997).

Canada geese are one of the most hazardous bird species for aircraft because of their large size and flocking behavior. The non-migratory population of Canada geese in the USA increased over 3-fold from 1 million to 3.5 million birds from 1990–2005. These birds are attracted to open spaces of airports to graze on grass. Aggressive management programs are needed to disperse geese from airports. Photo by USDA.

Air traffic has increased substantially since 1980. Passenger enplanements in the USA increased from about 310 million in 1980 to 731 million in 2005 (3.5 percent per year), and commercial air traffic increased from about 17.8 million aircraft movements in 1980 to 29.9 million in 2005 (2.1 percent per year, Federal Aviation Administration 2006). USA commercial air traffic is predicted to continue growing at a rate of at least 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, *Birds/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, 1990–2003 and 1990–2004 (Cleary et al. 1996, 1997, 1998, 1999, 2000, 2002a, 2002b, 2003, 2004, 2005). This is the 12th report in the series and covers the 16-year period, 1990–2005.

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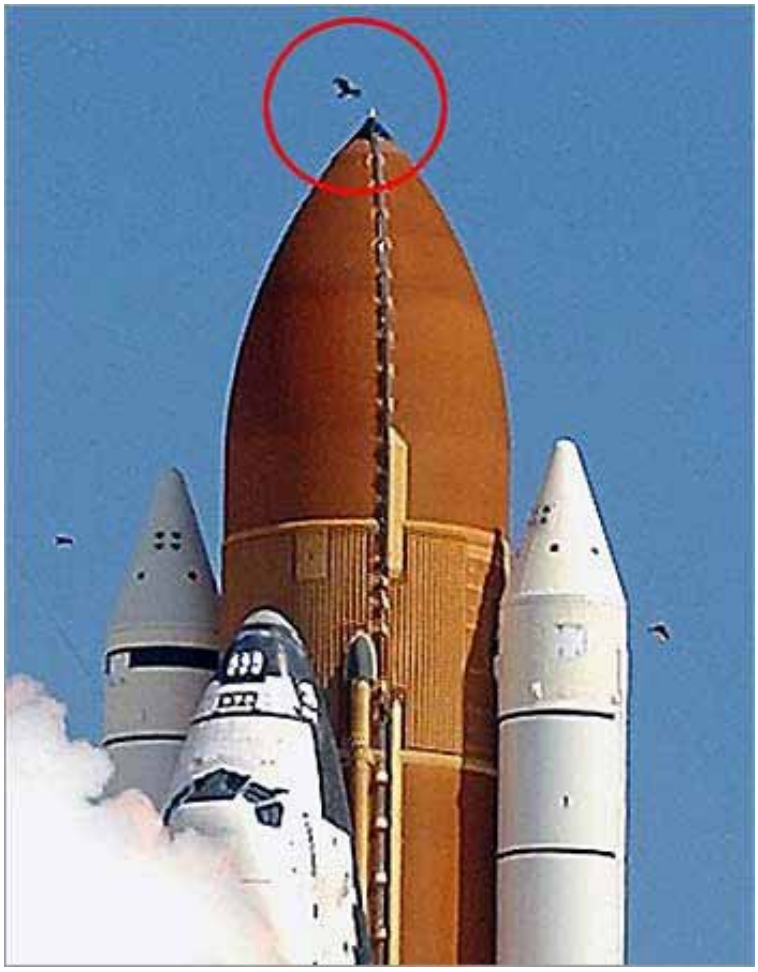
WILDLIFE STRIKES TO CIVIL AIRCRAFT IN THE UNITED STATES, 1990–2005

Introduction

This report presents a summary analysis of data from the FAA's National Wildlife Strike Database for the 16-year period of 1990 through 2005. Unless noted, all totals are for the 16-year period, and percentages are of the total known. Because of the large amount of data, Tables 2 through 16 present 16-year totals only and do not display data for individual years.



On 26 July 2005, at least one turkey vulture was struck by the external fuel tank on the Space Shuttle Discovery during launch at the Kennedy Space Center in Florida. The strike caused no apparent damage. The turkey vulture population in North America increased by 63 percent from 1980 to 2005.

In addition to the general analysis of wildlife strikes for 1990 through 2005, a special analysis of wildlife strikes involving helicopters is presented in Appendix A. Finally, a sample of significant wildlife strikes to civil aircraft in the USA during 2005 is presented in Appendix B. These recent strike examples demonstrate the widespread and diverse nature of the problem.

Results

Number of Reported Strikes

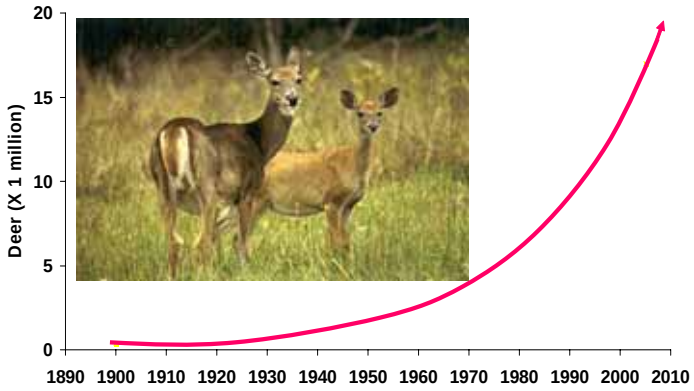
For the 16-year period (1990–2005), 66,392 strikes were reported to the FAA. Birds were involved in 97.5 percent of the reported strikes, terrestrial mammals in 2.2 percent, bats in 0.2 percent, and reptiles in 0.1 percent (Table 1).

The number of strikes annually reported quadrupled from 1,744 in 1990 to a record 7,136 in 2005 (Table 1, Figure 1). We suggest that the increase in reports from 1990 to 2005 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 2003). The temporary plateau in reported strikes from 2000-2003 may be related to a slight (<6 percent) decline in air traffic after the events of September 2001.

Methods of Reporting Strikes

Most (65 percent) of the 66,392 strike reports were filed using the paper (53 percent) or electronic (12 percent) version of FAA Form 5200-7, Bird/Other Wildlife Strike Report. Since the online version of this form became available in April 2001, use of the electronic reporting system has climbed dramatically. In 2005, 38 percent of the strike reports were submitted electronically (Table 2).



The white-tailed deer population in USA increased from 0.3 million to over 17 million, 1900–2005. Over 695 deer-aircraft collisions with civil aircraft were reported at USA Airports, 1990–2005.

Source of Reports

Airline personnel and pilots filed 31 percent and 25 percent of these 66,392 reports, respectively (Table 3). About 84 percent of the reported strikes involved commercial aircraft; the remainder involved business, private, and government 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 (5,517, 4,342, and 4,140, respectively) bird strike reports. Sixteen other states have each had over 1,000 bird strikes reported. New York, Texas, Michigan, Illinois, New Jersey, Colorado, and California each had 70 or more mammal strikes. In all, strikes were reported at 1,526 airports (1,326 airports in the USA and 200 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); 59 percent occurred during the landing (descent, approach, or landing roll) phase of flight; and 38 percent occurred during takeoff and climb (Table 8). About 60 percent of the bird strikes occurred when the aircraft was at a height of 100 feet or less above ground level (AGL), 73 percent occurred at 500 feet or less AGL, and 92 percent occurred at or below 3,000 feet AGL (Table 9).

Most terrestrial mammal strikes (58 percent) occurred between July and November with 33 percent of deer strikes concentrated in the October through November period (Table

6). Most terrestrial mammal strikes (63 percent) occurred at night (Table 7), 55 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).

On 30 November 2005 at 1717 hrs and 1200 ft AGL this Boeing 747 struck several birds on approach to a western USA airport, which is located on a major bird migration route. The aircraft sustained damage to the left outboard flap, engines 1 and 2 and a right wing flap fairing. The aircraft was out of service for four days.

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 8,750 strike events in which a total of 9,206 engines were reported as struck (8,314 events with one engine struck, 421 with two engines struck, 10 with three engines struck, and 5 with four engines struck). In 2,916 damaging bird-strike events involving engines, a total of 3,011 engines were damaged (2,822 events with one engine damaged, 93 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 64,734 bird strikes reported, 53,309 provided some indication as to the nature and extent of any damage. Of these 53,309 reports, 45,434 (85 percent) indicated the strike did not damage the aircraft; 4,240 (8 percent) indicated the aircraft suffered minor damage; 2,140 (4 percent) indicated the aircraft suffered substantial damage; 1,479 (3 percent) reported an uncertain level of damage; and 16 reports (less than 1 percent) indicated the aircraft was destroyed as a result of the strike (Table 11).

Of the 1,429 terrestrial mammal strikes reported, 1,022 reports provided some indication as to the nature and extent of any damage. Of these 1,022 reports, 368 (36 percent) indicated the strike did not damage the aircraft; 292 (29 percent) indicated the aircraft suffered minor damage; 293 (28 percent) indicated the aircraft suffered substantial damage; 49 (5 percent) reported an uncertain level of damage; and 20 (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).

In 13 percent and 56 percent of the bird and terrestrial mammal strike reports, respectively, an adverse effect-on-flight was reported (Table 12). Three percent of bird strikes resulted in an aborted takeoff compared to 18 percent of terrestrial mammal strikes.

Wildlife Species Involved in Strikes

Snowy owls from the Canadian arctic migrate to the northern USA in some winters in search of food. These invading owls often hunt for rodents and rabbits in the open spaces at airports, such as shown here in northern Ohio. Forty snowy owls have been reported as struck by civil aircraft at USA airports during winter months, 1990-2005 (as an example, see details of strike event on 28 December 2005 in Appendix B). Photo by G. Wright.

Table 13 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 identified wildlife species for the 16-year period, 1990 through 2005. Only 27,325 (42 percent) of the 64,734 bird strike reports provided information on the type of bird (e.g., gull or hawk). Furthermore, only 15,485 (57 percent) of these 27,325 reports provided identification to species level (e.g., ring-billed gull or red-tailed hawk; Table 13). Thus, birds were identified to species level in only 24 percent of the 64,734 reported bird strikes. In all, 330 identified species of birds were struck; 146 identified species were reported as causing damage.

Gulls (23 percent), doves/pigeons (14 percent), raptors (13 percent), waterfowl (10 percent), sparrows (7 percent), and starlings (6 percent) were the most frequently struck bird groups (Table 14). Gulls were involved in 2.4 times more strikes than waterfowl (6,201 and 2,613, respectively). Waterfowl, however, were involved in more damaging strikes (1,186 or 31 percent of all damaging strikes in which the bird type was identified) than were gulls (1,014 or 27 percent of all damaging strikes in which the bird type was identified). Gulls were responsible for the greatest number of bird strikes (805 or 29 percent) that had a negative effect-on-flight.

The most frequently struck terrestrial mammals were Artiodactyls – primarily deer (51 percent) – and Carnivores – primarily coyotes (29 percent) (Tables 13, 14). Artiodactyls were responsible for 93 percent of the mammal strikes that resulted in damage and 83 percent of the mammal strikes that had a negative effect-on-flight. In all, 33 identified species of terrestrial mammals and 5 identified species of bats were reported struck; 18 identified species of terrestrial mammals and 1 identified species of bat caused damage (Table 13).

Human Injuries and Fatalities Due to Wildlife Strikes

For the 16-year period, reports were received of 144 wildlife strikes that resulted in 172 human injuries and 9 fatalities. Waterfowl (geese and ducks) and birds of prey (raptors and owls) were involved in 63 (69 percent) of the 91 bird strikes where injury occurred and the type of bird was identified (Table 15). For bird strikes, 1 fatality was caused by a brown pelican and 7 fatalities were caused by unknown species.

On night takeoff, this Beechcraft Baron hit an 80-pound chow dog with the front landing gear. The dog was thrown into the right propeller. The center landing gear collapsed, resulting in damage to the left propeller and the rear landing gears. Properly installed airport perimeter fencing could have prevented this August 2004 incident.

Reports were received of 22 terrestrial mammal strikes that resulted in 31 human injuries and 1 fatality. Deer were responsible for 18 (86 percent) of the 21 mammal strikes that resulted in injury and for the strike that resulted in a fatality (Table 15).

Economic Losses Due to Wildlife Strikes

For the 16-year period, reported losses from bird strikes totaled 301,115 hours of aircraft downtime and $233.9 million in monetary losses. Reported losses from terrestrial mammal strikes totaled 235,100 hours of aircraft downtime and $34.8 million in monetary losses. Bat strikes resulted in 73 hours of aircraft downtime and $3.1 million in losses. Reptile strikes resulted in 3 hours of aircraft downtime (Table 13).

Of the 11,328 reports that indicated the strike had an adverse effect on the aircraft and/or flight, 3,273 provided an estimate of the aircraft down time (Σ = 536,291 hours, avg. = 163.9 hours down time/incident, Table 16). Of the reports providing a damage cost estimate for the incident; 2,097 gave an estimate of the direct aircraft damage cost (Σ = $236.55 million, avg. = $113,000 damage/incident), and 793 gave an estimate of other monetary losses (Σ = $35.24 million, avg. = $44,000 lost/incident). Other monetary losses include such expenses as lost revenue, the cost of putting passengers in hotels, re-scheduling aircraft, and flight cancellations.

Analysis of strike reports from USA airports and airlines indicated that less than 20 percent of all strikes were reported to the FAA (Cleary et al. 2005, Wright and Dolbeer 2005). Additionally, only 19 percent of reports indicating an adverse effect provided estimates of direct costs, and only 7 percent provided estimates of other (indirect) costs. Furthermore, many reports providing cost estimates were filed before aircraft damage and downtime had been fully assessed. 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 11,328 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, then at a minimum, wildlife strikes cost the USA civil aviation industry 116,006 hours per year of aircraft downtime and $111.33 million per year in monetary losses ($79.86 million in direct costs and $31.46 million per year in associated costs, Table 16). 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 580,029 hours of aircraft downtime and $556.63 million in monetary losses ($399.31 million in direct costs and $157.32 million in associated costs, Table 16).

This CRJ600 with 20 passengers on board ingested doves into #1 engine at rotation from a southern USA airport. The engine sustained substantial damage and the aircraft was forced to make a precautionary landing.

Conclusions

An analysis of 16 years of strike data reveals the magnitude and severity of the wildlife-aircraft strike problem for civil aviation in the USA. Wildlife strikes continue to pose a significant economic and safety risk for civil aviation in the USA. Management actions to reduce wildlife strikes are being implemented at many airports (e.g., Wenning et al. 2004, DeFusco et al. 2005), but much work remains to be done to reduce wildlife strikes.

To address the problem, airport managers first need to assess the wildlife hazards on their airports (Dolbeer et al. 2000). They then 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 needs 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 2005) provides guidance to airport personnel in developing and implementing wildlife hazard management plans. Adobe Acrobat© PDF versions of the manual 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 previous analyses (Cleary et al. 2005, Wright and Dolbeer 2005) 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 1990-2005, provided

information on the type of bird struck, and only about 24 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 at least a partial 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 using FAA Form 5200-7. Strikes can be reported electronically via the internet (http://wildlife-mitigation.tc.faa.gov) or Form 5200-7 can be accessed and printed for mailing in reports.

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 being 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.

Ospreys, once an endangered species because of DDT, have made a remarkable comeback and have adapted to urban and suburban habitats. This pair of ospreys is building their nest on a light standard in a west coast airport's parking lot.

The identification of the exact species of wildlife struck (e.g., ring-billed gull, Canada goose, mallard, 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 10th & Constitution Ave. NW Washington, DC 20560-0116 (Identify as “safety investigation material”) Phone# 202-633-0787 or 202-633-0791	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.

“In accordance with its Airport Certification Manual and the requirements of this section, each certificate holder must take immediate action to alleviate wildlife hazards whenever they are detected.” (Title 14, Code of Federal Regulations, Part 139.337 (a)). This photo was taken at a western USA airport in 2002, 2 months before a Learjet 36 was destroyed when it struck elk on take off.

LITERATURE CITED

Burger, J. 1983. Jet aircraft noise and bird strikes: why more birds are being hit. Environmental Pollution (Series A) 30:143–152.

Burt, W. H. 1980. A field guide to the mammals. Third Edition. Houghton Mifflin. Boston, Massachusetts USA 289 pages.

Cleary, E. C., and R. A. Dolbeer. 2005. Wildlife hazard management at airports, a manual for airport operators. Second edition. Federal Aviation Administration, Office of Airport Safety and Standards, Washington, DC, USA. 348 pages. (http://wildlife-mitigation.tc.faa.gov/).

Cleary, E. C., S. E. Wright, and R. A. Dolbeer. 1996. Wildlife strikes to civilian aircraft in the United States, 1993–1995. Serial Report Number 2. DOT/FAA/AAS/97-1. Federal Aviation Administration, Office of Airport Safety and Standards, Washington, DC, USA. 33 pages.

Cleary, E. C., S. E. Wright, and R. A. Dolbeer. 1997. Wildlife strikes to civil aircraft in the United States, 1992–1996. Serial Report Number 3. DOT/FAA/AAS/97-3. Federal Aviation Administration, Office of Airport Safety and Standards, Washington, DC, USA. 30 pages.

Cleary, E. C., S. E. Wright, and R. A. Dolbeer. 1998. Wildlife strikes to civil aircraft in the United States, 1991–1997. Serial Report Number 4. Federal Aviation Administration, Office of Airport Safety and Standards, Washington, DC, USA. 34 pages.

Cleary, E. C., S. E. Wright, and R. A. Dolbeer. 1999. Wildlife strikes to civil aircraft in the United States, 1990–1998. Serial Report Number 5. Federal Aviation Administration, Office of Airport Safety and Standards, Washington, DC, USA. 33 pages.

Cleary, E. C., S. E. Wright, and R. A. Dolbeer. 2000. Wildlife strikes to civil aircraft in the United States, 1990–1999. Serial Report Number 6. Federal Aviation Administration, Office of Airport Safety and Standards, Washington, DC, USA. 61 pages.

Cleary, E. C., S. E. Wright, and R. A. Dolbeer. 2002a. Wildlife strikes to civil aircraft in the United States, 1990–2000. Serial Report Number 7. Federal Aviation Administration, Office of Airport Safety and Standards, Washington, DC, USA. 37 pages.

Cleary, E. C., R. A. Dolbeer, and S. E. Wright. 2002b. Wildlife strikes to civil aircraft in the United States, 1990–2001. U.S. Department of Transportation, Federal Aviation Administration, Serial Report No. 8, DOT/FAA/AS/00-6 (AAS-310). Washington DC, USA. 50 pages.

Cleary, E. C., R. A. Dolbeer, and S. E. Wright. 2003. Wildlife strikes to civil aircraft in the United States, 1990–2002. U.S. Department of Transportation, Federal Aviation Administration, Serial Report No. 9 DOT/FAA/AS/00-6 (AAS-310). Washington DC, USA. 51 pages.

Cleary, E. C., R. A. Dolbeer, and S. E. Wright. 2004. Wildlife strikes to civil aircraft in the United States, 1990–2003. U.S. Department of Transportation, Federal Aviation Administration, Serial Report No. 10 DOT/FAA/AS/00-6 (AAS-310). Washington DC, USA. 54 pages.

Cleary, E. C., R. A. Dolbeer, and S. E. Wright. 2005. Wildlife strikes to civil aircraft in the United States, 1990–2004. U.S. Department of Transportation, Federal Aviation Administration, Serial Report No. 11 DOT/FAA/AS/00-6 (AAS-310). Washington DC, USA. 53 pages.

DeFusco, R. P., M. J. Hovan, J. T. Harper, and K. A. Heppard. 2005. North American Bird Strike Advisory System, Strategic Plan. Institute for Information Technology Applications, U.S. Air Force Academy, Colorado Springs, CO, USA. 31 pages.

Dolbeer, R. A. 2000. Birds and aircraft: fighting for airspace in crowded skies. Proceedings of the Vertebrate Pest Conference 19:37–43.

Dolbeer, R. A. 2006. Height distribution of birds recorded by collisions with aircraft. Journal of Wildlife Management 70 (5): In press.

Dolbeer, R. A. and P. Eschenfelder. 2003. Amplified bird-strike risks related to population increases of large birds in North America. Proceedings International Bird Strike Committee 26 (Volume 1):49–67.

Dolbeer, R. A., S. E. Wright, and E. C. Cleary. 1995. Bird and other wildlife strikes to civilian aircraft in the United States, 1994. Interim report, DTFA01-91-Z-02004. U.S. Department of Agriculture, for Federal Aviation Administration, FAA Technical Center, Atlantic City, NJ, USA. 38 pages.

Dolbeer, R. A., S. E. Wright, and E. C. Cleary. 2000. Ranking the hazard level of wildlife species to aviation. Wildlife Society Bulletin 28:372–378.

Dolton, D. D. and R. D. Rau. 2005. Mourning dove breeding population status, 2005. U.S. Fish and Wildlife Service, Laurel, MD, USA. 19 pages.

Dunning, J. B., Jr. (Editor). 1993. Avian body masses. CRC Press. Boca Raton, FL, USA. 371 pages.

Federal Aviation Administration. 2006. Terminal area forecast (TAF) system. Federal Aviation Administration. Washington, DC, USA. (www.apo.data.faa.gov/).

International Civil Aviation Organization. 1989. Manual on the ICAO Bird Strike Information System (IBIS). Third edition. Montreal, Quebec, Canada.

International Civil Aviation Organization. 1993. Convention on international civil aviation (international standards and recommended practices). Annex 16: Environmental Protection. Third edition. Montreal, Quebec, Canada.

Kelly, T. C., R. Bolger, and M. J. A. O'Callaghan. 1999. The behavioral response of birds to commercial aircraft. Pages 77–82 *in* Bird Strike '99, Proceedings of Bird Strike Committee-USA/Canada Meeting. Vancouver, B.C., Canada: Transport Canada, Ottawa, Ontario, Canada.

MacKinnon, B., R. Sowden, and S. Dudley, (editors). 2001. Sharing the skies: an aviation guide to the management of wildlife hazards. Transport Canada, Aviation Publishing Division, AARA, 5th Floor, Tower C, 330 Sparks Street, Ottawa, Ontario, K1A 0N8, Canada. 316 pages.

McCabe, T. R., and R. E. McCabe. 1997. Recounting whitetails past. Pages 11–26 *in* W. J. McShea, H. B. Underwood, and J. H. Rappole (editors). The science of overabundance: deer ecology and population management. Smithsonian Institution. Washington DC, USA. 402 pages.

Richardson, W. J., and T. West. 2000. Serious birdstrike accidents to military aircraft: updated list and summary. Pages 67–98 *in* Proceedings of 25th International Bird Strike Committee Meeting. Amsterdam, Netherlands.

Sauer, J. R., J. E. Hines, and J. Fallon. 2006. The North American Breeding Bird Survey, results and analysis 1966 - 2005. Version 6.2.2006. U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, MD, USA. (www.mbr-pwrc.usgs.gov/bbs/bbs2005.html).

Thorpe, J. 2003. Fatalities and destroyed aircraft due to bird strikes, 1912–2002. Pages 85–113 *in* Proceedings of the 26th International Bird Strike Committee Meeting (Volume 1). Warsaw, Poland.

Thorpe, J. 2005. Fatalities and destroyed aircraft due to bird strikes, 2002–2004 (with an appendix of animal strikes). Pages 17-24 *in* Proceedings of the 27th International Bird Strike Committee Meeting (Volume 1). Athens, Greece.

Wenning, K. M., M. J. Begier, and R. A. Dolbeer. 2004. Wildlife hazard management at airports: fifteen years of growth and progress for Wildlife Services. Pages 295–301 *in* Proceedings of 21st Vertebrate Pest Conference, University of California, Davis, CA, USA.

Wright, S. E. and R. A. Dolbeer. 2005. Percentage of wildlife strikes reported and species identified under a voluntary system. *In* Proceedings of Bird Strike Committee USA/Canada meeting, Vancouver, B.C. Canada. (www.birdstrikecanada.com).

TABLES

Table 1. Number of reported wildlife strikes to civil aircraft by wildlife group, USA, 1990–2005 (see Figure 1).

	Number of reported strikes-all aircraft					Commercial aircraft only[1]		
Year	Birds	Bats	Terrestrial mammals	Reptiles	Total	Total	Movements (x 1 million)[2]	Strikes/ 10,000 movements
1990	1,723	4	17	0	1,744	1,318	25.19	0.523
1991	2,127	3	36	0	2,166	1,649	24.92	0.662
1992	2,262	2	56	1	2,321	1,711	25.32	0.676
1993	2,287	6	53	0	2,346	1,671	25.70	0.650
1994	2,342	2	73	1	2,418	1,785	26.74	0.668
1995	2,499	5	69	8	2,581	1,876	27.22	0.689
1996	2,691	1	91	3	2,786	1,936	27.74	0.698
1997	3,353	1	92	14	3,460	2,457	27.92	0.880
1998	3,658	3	105	7	3,773	2,522	28.17	0.895
1999	5,001	7	89	1	5,098	3,851	28.94	1.331
2000	5,869	16	120	3	6,008	4,482	29.70	1.509
2001	5,645	8	137	8	5,798	4,162	29.36	1.418
2002	6,045	19	119	15	6,198	4,401	27.79	1.584
2003	5,856	20	126	5	6,007	4,284	28.08	1.526
2004	6,401	27	118	6	6,552	4,689	29.08	1.612
2005	6,975	26	128	7	7,136	5,153	29.89	1.724
Total	**64,734**	**150**	**1,429**	**79**	**66,392**	**47,947**	**441.76**	**1.085**

[1] See Table 4.

[2] Departures and arrivals by air carrier, commuter, and air taxi service (FAA 2006).

[3] The decline in reported strikes in 2001 was likely related to the decrease in air travel after 11 September 2001. 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, 1990–2005.

Source	16-year total	% of total known
FAA Form 5200-7[1] (Paper)	35,198	53
FAA Form 5200-7E[2] (Electronic)	7,722	12
Airline report	9,976	15
Multiple[3]	5,922	9
Airport report	3,583	5
Other[4]	1,290	2
Engine manufacturer	819	1
Aircraft Incident Report	767	1
Preliminary Aircraft Incident Report	799	1
Aviation Safety Reporting System	177	<1
Aircraft Incident Preliminary Notice	63	<1
National Transportation Safety Board	67	<1
U.S. Air Force BASH program	9	<1
Total	**66,392**	**100**

[1] Bird/Other Wildlife Strike Report.

[2] Electronic 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, 32 percent in 2004, and 38 percent in 2005.

[3] More than one type of 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, 1990–2005.

Person filing report	16-year total	% of total known
Airline Operations	15,978	31
Pilot	12,889	25
Carcass Found	8,254	16
Tower	7,586	15
Airport Operations	5,451	11
Other	1,745	3
Total known	**51,903**	**100**
Unknown	**14,489**	
Total	**66,392**	

[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, 1990–2005.

Type of operator	16-year total	% of total known
Commercial	47,947	84
Business	6,719	12
Private	1,736	3
Government/Police	344	<1
Total known	**56,746**	**100**
Unknown	**9,646**	
Total	**66,392**	

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), 1990–2005.

State	Reported strikes (16-year total)					State	Reported strikes (16-year total)			
	Birds	Mammals	Reptiles	Total			Birds	Mammals	Reptiles	Total
AK	476	23	0	499		NC	1,156	26	0	1,182
AL	570	12	0	582		ND	173	8	0	181
AR	256	15	0	271		NE	669	19	0	688
AZ	984	64	0	1,048		NH	374	13	0	387
CA	5,517	73	0	5,590		NJ	1,727	77	8	1,812
CO	1,843	74	0	1,917		NM	133	6	0	139
CT	677	17	0	694		NV	312	4	0	316
DC	1,593	35	0	1,628		NY	3,512	105	15	3,632
DE	51	1	0	52		OH	2,051	68	0	2,119
FL	4,342	60	45	4,447		OK	578	24	2	604
GA	1,035	22	0	1,057		OR	1,029	9	0	1,038
HI	1,448	8	0	1,456		PA	2,267	68	0	2,335
IA	406	15	0	421		PI	122	0	5	127
ID	153	7	0	160		PR	115	2	0	117
IL	3,059	79	1	3,139		RI	290	10	0	300
IN	734	20	0	754		SC	294	15	0	309
KS	173	6	0	179		SD	102	8	0	110
KY	1,606	17	0	1,623		TN	1,849	18	0	1,867
LA	1,100	21	2	1,123		TX	4,140	105	0	4,245
MA	853	18	0	871		UT	746	13	0	759
MD	738	50	0	788		VA	875	52	0	927
ME	190	8	0	198		VI	79	0	0	79
MI	1,523	79	0	1,602		VT	63	1	0	64
MN	562	22	0	584		WA	967	13	0	980
MO	1,375	30	0	1,405		WI	531	46	0	577
MS	212	6	0	218		WV	155	47	0	202
MT	84	7	0	91		WY	57	6	0	63
				Total known[1]			**55,926**	**1,552**	**78**	**57,556**
				Foreign[2]			**1,321**	**11**	**0**	**1,332**
				Unknown			**7,487**	**16**	**1**	**7,504**
				Total			**64,734**	**1,579[3]**	**79**	**66,392**

[1] Strikes were reported at 1,326 airports in the USA.

[2] Strikes to USA air carriers were reported at 200 foreign airports.

[3] Mammal strikes consisted of 1,429 strikes involving terrestrial species and 150 strikes involving bats.

Table 6. Number of reported bird and terrestrial mammal strikes to civil aircraft by month, USA, 1990–2005[1].

	All birds		All terrestrial mammals		Deer only[2]	
Month	16-year total	% of total known	16-year total	% of total known	16-year total	% of total known
Jan	2,455	4	75	5	30	4
Feb	2,228	3	63	4	27	4
Mar	3,459	5	90	6	37	5
Apr	4,491	7	92	6	43	6
May	6,052	9	72	5	29	4
Jun	4,897	8	124	9	51	7
Jul	7,201	11	142	10	59	8
Aug	8,683	13	163	11	68	10
Sep	8,828	14	152	11	71	10
Oct	8,465	13	183	13	92	13
Nov	5,006	8	190	13	137	20
Dec	2,969	5	83	6	51	7
Total	**64,734**	**100**	**1,429**	**100**	**695**	**100**

[1] In addition, 150 strikes with bats were reported, of which 31 percent occurred in August; 79 strikes with reptiles were reported, of which 28 percent occurred in June.

[2] Deer strikes were comprised of 652 white-tailed deer, 34 mule deer, and 9 deer not identified to species. Other wild artiodactyls struck (but not included in this column of table) were 9 wapiti (elk), 7 pronghorns, 3 moose, 2 caribou, 1 swine (feral hog), and 1 collared peccary.

Table 7. Reported time of occurrence of wildlife strikes to civil aircraft, USA, 1990–2005[1].

	Birds		Terrestrial mammals	
Time of day	16-year total	% of total known	16-year total	% of total known
Dawn	1,943	4	30	3
Day	27,346	63	226	24
Dusk	2,355	5	94	10
Night	11,851	27	606	63
Total known	**43,495**	**100**	**956**	**100**
Unknown	**21,239**		**473**	
Total[1]	**64,734**		**1,429**	

[1] In addition, 150 strikes with bats were reported: time not reported (108), night (33), dusk (5), day (3), and dawn (1). Also, 79 strikes with reptiles were reported: time not reported (66), day (6), night (4), dusk (2), and dawn (1).

Table 8. Reported phase of flight at time of wildlife strikes to civil aircraft, USA, 1990–2005[1].

	Birds		Terrestrial mammals	
Phase of flight	16-year total	% of total known	16-year total	% of total known
Parked	28	<1	1	<1
Taxi	194	<1	25	2
Takeoff run	9,562	20	369	34
Climb	8,978	18	22	2
En route	1,308	3	0	0
Descent	1,816	4	0	0
Approach	18,813	39	70	6
Landing roll	7,939	16	593	55
Total known	**48,638**	**100**	**1,080**	**100**
Unknown	**16,096**		**349**	
Total[1]	**64,734**		**1,429**	

[1] In addition, 150 strikes with bats were reported: phase of flight not reported (105), approach (29), climb (5), descent (4), landing roll (4), en route (1), and takeoff run (2). Also, 79 strikes with reptiles were reported: phase of flight not reported (58), takeoff run (8), taxi (5), approach (4), and landing roll (4).

Table 9. Number of reported bird strikes to civil aircraft by height (feet) above ground level (AGL), USA, 1990–2005[1].

Height of strike (feet AGL)	All reported strikes			Strikes with damage		
	16-year total	% of total known	% cum-ulative total	16-year total	% of total known	% cum-ulative total
0	17,756	41	41	1,580	27	27
1-100	8,037	19	60	996	17	44
101-200	2,109	5	65	280	5	49
201-300	1,357	3	68	179	3	52
301-400	831	2	70	132	2	54
401-500	1,483	3	73	230	4	58
501-600	431	1	74	81	1	59
601-700	329	1	75	67	1	60
701-800	687	2	77	148	3	63
801-900	214	<1	78	62	1	64
901-1,000	1,254	3	81	259	4	68
1,001-2,000	3,166	7	88	755	13	81
2,001-3,000	1,918	4	92	438	7	89
3,001-4,000	991	2	94	185	3	92
4,001-5,000	755	2	96	134	2	94
5,001-10,000	1,357	3	99	277	5	98
10,001-20,000	276	<1	99	87	1	99
20,001-30,000	13	<1	99	8	<1	100
>30,000	1	<1	100	1	<1	100
Total known	**42,965**	**100**		**5,899**	**100**	
Unknown height	**21,769**			**1,976**		
Total	**64,734**			**7,875**		

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

Table 10. Civil aircraft components reported as being struck and damaged by wildlife, USA, 1990–2005.

	Birds (16-year total)				Terrestrial mammals (16-year total)			
Aircraft component	Number struck	% of total	Number damaged	% of total	Number struck	% of total	Number damaged	% of total
Windshield	10,265	17	546	6	6	0	13	1
Engine(s)[1]	8,750	15	2,916	32	105	7	107	9
Nose	8,284	14	531	6	68	5	68	6
Wing/rotor	7,877	13	2,095	23	168	12	174	14
Fuselage	7,593	13	330	4	96	7	110	9
Radome	7,358	12	904	10	10	1	12	1
Other	3,091	5	713	8	167	12	163	14
Landing gear	2,807	5	292	3	552	38	285	24
Propeller	1,694	3	172	2	198	14	188	16
Tail	855	1	372	4	41	3	54	4
Light	475	1	373	4	23	2	30	2
Total[2]	**59,049**	**100**	**9,244**	**100**	**1,434**	**100**	**1,204**	**100**

[1] For birds, 9,206 engines were reported as struck in 8,750 strike events (8,314 events with one engine struck, 421 with two engines struck, 10 with three engines struck, and 5 with four engines struck). In 2,916 bird-strike events, a total of 3,011 engines were damaged (2,822 events with one engine damaged, 93 with two engines damaged, and 1 with three engines damaged). For terrestrial mammals, 112 engines were reported as struck in 105 strike events (98 events with one engine struck and 7 with two engines struck). In 107 terrestrial mammal strike events, a total of 121 engines were reported as damaged (93 events with one engine damaged and 14 with two engines damaged). Some engines were damaged without being struck when the landing gear collapsed.

[2] In addition, there were 150 bat strikes in which 45 and 6 components were reported struck and damaged, respectively: radome/nose (7, 0), windshield (14, 0), engine (5, 2), propeller (1, 0), wing/rotor (8, 3), fuselage (4, 0), tail (2, 1), other (2, 0), landing gear (1,0), light (1,0). For 79 reptile strikes, there were 17 and 5 components reported struck and damaged, respectively: windshield (1, 1), wing/rotor (1, 1), fuselage (1, 1), landing gear (12, 0); tail (1, 1), other (1, 1).

Table 11. Number of civil aircraft with reported damage resulting from wildlife strikes, USA, 1990–2005.

	Reported strikes					
	Birds		Terrestrial mammals		Total[1]	
Damage category[2]	16-year total	% of total known	16-year total	% of total known	16-year total	% of total known
None	**45,434**	**85**	**368**	**36**	**45,862**	**84**
Damage	**7,875**	**15**	**654**	**64**	**8,536**	**16**
Minor	4,240	8	292	29	4,535	9
Uncertain	1,479	3	49	5	1,529	3
Substantial	2,140	4	293	28	2,436	5
Destroyed	16	<1	20	2	36	<1
Total known	**53,309**	**100**	**1,022**	**100**	**54,398**	**100**
Unknown	**11,425**		**407**		**11,994**	
Total	**64,734**		**1,429**		**66,392**	

[1] Included in totals are 150 and 79 strikes involving bats and reptiles, respectively. For bats, 47 reports indicated no damage, 97 failed to report if damage occurred, 3 reported minor damage, 1 reported uncertain level of damage, and 2 reported substantial damage. For reptiles, 13 reports indicated no damage, 65 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. Reported effect-on-flight (EOF) of wildlife strikes to civil aircraft, USA, 1990–2005.

	Reported strikes					
	Birds		Terrestrial mammals		Total[1]	
Effect-on-flight[2]	16-year total	% of total known	16-year total	% of total known	16-year total	% of total known
None	33,309	87	356	44	33,716	86
Negative effect	5,127	13	458	56	5,594	14
Precautionary landing	2,646	7	69	8	2,718	7
Aborted takeoff	1,270	3	148	18	1,418	4
Engine shutdown	286	1	23	3	309	1
Other	925	2	218	27	1,149	3
Total known	**38,436**	**100**	**814**	**100**	**39,310**	**100**
Unknown	**26,298**		**615**		**27,082**	
Total	**64,734**		**1,429**		**66,392**	

[1] Included in totals are 150 and 79 strikes involving bats and reptiles, respectively. For bats, 36 reports indicated no effect-on-flight, 112 failed to report if an effect-on-flight occurred, and 2 reported a precautionary landing. For reptiles, 15 reports indicated no effect-on-flight, 57 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 13. Total reported strikes, strikes causing damage, strikes having a negative effect-on-flight (EOF), strikes involving >1 animal, aircraft downtime, and costs by identified wildlife species for civil aircraft, USA, 1990–2005 (page 1 of 15).

Wildlife group or species[2]	16-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[3]	Aircraft down time (hrs)	Reported costs ($)
Birds						
Loons	**12**	**9**	**6**		**2,809**	**1,754,200**
Loons	3	3	2		557	251,200
Common loon	9	6	4		2,252	1,503,000
Grebes	**29**	**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	6		1			
Horned grebe	4	1	1		72	17,772
Red-necked grebe	1					
Albatrosses/shearwaters	**30**	**5**	**5**		**147**	**60,000**
Laysan albatross	20	5	5		147	60,000
Black-footed albatross	1					
Bonin petrel	1					
Wedge-tailed shearwater	5					
Townsend's shearwater	2					
Fork-tailed storm-petrel	1					
Tropicbirds	**5**	**3**	**3**		**106**	**35,800**
Tropicbirds	2	2	2		106	30,200
White-tailed tropicbird	1					
Red-tailed tropicbird	2	1	1			5,600
Pelicans	**38**	**18**	**12**	**2**	**129**	**36,000**
Pelicans	3	2			92	
Australian pelican	1	1	1			
Brown pelican	33	15	11	2	37	36,000
American white pelican	1					
Red-footed booby	**1**					
Cormorants	**41**	**19**	**13**	**10**	**78**	**2,147,370**
Cormorants	1					
Great cormorant	2	1		2		
Dble-crested cormorant	37	18	13	8	78	2,147,370
Pelagic cormorant	1					
Anhinga	**11**	**4**	**4**	**2**	**116**	**4,300**

Table 13. Continued (page 2 of 15).

Wildlife group or species[2]	16-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[3]	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				
Herons	**262**	**48**	**34**	**11**	**2,489**	**2,928,792**
Herons	40	12	8	4	98	3,000
Great blue heron	152	32	24	3	1,801	2,886,592
B-crowned night-heron	16	2		2	14	31,000
Little blue heron	2					
Green heron	3					
Y-crowned night heron	2					
American bittern	4	2	2		576	8,200
Yellow bittern	43			2		
Egrets	**387**	**43**	**54**	**102**	**3,644**	**5,306,240**
Egrets	248	30	37	73	3,451	3,465,140
Cattle egret	100	8	13	25	73	300
Great egret	27	3	4	3	96	1,840,800
Snowy egret	12	2		1	24	
Storks/ibises	**24**	**5**	**4**	**4**	**1**	
White stork	1	1				
Wood stork	4					
Ibises	9	1	2	1		
Glossy ibis	1			1		
White ibis	4	1	1			
White-faced ibis	4	2		2		
Roseate spoonbill	1		1		1	
Waterfowl	**2,613**	**1,184**	**560**	**976**	**82,372**	**79,772,580**
Ducks, geese, swans	127	64	28	53	715	758,775
Ducks	587	204	90	199	4,353	3,646,592
American wigeon	20	11	5	7	327	888,089
Northern pintail	34	21	10	15	1,222	256,189
Green-winged teal	12	3	2	2	54	235,250
Blue-winged teal	9	6	2	6	105	601,440
European wigeon	1			1		
Mallard	344	93	48	78	3,881	4,566,841

Table 13. Continued (page 3 of 15).

Wildlife group or species[2]	16-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[3]	Aircraft down time (hrs)	Reported costs ($)
Common eider	2	2	1	1		
Ring-necked duck	5	3	2	2	72	9,568
Greater scaup	4	1	1	1		
Wood duck	14	6	2	2	102	77,704
Muscovy duck	1	1			120	443,332
Red-breasted merganser	1	1		1		
Hooded merganser	3	1		1		
Common merganser	1	1	1		72	2,500
Northern shoveler	16	8	2	7	624	1,043,300
Gadwall	13	1	1	2		
Canvasback	7	3		3	60	45,000
American black duck	13	3	1	6		
Mottled duck	6	2	3	2	24	
Lesser scaup	8	6	3	3	984	101,000
Ruddy duck	9	3			24	8,446
Redhead	1	1		1		
Bufflehead	2					
Long-tailed duck	1	1				
Philippine duck	1	1	1	1	96	9,456,000
Geese	314	180	81	111	17,049	2,120,746
Snow goose	59	44	21	32	3,329	16,814,536
Canada goose	965	495	248	423	48,515	37,345,324
Brant	13	6	3	6	40	1,271
Gr. white-fronted goose	7	6	1	5	268	755,887
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	**3,510**	**645**	**426**	**130**	**61,314**	**23,741,221**
Hawks, eagles, vultures	28	15	6	1	255	9,050
Vultures	214	128	63	24	19,384	8,974,775
Black vulture	27	15	14	5	4,609	365,987
Turkey vulture	236	129	82	10	16,748	2,300,408
Osprey	105	23	11	2	2,087	219,803

Table 13. Continued (page 4 of 15).

Wildlife group or species[2]	16-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[3]	Aircraft down time (hrs)	Reported costs ($)
White-tailed kite	4	2				
Black kite	2	1	1			
Swallow-tailed kite	1					
Eagles	6	3	2	1		
Bald eagle	71	28	18	7	4,660	200,974
Golden eagle	2	1	1		72	1,000
Hawks	809	162	111	23	8,626	920,568
Red-tailed hawk	637	113	85	8	3,963	5,013,813
Rough-legged hawk	10					
Red-shouldered hawk	12	1	1		41	900
Swainson's hawk	18	1	2		4	
Sharp-shinned hawk	6					
Cooper's hawk	9					
Ferruginous hawk	2					
Broad-winged hawk	5					
Harris' hawk	1					
Common buzzard	1				24	
Northern harrier	48	1	1	1		200,000
Lappet-faced vulture	1	1	1		240	4,000,000
Falcons	29	2	3	1	80	30,000
Peregrine falcon	87	7	2	4	30	235,500
Gyrfalcon	1					
Merlin	22		2		3	130
Prairie falcon	3					
American kestrel	1,112	12	20	43	488	1,268,313
Eurasian kestrel	1					
Gallinaceous birds	**123**	**32**	**26**	**23**	**975**	**527,287**
Grouse	6	2		2	2	
Greater sage grouse	5	3	4	1	337	256,077
Sharp-tailed grouse	1	1	1		24	500
Ptarmigans	6	4	1	2	57	57,500
Black francolin	2					
Quails	9		2	3		
Northern bobwhite	6	2	3	1	73	800

Table 13. Continued (page 5 of 15).

Wildlife group or species[2]	16-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[3]	Aircraft down time (hrs)	Reported costs ($)
Ring-necked pheasant	48	10	8	5	15	2,000
Gray partridge	5	2	1	3	24	120
Chukar	1					
Grey francolin	1					
Guineafowl	1	1		1		
Wild turkey	32	7	6	5	443	210,290
Cranes	**70**	**25**	**21**	**22**	**2,304**	**379,760**
Cranes	11	3	5	1	31	250,000
Sandhill crane	59	22	16	21	2,273	129,760
Rails/gallinules	**49**	**11**	**4**	**4**	**807**	**642,476**
Rails	1	1		1		
Sora	1					
Common moorhen	2	1	1		24	990
American coot	39	9	3	3	783	641,486
Purple gallinule	2					
Virginia rail	2					
Clapper rail	2					
Shorebirds	**1,439**	**50**	**77**	**291**	**1,162**	**2,823,256**
Shorebirds	15			7		
American oystercatcher	17			2		
Plovers	38	3	4	8	24	
European golden-plover	3					
American golden-plover	23		2	5	2	
Black-bellied plover	26	2	2	3	12	38,622
Snowy plover	1			1		
Killdeer	676	22	30	104	218	2,332,153
Pacific golden-plover	314	1	4	54	15	1,200
Semipalmated plover	12			6		
Northern lapwing	1	1	1	1	25	
Southern lapwing	1	1	1			8,000
Sandpipers	122	8	18	50	168	106,560
Upland sandpiper	53	4	5	6	12	1,000
Spotted sandpiper	3			1		
Willett	4			2		
Common snipe	19	2	1	2		12,615
American woodcock	12	1	2	2		

Table 13. Continued (page 6 of 15).

Wildlife group or species[2]	16-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[3]	Aircraft down time (hrs)	Reported costs ($)
Dunlin	12	2	1	4	504	205,300
Baird's sandpiper	3			1		
Western sandpiper	16	1	1	9	60	94,311
Pectoral sandpiper	1					
Sanderling	7		1	5		
Buff-breasted sandpiper	7			2		
Ruddy turnstone	4					
Least sandpiper	17		2	6	2	
Semipalmated sandpiper	9			3		
Lesser yellowlegs	2			1		
Short-billed dowitcher	2					
Hudsonian godwit	1	1	1	1	96	23,495
Solitary sandpiper	2			1		
Greater yellowlegs	1					
Long-billed dowitcher	2					
Red knot	1					
Whimbrel	5	1	1	1	24	
Long-billed curlew	3					
American avocet	3			2		
Black-necked stilt	1			1		
Gulls	**6,201**	**1,014**	**805**	**1,568**	**41,630**	**24,153,973**
Gulls	4,780	852	662	1,309	33,855	18,413,646
Herring gull	472	60	57	64	485	1,412,745
Mew gull	17	2	1	2		1,000
Ring-billed gull	556	52	48	122	2,018	2,271,280
Glaucous-winged gull	30	11	4	8	281	346,445
Great black-backed gull	53	7	5	3	27	250,000
Franklin's gull	18	3	3	9	18	139,000
Laughing gull	182	12	12	32	715	529,000
Bonaparte's gull	15	2	2	5		65,000
Western gull	45	7	4	7	92	540,857
California gull	28	5	6	5	4,139	185,000
Heermann's gull	1			1		
Thayer's gull	2					
Yellow-legged gull	2	1	1	1		
Terns	**85**	**4**	**2**	**23**	**4**	
Terns	35	2		12		

Table 13. Continued (page 7 of 15).

Wildlife group or species[2]	16-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[3]	Aircraft down time (hrs)	Reported costs ($)
Caspian tern	14			1		
Common tern	9			1		
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	5		1	1		
Royal tern	1					
Sooty tern	1					
Black skimmer	3	1		1		
Pigeons/ doves	**3,749**	**279**	**314**	**1,076**	**16,036**	**9,145,254**
Pigeons, doves	11	1	1	8	24	400
Pigeons	21	3	3	10	26	46,050
Doves	583	36	59	182	279	282,360
Rock pigeon	1,204	149	133	454	13,472	4,848,699
Racing pigeon	14	3	2	6	72	
Mourning dove	1,761	83	112	401	2,065	3,696,340
Spotted dove	43	3	2	4	96	271,405
Zebra dove	79	1	2	11	2	
Inca dove	14					
Philippine turtle dove	4					
White-winged dove	9					
Common ground-dove	6					
Parrots	**7**			**1**		
Parrots	4			1		
Budgerigar	2					
Black-hooded parakeet	1					
Cuckoos	**7**	**1**		**2**		
Cuckoos	1			1		
Yellow-billed cuckoo	5	1		1		
Common cuckoo	1					
Owls	**727**	**63**	**39**	**6**	**1,398**	**3,873,878**
Owls	212	24	13	3	956	296,875

Table 13. Continued (page 8 of 15).

Wildlife group or species[2]	16-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[3]	Aircraft down time (hrs)	Reported costs ($)
Barn owl	304	18	14	2	216	1,821,900
Snowy owl	40	5	4		46	27,500
Short-eared owl	70	2	2		12	45
Long-eared owl	7	2	1			
Northern saw-whet owl	3					
Burrowing owl	35	1				
Barred owl	4	1	1			
Northern pygmy-owl	1					
Eastern screech owl	2	1			24	7,558
Great horned owl	49	9	4	1	144	1,720,000
Nightjars	**104**	**2**		**7**		
Nightjars	2	1				
Whip-poor-will	2					
Common poorwill	4					
Lesser nighthawk	3					
Chuck-will's-widow	1					
Common nighthawk	92	1		7		
Swifts	**72**	**2**		**7**		
Swifts	8	1		3		
Chimney swift	56	1		4		
Vaux's swift	1					
White-throated swift	7					
Anna's hummingbird	**1**					
Belted kingfisher	**6**					
Woodpeckers	**31**	**2**	**4**	**1**	**1**	**15,000**
Woodpecker	7		1		1	
Downy woodpeckers	1		1			
Northern flicker	16	2				
Yellow-bellied sapsucker	4		1	1		
Hairy woodpecker	2					
Red-naped sapsucker	1		1			15,000
Flycatchers	**52**	**1**	**3**	**4**	**1**	**9,800**
Tyrant flycatchers	3			1	1	
Eastern wood-pewee	1					
Great crested flycatcher	1					
Eastern kingbird	6	1	1			9,800

Table 13. Continued (page 9 of 15).

Wildlife group or species[2]	16-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[3]	Aircraft down time (hrs)	Reported costs ($)
Scissor-tailed flycatcher	19		2	1		
Acadian flycatcher	1					
Western kingbird	18			2		
Ash-throated flycatcher	1					
Western wood-pewee	1					
Sulphur-bellied flycatcher	1					
Larks	**405**	**7**	**9**	**106**	**8**	**504,625**
Larks	2					
Eurasian skylark	9			1		
Horned lark	394	7	9	105	8	504,625
Swallows	**1,097**	**15**	**30**	**315**	**140**	**40,582**
Swallows	374	4	23	130	25	
Purple martin	53	2		13	2	
Bank swallow	49	2		27	1	
Barn swallow	391	4	2	78	99	27,282
Cliff swallow	118	3	2	26	9	13,250
Tree swallow	97		3	41	4	50
Violet-green swallow	7					
N. rough-winged swallow	8					
Starlings	**1,511**	**71**	**95**	**622**	**1,163**	**2,916,474**
European starling	1,479	70	94	613	1,161	2,916,474
Mynas	3			2		
Common myna	29	1	1	7	2	
Crows/jays/magpies	**431**	**45**	**41**	**67**	**5,882**	**1,423,558**
Crows	194	17	18	30	209	129,500
American crow	190	19	17	29	5,562	1,265,013
Carrion crow	1	1				
Hooded crow	1	1	1			
Northwestern crow	1			1		
Blue jay	8					
Ravens	5	2	1	2	2	90
Common raven	15	3	2	1	108	28,400
Yellow-billed magpie	8			2		
Black-billed magpie	8	2	2	2	1	555
Chickadees	**12**	**1**		**3**		
Chickadees	4	1		2		

Table 13. Continued (page 10 of 15).

Wildlife group or species[2]	16-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[3]	Aircraft down time (hrs)	Reported costs ($)
Black-capped chickadee	**8**					
Wrens	**36**	**1**	**1**	**7**		
Wrens	34	1	1	7		
Carolina wren	1					
Rock wren	1					
Mimics	**49**	**1**	**2**			**120**
Brown thrasher	5					120
Northern mockingbird	37	1	2			
Gray catbird	7					
Thrushes	**222**	**16**	**16**	**24**	**50**	**2,157,710**
Thrushes	12	3	1	2	7	25,500
Western bluebird	2				3	
Swainson's thrush	7	2	1	1		2,000,000
American robin	190	11	12	20	40	131,930
Hermit thrush	3					
Eastern bluebird	2					
Gray-cheeked thrush	1					
Varied thrush	2		1			
Wood thrush	3		1	1		280
Vireos	**6**			**1**		
Vireos	1					
Yellow-throated vireo	1					
Warbling vireo	1			1		
Red-eyed vireo	2					
Cassin's vireo	1					
Warblers	**35**					
Wood warblers	15					
Canada warbler	1					
Yellow-breasted chat	3					
Pine warbler	1					
Black and white warbler	2					
Northern parula warbler	1					
Ovenbird	1					
Wilson's warbler	1					
Common yellowthroat	2					
American redstart	2					

Table 13. Continued (page 11 of 15).

Wildlife group or species[2]	16-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[3]	Aircraft down time (hrs)	Reported costs ($)
Northern waterthrush	1					
Nashville warbler	3					
Townsend's warbler	1					
Palm warbler	1					
Meadowlarks	**504**	**8**	**15**	**67**	**190**	**203,452**
Meadowlarks	69	1	3	5	10	
Eastern meadowlark	265	3	5	26	4	
Western meadowlark	170	4	7	36	176	203,452
Blackbirds/ Orioles	**1,178**	**85**	**91**	**345**	**1,451**	**1,016,175**
Blackbirds	965	71	75	301	580	862,425
Red-winged blackbird	57	1	4	11	6	750
Yellow-headed blackbird	5	1	1	1		
Brewer's blackbird	13					
Brown-headed cowbird	35	1	1	14	1	
Bobolink	3		1			
Orioles	5					
Baltimore oriole	3			1		
Grackles	48	5	2	10	722	108,000
Common grackle	32	4	5	6	121	45,000
Boat-tailed grackle	4	1	1		20	
Great-tailed grackle	5			1		
Scarlet tanager	2	1				
Western tanager	1		1		1	
Finches	**81**		**5**	**14**	**50**	**5,000**
Finches	40		4	11	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	10					
House finch	14					
Smith's longspur	1					
Dickcissel	1					
White-winged crossbill	1					
Red avadavat	1					

Table 13. Continued (page 12 of 15).

Wildlife group or species[2]	16-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[3]	Aircraft down time (hrs)	Reported costs ($)
Red-crested cardinal	2			1		
Northern cardinal	1					
Buntings	**96**	**3**	**12**	**58**	**19**	
Snow bunting	78	2	12	56	19	
Indigo bunting	1					
Lazuli bunting	1					
Lark bunting	16	1		2		
Sparrows	**1,803**	**34**	**70**	**477**	**47**	**8,550**
Sparrows	1,716	31	70	470	44	3,050
Savannah sparrow	39	1		2		1,000
Fox sparrow	6	1				4,100
White-throated sparrow	8	1				
Golden-crowned sparrow	1					
Field sparrow	1					
Lark sparrow	1					
White-crowned sparrow	3					
Grasshopper sparrow	2					
Java sparrow	1					
Vesper sparrow	2					
Chipping sparrow	1					
Lincoln's sparrow	1					
Song sparrow	19			5	3	400
Sage sparrow	2					
Towhees	**4**					
Rufous-sided towhee	3					
Green-tailed towhee	1					
Mannikins	**73**		**1**	**38**	**3**	**2,000**
Mannikins	19			9		
Nutmeg mannikin	25			15	1	
Chestnut mannikin	29		1	14	2	2,000
Misc. perching birds	**87**	**8**	**3**	**13**	**53**	**83,600**
Perching birds	29	7	2	3	49	83,600
House sparrow	31	1		4		
Red-vented bulbul	1			1		
Wrentit	1					
American pipit	7			1		

Table 13. Continued (page 13 of 15).

Wildlife group or species[2]	16-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[3]	Aircraft down time (hrs)	Reported costs ($)
Cedar waxwing	13		1	3	4	
Loggerhead shrike	2					
Japanese white-eye	1					
Warbling silverbill	1			1		
Common waxbill	1					
Total known birds	**27,325**	**3,773**	**2,812**	**6,431**	**226,664**	**165,841,705**
Total unknown birds	**37,409**	**4,123**	**2,315**	**4,105**	**74,451**	**68,098,396**
Unknown birds - ? size	18,114	2,124	1,018	1,105	19,710	26,326,027
Unknown birds - large	1,444	645	301	175	20,934	22,431,101
Unknown birds - medium	5,041	854	454	738	26,647	8,685,386
Unknown birds - small	12,810	500	542	2,087	7,160	10,655,882
Total birds	**64,734**	**7,896**	**5,127**	**10,536**	**301,115**	**233,940,101**
Flying Mammals (Bats)						
Old world fruit bats	3	1	2	1	72	3,069,400
Red bat	9	1		1	1	
Hoary bat	2					
E. small-footed myotis	1					
Little brown bat	11					
Free-tailed bats	5			1		
Brazilian free-tailed bat	11					
Total known bats	**42**	**2**	**2**	**3**	**73**	**3,069,400**
Unknown bats	**108**	**4**		**14**		**6,615**
Total bats	**150**	**6**	**2**	**17**	**73**	**3,076,015**
Terrestrial mammals						
Marsupials (opossum)	**41**					
Xenarthyras (armadillo)	**15**	**1**	**2**		**8**	**700**
Lagomorphs	**123**	**3**	**4**	**2**	**6**	**24,384**
Black-tailed jackrabbit	54	2	1			24,384
White-tailed jackrabbit	6			1		
Rabbits	27			1		
Eastern cottontail	36	1	3		6	

Table 13. Continued (page 14 of 15).

Wildlife group or species[2]	16-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[3]	Aircraft down time (hrs)	Reported costs ($)
Rodents	**95**	**2**	**2**		**3**	
Prairie dog	6		1			
Woodchuck	65	2	1		3	
Woodrats	2					
Muskrat	9					
Black rat	2					
Norway rat	3					
N. American porcupine	8					
Carnivores	**414**	**39**	**65**	**2**	**12,314**	**2,988,576**
Canids	3		1			
Coyote	198	23	41		10,044	2,652,640
Domestic dog	24	8	13		96	300,000
Fox	49	4	2		10	750
Red fox	30		3			
Common gray fox	3	1	1		2	186
Raccoon	35	2	3	1	2,160	35,000
White-nosed coati	1					
Ringtail	1					
Skunks	12		1		2	
Striped skunk	42			1		
River otter	1	1				
Badger	2					
House cat	11					
Small Indian mongoose	2					
Artiodactyls	**726**	**599**	**376**	**73**	**221,761**	**31,736,105**
Deer	9	9	6		696	197,000
White-tailed deer	652	534	329	63	151,336	25,136,106
Mule deer	34	29	20	3	6,504	563,695
Wapiti (elk)	9	9	6	2	11,560	5,496,204
Moose	3	1	3			
Caribou	2	2	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		

Table 13. Continued (page 15 of 15).

Wildlife group or species[2]	16-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[3]	Aircraft down time (hrs)	Reported costs ($)
Perissodactyls (horse)	**3**	**3**	**3**		**1,008**	**23,849**
Total known terrestrial mammals	**1,417**	**647**	**452**	**77**	**235,100**	**34,773,614**
Unknown terrestrial mammals	**12**	**6**	**6**	**1**		
Total terrestrial mammals	**1,429**	**653**	**458**	**78**	**235,100**	**34,773,614**
Reptiles						
Turtles	**58**		**2**	**1**		
Turtles	36		2	1		
Florida soft shell turtle	4					
Eastern box turtle	4					
Common snapping turtle	3					
Diamondback terrapin	10					
Painted turtle	1					
American alligator	**14**	**1**	**2**		**3**	
Green Iguana	**7**		**3**			
Total reptiles	**79**	**1**	**7**	**1**	**3**	
Total known (all species)	**28,863**	**4,423**	**3,273**	**6,512**	**461,840**	**203,684,719**
Total unknown	**37,529**	**4,133**	**2,321**	**4,120**	**74,451**	**68,105,011**
Grand total	**66,392**	**8,556**	**5,594**	**10,632**	**536,291**	**271,789,730**

[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 16). Finally, even when cost estimates were provided, many reports were filed before aircraft damage had been fully assessed. See Table 16 for a more detailed projection of actual economic losses.

[2] Mean and range of body masses for most bird and mammal species in list are presented in Dunning (1993) and Burt (1980).

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

Table 14. Number of reported strikes, strikes with damage, and strikes having a negative effect-on-flight (EOF) for the six most commonly struck bird groups and three most commonly struck terrestrial mammal groups, civil aircraft, USA, 1990–2005.

	Reported strikes		Strikes with damage		Strikes with EOF	
Species group[1]	16-year total	% of total known	16-year total	% of total known	16-year total	% of total known
Birds						
Gulls	6,201	23	1,014	27	805	29
Pigeons/ doves	3,749	14	279	7	314	11
Raptors	3,510	13	645	17	426	15
Waterfowl	2,613	10	1,186	31	560	20
Sparrows	1,803	7	34	1	70	2
Starlings	1,511	6	71	2	95	3
All other known	7,938	29	544	14	542	19
Total known birds	**27,325**	**100**	**3,773**	**100**	**2,812**	**100**
Unknown birds	**37,409**		**4,123**		**2,315**	
Total birds	**64,734**		**7,896**		**5,127**	
Terrestrial mammals						
Artiodactyls	726	51	599	93	376	83
Carnivores	414	29	39	6	65	14
Lagomorphs	123	9	3	<1	4	1
All other known	154	11	6	1	7	2
Total known mammals	**1,417**	**100**	**647**	**100**	**452**	**100**
Unknown mammals	**12**		**6**		**6**	
Total mammals	**1,429**		**653**		**458**	

[1] See Table 13 for listing of species within each species group.

Table 15. Number of strikes to civil aircraft causing human injury or fatality and number of injuries and fatalities by wildlife species, USA, 1990–2005.

	No. of strikes	No. of injuries–fatalities			No. of strikes	No. of injuries-fatalities
Birds				**Birds (continued)**		
Waterfowl	34	37–0		Misc. water birds	11	10–1
Canada goose	13	14–0		American coot	2	2–0
Ducks	11	13–0		Egrets	1	1–0
Geese	5	5–0		Great frigatebird	1	1–0
Mallard	2	2–0		Horned grebe	1	1–0
Lesser scaup	1	1–0		Anhinga	1	1–0
Long-tailed duck	1	1–0		D.-crested cormorant	1	1–0
Snow goose	1	1–0		Brown pelican	1	0–1
Raptors/owls	29	37–0		Red-tailed tropicbird	1	1–0
Vultures	9	9–0		Sandhill crane	1	1–0
Turkey vulture	8	10–0		Western grebe	1	1–0
Black vulture	2	2–0		Misc. birds	2	3–0
Red-tailed hawk	3	4–0		Sharp-tailed grouse	1	2–0
Hawks	2	3–0		Sparrows	1	1–0
American kestrel	1	5–0		Unknown birds	31	29–7
Osprey	2	2–0		**Total birds**	**122**	**141–8**
Golden eagle	1	1–0				
Owls	1	1–0		**Mammals**		
Gulls	10	17–0		White-tailed deer	17	23–1
Gulls	7	8–0		Mule deer	1	2–0
Herring gull	2	2–0		Cattle	2	3–0
Ring-billed gull	1	7–0		Horse	1	1–0
Doves/Pigeons	5	8–0		Domestic dog	1	2–0
Rock pigeon	2	2–0		**Total mammals**	**22**	**31–1**
Doves	1	1–0				
Mourning dove	1	1–0		**Total (all species)**	**144**	**172–9**
Spotted dove	1	4–0				

Table 16. 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, 1990–2005.

	Number of reports				Reported time (hours) aircraft out of service (No. of reports)	Cost in millions of dollars (Number of reports)		
	Total reports	Reports indicating adverse effect	Reports indicating aircraft damage	Reports indicating negative EOF		Direct cost	Other cost	Total cost
16-yr total	66,392	11,328	8,536	5,594	536,291	236.548	35.242	271.790
					(3,273)	(2,097)	(793)	
16-yr avg.	4,150	708	534	350	33,518	14.784	2.203	16.987
					(205)	(131)	(50)	
Mean losses per incident reported					163.9	0.113	0.044	0.157
Estimated annual losses								
Minimum[1]					**116,006**	**79.862**	**31.464**	**111.326**
Maximum[2]					**580,029**	**399.312**	**157.322**	**556.634**

[1] Minimum values are based on the assumption that all 11,328 reported strikes indicating an adverse effect (negative EOF and/or damage) to aircraft (mean of 708/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 11,328 reported strikes indicating an adverse effect represent only 20 percent of the total strikes that occurred (Cleary et al. 2005, Wright and Dolbeer 2005).

FIGURES

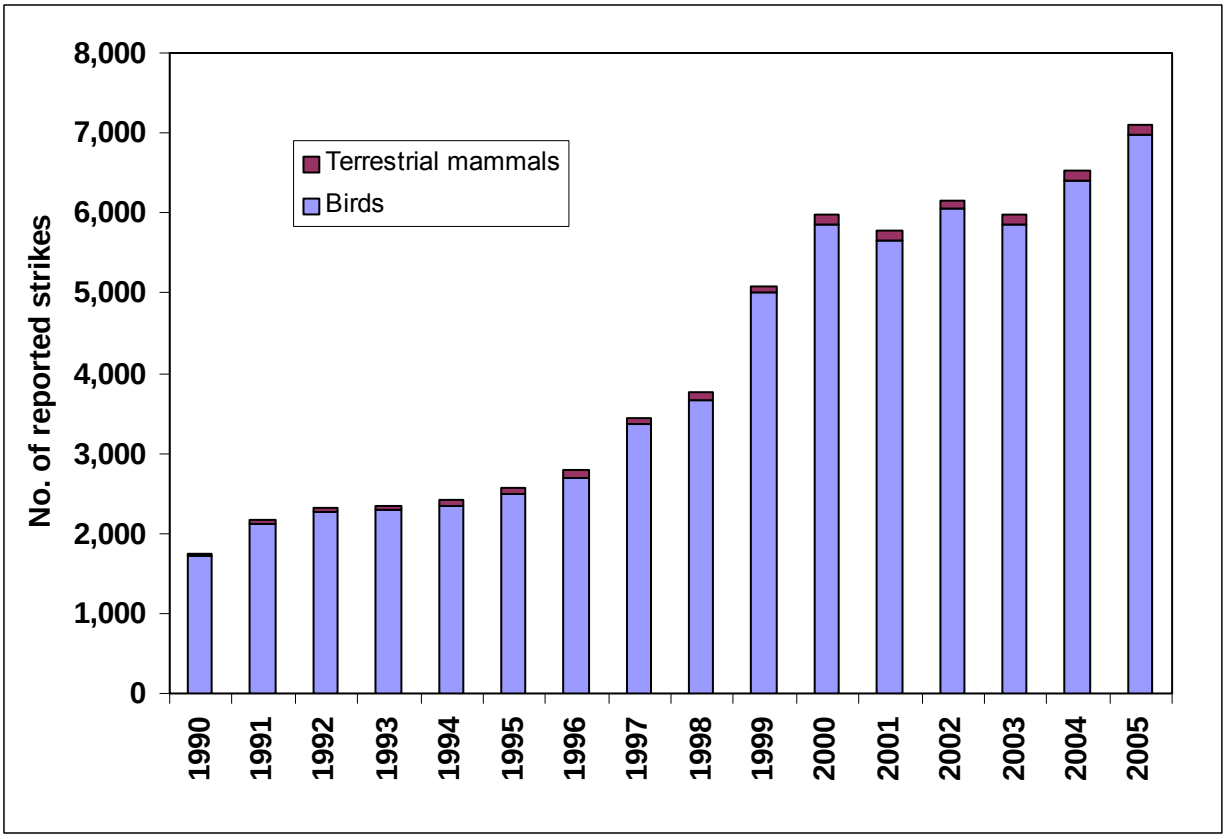


Figure 1. Number of reported bird (N = 64,734) and terrestrial mammal (N = 1,429) strikes to civil aircraft, USA, 1990–2005. Additionally, 150 and 79 strikes involving bats and reptiles, respectively, were reported for this 16-year period (see Table 1).

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APPENDIX A.

Bird Strikes to Civil Helicopters in the United States, 1990–2005

A Bell 407 air ambulance helicopter en-route at 1,000 ft AGL hit three blue-winged teal during a flight to an automobile accident in South Dakota in April 2005. The windshield shattered and glass and duck blood were splattered through the aircraft, temporarily blinding the pilot. The pilot recovered and made an emergency landing on a road.

To our knowledge, there has been no published analysis of bird strike data for helicopters. From 1990–2005, 370 (0.6 percent) of the 64,734 reported bird strikes to civil aircraft involved helicopters (Table A1). We believe that this is a sufficient sample size to provide an initial summary and analysis of data for bird strikes involving helicopters.

Of the 370 reported bird strikes involving helicopters, 186 (50 percent) indicated damage and 67 (18 percent) indicated substantial damage (Table A1). In contrast, only 15 percent of bird strikes with all aircraft types resulted in damage and 4 percent resulted in substantial damage (Table 11). Whereas helicopters accounted for only 0.6 percent of all bird strikes, helicopters accounted for 13 percent (2) of the 16 aircraft

destroyed and 24 percent (34) of the 141 injuries caused by bird strikes (Tables A1, 11, 15).

Sixty-three percent of the bird strikes to helicopters and 77 percent of the damaging strikes occurred during the en-route phase of flight (Table A1). In contrast, only 2 percent of bird strikes and 7 percent of damaging strikes for fixed-wing aircraft occurred during the en-route phase. The much higher en-route strike rate for helicopters is related to the lower height AGL at which helicopters typically fly compared to fixed-wing aircraft. For helicopters, about 52 percent of strikes occurred from 501 to 2,000 feet AGL (Table A2) compared to 14 percent for all aircraft (Table 9). This is a height zone frequently used by many bird species, especially gulls, waterfowl, raptors and vultures (Dolbeer 2006)—the species most commonly struck by helicopters (Table A3). Ninety-seven percent of strikes with helicopters causing damage occurred at an indicated airspeed of more than 60 knots (Table A2).

Windshields represented 36 percent of helicopter components reported as struck and 41 percent of components damaged (Table A4). In contrast, windshields represented 17 and 6 percent, respectively, of all components struck and damaged for all aircraft types (Table 10). The high percentage of windshields damaged for helicopters, combined with the disproportionate number of human injuries, indicates that improvements are needed in windshield design and strength for these aircraft. In addition, helicopter pilots should consider wearing protective head and eye gear, especially when flying during periods of peak bird migration in spring and fall.

APPENDIX A TABLES

Table A1. Reported phase of flight and damage at time of bird strikes to civil helicopters, USA, 1990–2005.

	No. of strikes		No. of strikes with damage	
Phase of flight	16-year total	% of total known	16-year total	% of total known
Parked	5	1	0	0
Taxi	5	1	1	<1
Takeoff run	7	2	0	0
Climb	55	16	18	10
En route[1]	221	63	137	77
Descent	12	3	7	4
Approach	44	13	16	9
Landing roll	3	<1	0	0
Total known	**352**	**100**	**179**	**100**
Unknown	**18**		**7**	
Total	**370**		**186[2]**	

[1] In comparison, for fixed-winged aircraft only 1,051 (2 percent) of 47,711 strikes occurred during en-route and only 465 (7 percent) of 6,499 damaging strikes occurred en-route.

[2] Of the 186 bird strike incidents in which damage occurred, 2 helicopters were destroyed, 67 received substantial damage, 87 received minor damage, and 30 received an undetermined level of damage. Thirty-four pilots or passengers were reported as injured in 29 bird strike events with helicopters.

Table A2. Number of reported bird strikes to civil helicopters by height (feet) above ground level (AGL), USA, 1990–2005.

Height of strike (feet AGL)	All reported strikes[1]			Strikes with damage[1]		
	16-year total	% of total known	% cum-ulative total	16-year total	% of total known	% cum-ulative total
0	17	5	5	1	<1	<1
1-100	38	12	17	8	5	5
101-500	112	34	51	56	35	40
501-1000	86	26	77	54	34	74
1001-2000	52	16	93	29	18	92
2001-5100[2]	23	7	100	12	8	100
Total known	**328**	**100**		**160**	**100**	
Unknown height	**42**			**26**		
Total	**370**			**186**		

[1] Ninety percent of all reported bird strikes with civil helicopters occurred at an indicated air speed (IAS) ≥60 knots and 97 percent of strikes causing damage occurred at an IAS ≥60 knots.

[2] The maximum height AGL for a reported helicopter strike was 5,100 feet.

Table A3. Number of reported strikes and strikes with damage to civil helicopters for the four most commonly struck bird groups, USA, 1990–2005.

	Reported strikes		Strikes with damage	
Species group	16-year total	% of total known	16-year total	% of total known
Gulls	65	32	35	28
Waterfowl	49	24	37	29
Vultures	19	9	17	13
Raptors	17	8	10	8
All other known	54	26	28	22
Total known birds	**204**	**100**	**127**	**100**
Unknown birds	**166**		**59**	
Total birds	**370**[1]		**186**	

[1] Thirty-two (9 percent) of the 370 strike events with helicopters involved multiple birds.

Table A4. Civil helicopter components reported as being struck and damaged by birds, USA, 1990–2005.

	Struck		Damaged	
Aircraft component	Number	% of total	Number	% of total
Windshield	157	36	98	41
Rotor	95	21	26	11
Nose	53	12	29	12
Other	46	10	40	17
Fuselage	41	9	17	7
Engine	19	4	7	3
Radome	12	3	7	3
Tail	9	2	5	2
Landing gear	6	1	3	1
Light	4	<1	6	3
Total	**442**	**100**	**238**	**100**

APPENDIX B.

Selected Significant Strikes to Civil Aircraft in the United States, 2005

During the post-flight inspection of an MD-80 at a west coast USA airport in November 2005, bird-strike damage to the #1 engine was discovered. Feather remains sent to the Smithsonian Institution identified the bird as an American robin (mean body mass = 80 grams). Cost of repairs was $80,000 and time-out-of-service for aircraft was 32 hours.

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 66,392 strike reports from 1,326 USA airports and 200 foreign airports for 1990 through 2005 (7,136 strikes in 2005), but we estimate that this represents only about 20 percent of the strikes that have occurred. The following 2005 examples from the database demonstrate the serious impact that strikes by birds or other wildlife can have on aircraft. These examples, from throughout the USA, demonstrate 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:	07 January 2005

Aircraft: Hawker 1000
Airport: Bowerman (WA)
Phase of Flight: Climb
Effect on Flight: Precautionary landing
Damage: Engine #1 and #2
Wildlife Species: Dunlin

Comments from Report: Area is a wildlife refuge with known hazards but no specific warning was issued. Pilot pulled up to avoid birds. Core ingestion in both engines. Aircraft was not flyable. Company had to rent two engines while the damaged ones were being torn down for inspection and repair. The landing gear was covered with small birds. Airport personnel believe the birds were dunlins.

Date:	12 January 2005

Aircraft: B-747
Airport: Tokyo Intl.
Phase of Flight: Takeoff
Effect on Flight: Aborted takeoff
Damage: Engine, wing
Wildlife Species: Hooded crow

Comments from Report: Flight crew saw 2 birds on centerline. They also saw a large crane-like bird pass under the nose and a crow passing off to the left. They heard a loud bang and the aircraft yawed left. Takeoff was aborted. Two fan blades broke though the cowl, others were damaged. All fan blades were replaced. A leading edge flap panel was damaged by broken fan blades. ID by Smithsonian, Division of Birds. (U.S. carrier)

Date:	02 February 2005

Aircraft: PA-28
Airport: Brandywine (PA)
Phase of Flight: Climb
Effect on Flight: Precautionary landing
Damage: Propeller, wing
Wildlife Species: Canada goose

Comments from Report: Significant damage to the wing at the point where it attaches to the fuselage. Although there was minor propeller damage, the engine had to be torn down for inspection. Time out of service was 1 month. Cost of repairs, $15,000.

Date:	18 February 2005

Aircraft: MD-10
Airport: Oakland (CA)
Phase of Flight: Climb (1,500' AGL)
Effect on Flight: Precautionary landing
Damage: Engine
Wildlife Species: Unknown bird

Comments from Report: Bird was ingested in the #2 engine, which caused a major vibration to the tail. Fuel was dumped before making an emergency landing. After landing, discovered the inlet fan had lost 2 blades, 1 exited from the side, punching a hole in the acoustic panel. Fan blades were replaced and panel was repaired. Time out of service was 2 weeks. Cost of repairs, $59,000 and other costs totaled $105,000.

Date:	20 February 2005

Aircraft: Cessna Citation Ultra
Airport: Miami Intl. (FL)
Phase of Flight: Climb
Effect on Flight: None
Damage: Tail
Wildlife Species: Turkey vulture

Comments from Report: Hit a turkey vulture after departure. Impact did not appear to be that hard. No indications on the controls of any major damage. Reduced speed as a preventive measure. After landing, found a hole about 1 foot in diameter in the tail. The tail was replaced. ID by Smithsonian, Division of Birds. Time out of service was 2.5 months. Cost of repairs estimated to be $25,000.

Date:	27 February 2005

Aircraft: B-737-300
Airport: Orlando Intl. (FL)
Phase of Flight: Takeoff
Effect on Flight: None
Damage: Engine
Wildlife Species: Gull

Comments from Report: Strike had no effect on engine operation. After landing, they found several N1 stage blades dented. Eight pairs of blades were replaced. Cost $160,000.

Date:	4 March 2005

Aircraft: B-757-200
Airport: Mineta San Jose Intl. (CA)
Phase of Flight: Climb (5' AGL)
Effect on Flight: Engine shut down, precautionary landing
Damage: Engine
Wildlife Species: Gull

Comments from Report: A flock of gulls and other small birds landed on the runway as the aircraft was rotating for takeoff. The left engine ingested at least 1. The aircraft returned to the airport on the right engine while emergency vehicles stood by. The plane taxied to the gate. Several fan blades were bent. No major engine parameter variations reported. Remains were not saved for ID.

Date:	30 March 2005

Aircraft: SA 227
Airport: Dade-Collier Training and Transportation Airport (FL)
Phase of Flight: Landing roll
Effect on Flight: Not reported
Damage: Propeller, fuselage
Wildlife Species: White-tailed deer

Comments from Report: During landing, while engines were in reverse, last deer in a group of 8, hit the prop causing it to detach and puncture the fuselage. Also damaged were the nose wheel steering and right engine nacelle. Aircraft was a write-off due to cost of repairs ($580,000) being close to the plane's value of $650,000.

Date:	1 April 2005

Aircraft: B-757-200
Airport: Oakland Intl. (CA)
Phase of Flight: Climb (600' AGL)
Effect on Flight: Precautionary landing
Damage: Engine
Wildlife Species: Common loon

Comments from Report: Common loon was ingested into the engine core during climb-out. An emergency was declared and the aircraft diverted to SFO. Engine was not shut down. Vibration and burning smell reported by flight attendant. Fan blades and nose cowl were damaged. Engine was replaced. ID by Smithsonian, Division of Birds. Costs reported at over $1.5 million.

Date:	9 April 2005

Aircraft: B-737-300
Airport: Chicago O' Hare Intl. (IL)
Phase of Flight: Climb (1,500' AGL)
Effect on Flight: Precautionary landing
Damage: Radome, horizontal stabilizer, engine
Wildlife Species: Unknown bird

Comments from Report: Hit several birds. Core ingestion on #2 engine. Engine was removed for repair. Also damaged were radome, left wing, vertical fin and pitot static probe. Aircraft was ferried out for repairs. Time out of service was 15 days. Cost of engine repairs $40,000.

Date:	17 April 2005

Aircraft: Bell 407
Airport: near Brentford (SD)
Phase of Flight: En Route (1,000' AGL)
Effect on Flight: Emergency landing
Damage: Windshield
Wildlife Species: Blue-winged teal

Comments from Report: On the way to the scene of an auto accident at night, a helicopter was hit by 3 ducks. The windshield shattered and blood from the ducks temporarily blinded the pilot. His crew helped direct him to a safe landing spot on a road. The helicopter was then moved to a nearby farm. Time out of service was 8 hours. Cost of repairs $1,440.

Date:	20 April 2005

Aircraft: B-777
Airport: Unknown (DEN-SFO)
Phase of Flight: En Route
Effect on Flight: None
Damage: Engine
Wildlife Species: Unknown bird

Comments from Report: Engine was replaced due to blade damage found in three stages. Time out of service was 9 days. Cost of repairs at least $2 million.

Date:	24 April 2005

Aircraft: B-747
Airport: John F. Kennedy Intl. (NY)
Phase of Flight: Takeoff
Effect on Flight: Engine shut down, precautionary landing
Damage: Engine
Wildlife Species: Great black-backed and herring gulls

Comments from Report: The aircraft hit several gulls at rotation and shut down the #2 engine due to vibration. Aircraft returned to land after dumping 18,700 pounds of fuel. Several fan blades had to be replaced, others repaired. Passengers were delayed about 3 hours. Several great black-backed gulls were found on the runway, and the Smithsonian identified the remains sent by the engine manufacturer as a herring gull.

Date:	9 May 2005

Aircraft: Rockwell NA 265
Airport: Brownwood Regional (TX)
Phase of Flight: Takeoff
Effect on Flight: Aborted takeoff, overran runway
Damage: Engine
Wildlife Species: Unknown bird

Comments from Report: A loud bang was heard followed by plane swerving left as aircraft was about to takeoff. Captain aborted takeoff due to rapidly losing directional control. Plane overran runway, hit a fence and trees, crossed a road and came to rest in a plowed field. Fuel was leaking from left wing. Evidence of bird residue was found in the left engine. No serious injuries to those on board. NTSB report was source for this strike. Expert on birds in engines suggested that it would be unusual to find remains in the hot section of an engine and not find any on the 1st stage blades.

Date:	31 May 2005

Aircraft: B-757
Airport: Lihue Intl. (HI)
Phase of Flight: Takeoff
Effect on Flight: Engine shut down, precautionary landing
Damage: Engine
Wildlife Species: Barn owl

Comments from Report: Pilots saw bird go by right side of aircraft then felt a vibration in right engine. A precautionary landing was made at a nearby airport. Found damage to acoustic liner, several fan blades and LPC and HPC. Engine was removed for repairs. ID by Smithsonian, Division of Birds. Time out of service was 4 days; cost was over $1 million.

Date:	10 June 2005

Aircraft: DC-9-30
Airport: Kansas City Intl. (MO)
Phase of Flight: Climb (10' AGL)
Effect on Flight: Emergency landing
Damage: Engine
Wildlife Species: American kestrel

Comments from Report: First officer saw small bird fly in front of the aircraft and disappear to the left. At rotation, the aircraft began to vibrate, yawed to the left, and made several loud banging noises as the compressor stalled in the left engine. Pilot notified the tower and made an emergency landing that was uneventful. The engine was run at idle until after landing. Several fan blades were damaged along with the fan case. The flight was cancelled. ID by Smithsonian, Division of Birds. Cost of repairs estimated at $800,000.

Date:	24 June 2005

Aircraft: A-310
Airport: Subic Bay (Philippines)
Phase of Flight: Takeoff
Effect on Flight: Aborted takeoff
Damage: Engine, cowling, wing
Wildlife Species: Philippine duck

Comments from Report: Engine had multiple birdstrikes on takeoff roll. A loud bang was heard followed by vibration and pull to right. Fan blades were badly damaged. A large section of nose cowl was torn from the nacelle and a fan cowling was damaged. The #3 flap fairing was damaged by engine shrapnel. Engine and cowling were replaced. ID by Smithsonian, Division of Birds. Time out of service was 4 days. Cost of repairs estimated at $9,456,000 (U.S. carrier).

Date:	4 August 2005

Aircraft: C-421
Airport: Rooke Field (TX)
Phase of Flight: Landing roll
Effect on Flight: Separated nose gear
Damage: Nose landing gear, propellers
Wildlife Species: White-tailed deer

Comments from Report: Aircraft hit a deer while landing, which caused the nose gear to collapse. Both propellers were damaged. Cost of repairs estimated at $100,000.

Date:	17 August 2005

Aircraft: C-421
Airport: Merritt Island (FL)
Phase of Flight: Descent (2,000' AGL)
Effect on Flight: Emergency landing
Damage: Wing, tip tank, electronics
Wildlife Species: Black vulture

Comments from Report: Collision with a black vulture ripped the wing and punctured the fuel tank causing fuel to spray out. The strike also damaged the light that confirmed the landing gear was down. Pilot was not sure if gear was down and called for an emergency landing. State Secretary of Transportation was on board along with other dignitaries. Bird ID by Smithsonian, Division of Birds.

Date:	23 August 2005

Aircraft: MD 520
Airport: near Phoenix (AZ)
Phase of Flight: En Route (400' AGL)
Effect on Flight: Emergency landing
Damage: Windshield, rotor blades
Wildlife Species: American coot

Comments from Report: Bird hit windscreen and shattered left side injuring the pilot. A precautionary landing was made at the Coliseum. Rotor blades were scratched and will be replaced. Time out of service estimated at 3-4 weeks. Cost for windscreen was $30,000. Bird ID by Smithsonian, Division of Birds.

Date:	1 September 2005

Aircraft: Falcon 20
Airport: Lorain County (OH)
Phase of Flight: Climb (15' AGL)
Effect on Flight: Overran runway
Damage: Engines, tail, wings, fuselage, landing gear
Wildlife Species: Mourning dove

Comments from Report: Shortly after rotation, aircraft hit a flock of birds causing the #1 engine to flame out. As the gear was retracted, they hit another flock, which caused the #2 engine RPM to roll-back. The pilot was not able to sustain airspeed or altitude and crash-landed, sliding through a ditch and airport perimeter fence, crossing a road, and ending in a corn–field. Aircraft sustained major structural damage beyond economical repairs. Both pilots were taken to hospital. Only the copilot sustained minor injuries. The NTSB investigated. Costs totaled $1.4 million.

Date:	3 September 2005

Aircraft: B-757
Airport: Cleveland Hopkins Intl. (OH)
Phase of Flight: Climb (100' AGL)
Effect on Flight: Avoidance maneuver
Damage: Engines
Wildlife Species: European starling

Comments from Report: Pilots saw large flock of starlings just after rotation. First officer pulled up trying to avoid major part of the flock. They heard birds hit and immediately a foul smell entered cockpit. Engine instruments remained normal and flight continued to ORD. Both engines sustained damage. Approximately 50 starlings were found on the runway 3 hrs after the strike. Time out of service was approximately 2 days, and cost was estimated at $425,000.

Date:	12 September 2005

Aircraft: Piper Aztec
Airport: Anoka County (MN)
Phase of Flight: Landing roll
Effect on Flight: Not reported
Damage: Engine, prop, wing, landing gear
Wildlife Species: White-tailed deer

Comments from Report: Deer was cut in two by propeller. Photos show significant damage to landing gear. Time out of service was 3 days, and cost totaled $50,000.

Date:	13 September 2005

Aircraft: DC-10
Airport: Forth Worth Meacham Intl. (TX)
Phase of Flight: Landing roll
Effect on Flight: Engine shut down
Damage: Engine
Wildlife Species: Rock pigeon

Comments from Report: Ingested 15-20 pigeons in the #3 engine on landing. Engine change required. ID by Smithsonian, Division of Birds. Aircraft was out of service for 1 week. Cost estimated at $1.5 -$2 million.

Date:	30 September 2005

Aircraft: DC-10-10
Airport: Unknown
Phase of Flight: Unknown
Effect on Flight: None
Damage: Engine
Wildlife Species: Wood duck

Comments from Report: During maintenance inspection evidence of strike was found on the #1 engine. Spinner had a large dent, and some fan blades were bent. Engine was borescoped. Complete set of fan blades was replaced. ID by Smithsonian, Division of Birds. Cost of repairs was $40,000. Aircraft was out of service for 2 days.

Date:	16 October 2005

Aircraft: BE-1900
Airport: Ogdensburg Intl. (NY)
Phase of Flight: Takeoff
Effect on Flight: Nose gear collapsed
Damage: Engine #1 and #2, propellers, landing gear, nose, fuselage
Wildlife Species: Coyote

Comments from Report: Aircraft struck a coyote during takeoff run. The nose gear collapsed causing the plane to skid to a stop on the runway. Propeller blades went through the skin of the aircraft. Insurance declared aircraft a total loss. Cost of repairs would have been $1.5 million.

Date:	17 October 2005

Aircraft: BE-400
Airport: Nut Tree (CA)
Phase of Flight: Landing roll
Effect on Flight: None
Damage: Engine, landing gear, fuselage, pitot tube
Wildlife Species: Wild turkey

Comments from Report: Aircraft struck approximately 20 wild turkeys on landing rollout. One engine had to be replaced after a bird was ingested. The other engine had evidence of a strike and was borescoped. A tire had a 1" strip of tread missing, and the right wing stall strip was dented. Pitot tube was replaced. Aircraft was out of service for 4 days, and costs totaled over $76,000.

Date:	1 November 2005

Aircraft: A-300
Airport: Joe Foss Field (SD)
Phase of Flight: Climb (6,000' MSL)
Effect on Flight: Precautionary landing
Damage: Engine
Wildlife Species: Mallard

Comments from Report: While climbing through 6,000 ft, the #2 engine sustained a bird strike from a single large bird. Flight crew reported engine vibrations and considerable noise. They kept the engine running at idle, declared an emergency, and returned to the airport, landing uneventfully. Several fan blades were damaged along with the acoustic liner and inlet guide vanes. Flight was delayed about 3 hrs. Aircraft was substituted, and engine and inlet cowl were replaced. ID by Smithsonian, Division of Birds. Cost was $518,000.

Date:	30 November 2005

Aircraft: B-747
Airport: Denver Intl. (CO)
Phase of Flight: Approach (1,200' AGL)
Effect on Flight: None
Damage: Engines, wing
Wildlife Species: Canada goose

Comments from Report: On approach, both the # 1 and 2 engines were struck by geese. No abnormal engine parameters were noted. The #1 engine was shut down after landing. Two fan blades on the #1 engine and 9 fan blades on the #2 engine were damaged. Inspection found core ingestion in both engines. The left outboard mid-flap had a 6-inch hole. Right outboard flap inboard canoe was also penetrated. A leg with webbed foot was protruding from the hole. ID by Smithsonian, Division of Birds. Cost $194,000.

Date:	13 December 2005

Aircraft: Embraer 145
Airport: Harrisburg Intl. (PA)
Phase of Flight: Approach (5,000' AGL)
Effect on Flight: Compressor stalls
Damage: Engine
Wildlife Species: Canada goose

Comments from Report: During approach crew saw a streak out left window, followed by a jolt. A smell was immediately detected. Crew turned off the LH pack and reduced power to idle to slow the plane. Engine experienced violent compressor stalls when power was increased. ID by Smithsonian, Division of Birds.

Date:	28 December 2005

Aircraft: B-737-300
Airport: Chicago Midway Intl. (IL)
Phase of Flight: Climb (300' AGL)
Effect on Flight: Precautionary landing, flight diverted to ORD
Damage: Engine
Wildlife Species: Snowy owl

Comments from Report: One large bird was ingested into the #2 engine. A precautionary landing was made at Chicago O'Hare. One engine was destroyed. Passengers were put on other flights. ID by Smithsonian, Division of Birds. Aircraft was out of service at least 24 hours.

Date:	28 December 2005

Aircraft: B-737-500
Airport: Sacramento Intl. (CA)
Phase of Flight: Climb (800' AGL)
Effect on Flight: Precautionary landing
Damage: Engine
Wildlife Species: Unknown bird

Comments from Report: Pilot saw a large white bird fly by left and heard a loud pop and the left engine began vibrating. Aircraft returned to the airport. All fan blades were replaced. Passengers were put on other flights. Cost of repairs was $210,400.

Date:	30 December 2005

Aircraft: Bell 206
Airport: Near Washington, LA
Phase of Flight: En Route (500' AGL)
Effect on Flight: Precautionary landing
Damage: Aircraft destroyed
Wildlife Species: Vulture

Comments from Report: Pilot looked up from instruments to see a large vulture crashing into the windshield. He was temporarily blinded by blood and wind. After regaining control, the pilot tried to land in a bean field nearby, but blood was hampering his vision, and the left skid hit the ground first causing the aircraft to tip on its side. Pilot was taken to the hospital and had several surgeries to repair his face, teeth, and eye. Cost of repairs was $1.5 million.

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