August 2003

The National Wildlife Strike Database for the USA: 1990 to 2002 and Beyond

Sandra E. Wright
U.S. Department of Agriculture, Wildlife Services, Sandusky, OH, sandra.e.wright@usda.gov

Richard A. Dolbeer
U.S. Department of Agriculture, Wildlife Services, Sandusky, OH, richard.a.dolbeer@usda.gov

The National Wildlife Strike Database for the USA: 1990 to 2002 and Beyond

Sandra E. Wright, U.S. Department of Agriculture, Wildlife Services, 6100 Columbus Avenue, Sandusky, OH 44870, 419/625-0242; Fax: 419/625-8465; E-mail: sandra.e.wright@usda.gov

Richard A. Dolbeer, U.S. Department of Agriculture, Wildlife Services, 6100 Columbus Avenue, Sandusky, OH 44870, 419/625-0242; Fax 419/625-8465:E-mail: richard.a.dolbeer@usda.gov

***ABSTRACT*:** The National Wildlife Strike Database for Civil Aviation in the USA became operational in 1995 with the initiation of data entry of all strikes beginning in 1990. Since 1995, approximately 46,600 reported strikes from 1990-2002 involving civil aircraft in the USA or for USA carriers in foreign countries have been entered into the database. About 97% of the reported strikes have involved birds and 3% have been with mammals or reptiles. Over 2,000 reported strikes have indicated substantial damage to the aircraft. The database has proven to be an extremely useful source of objective information on the extent and nature of wildlife strikes for individual airports and for researchers and engineers conducting national studies. Selected records and fields of the database are now available online at http://wildlife-mitigation.tc.faa.gov for use by airport personnel, engine manufacturers, FAA officials and others. Although the database is already a powerful research and management tool, improvements are needed in the reporting procedures to make the database even more useful. First, we estimate that up to 80% of strikes with civil aircraft were not reported under the current voluntary reporting system. Furthermore, only 19,324 (43%) of the 45,340 reported bird strikes identified the bird to species group (e.g., gull or hawk) and only 9,350 (48%) of these 19,324 reports further identified the bird to species level (e.g., ring-billed gull [Larus delewarensis]). Thus, only 19% of the bird strike reports identified the bird to species. Identification of species struck is critical for prioritizing bird management activities at airports and for engineering/airworthiness studies of aircraft and engine components. To improve species identification, the Feather Laboratory at the Smithsonian Institution, through an agreement with the Federal Aviation Administration, now provides free identification of bird strike remains for civil aircraft in the USA (instructions can be found at the above website). Improvements are also needed in the reporting of other critical strike variables. For example, height above ground level at the time of the strike was not provided in 13,888 (31%) of the 45,340 bird strikes. During the past 8 years, the National Wildlife Strike Database for Civil Aviation in the USA has provided a scientific foundation for the various efforts underway to reduce the problem of bird and other wildlife strikes with aircraft. Improvements in reporting as outlined above will make the database even more powerful and useful in the years ahead.

Introduction and History of the Database

Bird and other wildlife strikes to aircraft are a serious economic and safety problem in the United States. Since 1968, the Federal Aviation Administration (FAA) has requested, but not mandated, that pilot and airport personnel report all wildlife strikes on FAA Form 5200-7. However, the extent and nature of the bird strike problem for civil aircraft in the USA or USA aircraft at foreign airports, had been largely unquantified until 1995 (Dolbeer et al. 1995).

The U.S. Department of Agriculture (USDA), Wildlife Services (WS), National Wildlife Research Center took over management of the Wildlife Strike Database for the FAA in 1995 through an interagency agreement. An initial screening of data from1990-1994, indicated over 70 % of the records in the database had critical errors in variables such as date of the incident, species struck, or type of damage. In addition, about 10 % of the records were duplicate entries. These errors have been corrected. There were 11,000 strike reports in the database for 1990-1995 (an average of less than 2,000 per year). There now are approximately 46,600 strike reports in the database for 1990-2002 (97% birds, 3% mammals and <1% reptiles) with an average of 4,100 per year since 1995. In all, 251 bird species have been reported as struck by civil aircraft, 1990-2002 (Table 1) and 121 species of birds have been reported as causing damage

(Table 2). Many additional species have likely been struck because only 43% (19,324) of the 45,340 reported bird strikes have identified the bird to species group (e.g., gull, hawk) and only 48% (9,350) of these strikes have identified the bird to species. Strikes are reported mainly through FAA Form 5200-7 (66%) both by mail and the Internet (http://wildlife-mitigation.tc.faa.gov). The rate of reporting has increased over 350% since 1990.

Jeff Rapol, at the FAA Office of Airport Safety and Standards, Washington, D.C. was instrumental in making changes in the computer program for entering data to reduce the possibilities of mistakes and inconsistencies in the data entry process. In 2001, Archie Dickey and Allen Newman, Embry Riddle Aeronautical University in Arizona, received funding from the FAA Technical Center in Atlantic City, New Jersey to convert the database from a DOS format to an Access format. Dickey and Newman also created a website for information about bird and other wildlife strikes (http://wildlife-mitigation.tc.faa.gov).

Uses of the Database

The FAA, in cooperation with WS, has produced annual reports since 1995 that present a summary analysis of data from the FAA National Wildlife Strike Database. The most recent report covers the period 1990 through 2002 (Cleary et al. 2003). Analyzing the strike report data annually and producing an annual report have been important for three reasons. First, errors and inconsistencies are identified and corrected, thus enhancing the integrity and usefulness of the data. Second, these reports provide a scientific foundation for work being done to reduce strikes. Third, these reports demonstrate to the civil aviation industry that the data from the strike reports are being used to improve aviation safety. Generally, copies of the annual report, "Wildlife Strikes to Civil Aircraft in the United States" are sent to all certificated airports in the United States. The report is also available online at http://wildlife-mitigation.tc.faa.gov.

These reports help justify wildlife management actions at airports that otherwise might be considered too controversial to undertake. For example, when biologists planned a deer kill at the Philadelphia Airport, they were challenged by various animal rights groups who argued that deer could not be a hazard to aviation. By using the FAA database, the biologist was able to show quantitatively that deer are a hazard at airports, especially in Pennsylvania. The Human Society and other organizations withdrew their opposition to the hunt.

The database is an increasingly important tool for understanding and reducing wildlife hazards to aviation. The aviation community has long believed that most bird strikes are an act of God, and therefore unpreventable, but the database has shown just the opposite. About 71 % of the reported strikes occurred below 500 feet above ground level and 36 % occurred when the aircraft was on the ground during takeoff run or landing roll. This indicates that the focus of strike prevention activity must begin on and around the airport. As the number of USDA, WS biologists working at airports has increased, use of the database has increased correspondingly. The biologists are able to research the strike history of an airport as part of a Wildlife Hazard Assessment.

The Wildlife-Mitigation website (http://wildlife-mitigation.tc.faa.gov) can be used to report strikes, but it also provides access to the database. For example, WS biologists who need a strike history of the airport where they are conducting a Wildlife Hazard Assessment are now able to access the database for any airport in their state once they receive the password. Airport operators, airline operators and engine manufacturers can view the data that pertains to them as long as they obtain a password from the FAA biologist. To date, 46 airport operators, 6 airline operators, and 2 engine manufacturers have requested and been granted access to the database. The general public also has limited access to certain data such as a strike summary of species by state. Specific details as to airline, aircraft, engine and airport are not available to them through the website.

In order to prioritize management actions to reduce wildlife hazards, airport operators need guidance on the relative risk posed by various species. Dolbeer et al. 2000, in a paper "Ranking the Hazard Level of Wildlife Species to Aviation" showed that not all wildlife were equally hazardous to aviation. Twenty-one species or species groups were selected for which there were at least 17 strike reports in the FAA database.

For more information on bird strikes visit
http://www.birdstrikecanada.com/ and http://wildlifedamage.unl.edu

The groups were ranked for relative hazard to aircraft based on the percentage of strikes causing damage, major damage, and an effect-on-flight. Deer, vultures, and geese were ranked 1, 2, and 3 respectively as the most hazardous species groups, while blackbirds/starlings, sparrows and swallows were least hazardous (ranked 19, 20 and 21 respectively). The hazard score was strongly related to mean body mass for the 21 species groups.

Future Issues

Although more airlines and airports are reporting strikes each year, 25% of the strikes reported from 1990-2002 were not reported on the current FAA Form 5200-7 (Cleary et al. 2003). When FAA Form 5200-7 is not used, important information is often omitted, for example, height above ground level. Because of this, the database manager must make additional contacts with the parties involved. As more strikes are reported each year, it will become impossible to follow up on every strike with missing data.

The accurate identification of species involved in bird strikes is vital to decisions regarding airfield habitat management, aircraft engineering, and aviation safety. From 1990 to 2002, only 42% of the 45,323 bird strike reports provided information on the species group (e.g., gull or duck). Furthermore, only 23 % (10,374) of the 45,323 reports provided identification to species (e.g., herring gull or mallard). If we assume that the 45,323 reported strikes represent 20% of the total strikes that occurred (Cleary et al. 2003), then there were actually 226,615 bird strikes from 1990-2002. This means that only about 5% (10,374) of the estimated bird strikes occurring were identified to species.

The Smithsonian Feather Lab has been identifying birds involved in civil aviation strikes for the FAA since 1999. From 1999-2002, 371 species have been identified through this service (5 in 1999, 51 in 2000, 114 in 2001, and 201in 2002. (Marcy Heacker-Skeans, Personal communication). A significant increase has occurred in the number of bird remains being sent for identification. This service is being promoted by several methods. One way is through WS biologists working with airport operations personnel. Another way is by a poster that was created in 2002 to show the damage that birds cause and provide information about submitting feather remains.

A third way to improve strike reporting is through the strike reporting form on the Internet that allows the person reporting the strike to indicate if they collected remains and sent them to the Smithsonian for ID. This feature creates awareness that the feather ID service is available. The wildlife-mitigation website also has a link for instructions on how to submit feather remains.

Now that we are making progress with the bird identification problem, the next item that needs attention is obtaining costs incurred from wildlife strikes. Some airlines cannot provide the cost for damage or lost revenue from wildlife strikes because they do not keep track of it. Others may file a strike report before the costs are known, not realizing they have the option of waiting until all data are available to file the report or updating a strike reported via the Wildlife-Mitigation website. Of the 6,606 reports from 1990-2002 that indicated the strike caused damage to the aircraft, only 1,560 (24%) provided an estimate of the aircraft damage cost (Cleary et al, 2003). In addition, even when a bird strike did not cause damage, an inspection is usually required which costs the airline both time and money; this information is rarely reported. One airline's flight safety office told me, "We don't keep track of costs under $750,000 because the insurance covers the losses." Perhaps it is time to contact the insurance companies that insure aircraft for their data.

Conclusions

Since 1995, when USDA, WS began managing the FAA Wildlife Strike Database, strike reporting has increased more than three-fold and the database now contains approximately 46,600 strike reports (1990-2002). The data are regularly checked for errors and analyzed and a report is produced annually that summarizes all strike data since 1990. The database and the reports play an increasingly important role in providing a scientific foundation for management of hazardous wildlife at and around airports. The strike report form (FAA 5200-7) has been updated and made available on the Internet, making it easier to file a report. The problem of identifying birds that were struck has been addressed through a cooperative agreement between the FAA and the Smithsonian Feather Lab. This free feather identification service

needs to be promoted. The next step should be to seek the cooperation of airlines and insurance companies to provide the actual costs of damaging strikes and inspections of non-damaging strikes.

Acknowledgments
This research was supported by the FAA, William Hughes Technical Center, Atlantic City, New Jersey, under agreement DTGA03-99-x-90001. Opinions express in this study do not necessarily reflect current FAA policy decisions regarding the control of wildlife on or near airports. We appreciate the support and advice of FAA employees S. Agrawal, M. Hoven, and J.L. Rapol. E. Cleary, and R. C. Beason reviewed the manuscript and provided advice on analysis.

Literature Cited
Cleary, E. C., R. A. Dolbeer, and S. E. Wright, 2003. Wildlife strikes to civil aircraft in the United States, 1990-2002. Serial Report Number 9. Federal Aviation Administration, Office of Airport Safety and Standards, Washington, DC. 51 pages. http://wildlife-mitigation.tc.faa.gov

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. 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.

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

Table 1. The top twenty bird species reported as struck by civil aircraft, USA, 1990-2002.

		Category of reported damage[1]						
Rank	Species	De-stroyed	Sub-stantial	Minor	Un-certain	None	Not reported	Total
1	Mourning dove		20	15	15	450	565	1065
2	European starling		15	24	8	691	277	1015
3	Rock dove		54	49	16	503	274	896
4	Canada goose	1	111	163	64	270	59	668
5	American kestrel		6	1	3	163	487	660
6	Killdeer		2	7	6	188	205	408
7	Red-tailed hawk		24	33	14	158	169	398
8	Ring-billed gull		12	7	5	90	196	310
9	Herring gull		29	7	4	77	149	266
10	Mallard		27	29	7	92	87	242
11	Barn swallow		1	1	1	85	92	180
12	Turkey vulture	1	32	42	18	44	20	157
13	Eastern meadowlark		1	1		61	93	156
14	Horned lark		3	1	1	38	110	153
15	American crow		7	10	1	85	47	150
16	American robin		2	5	2	119	19	147
17	Barn owl		7	2	1	55	81	146
18	Pacific golden-plover					89	55	144
19	Laughing gull		4	1	1	46	73	125
20	Great blue heron		3	11	4	47	40	105
	231 other species	1	138	136	33	743	908	2541
	Grand total	**3**	**498**	**545**	**204**	**4094**	**4006**	**9350**[2]

[1] 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.

[2] In addition there were 9,974 reported strikes in which the bird was identified to species group (e.g. gull, hawk) but not to species and there were 26,016 strikes in which the bird was classified as unknown.

Table 2. The top 20 bird species reported as struck and causing damage to civil aircraft, USA ,1990-2002.

		Category of reported damage[1]				
Rank	Species	De-stroyed	Minor	Un-certain	Sub-stantial	Total
1	Canada goose	1	163	64	111	339
2	Rock dove		49	16	54	119
3	Turkey vulture	1	42	18	32	93
4	Red-tailed hawk		33	14	24	71
5	Mallard		29	7	27	63
6	Mourning dove		15	15	20	50
7	European starling		24	8	15	47
8	Herring gull		7	4	29	40
9	Snow goose		11	5	17	33
10	Ring-billed gull		7	5	12	24
11	American crow		10	1	7	18
12	Great blue heron		11	4	3	18
13	Bald eagle		13	2	2	17
14	Osprey		8	1	7	16
15	Sandhill crane		10		6	16
16	Killdeer		7	6	2	15
17	Double-crested cormorant		4	2	5	11
18	Brown pelican	1	7	2	1	11
19	American kestrel		1	3	6	10
20	Barn owl		2	1	7	10
	101 other species	0	92	26	111	229
	Grand total	**3**	**545**	**204**	**498**	**1250**

[1]See footnote for Table 1.