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An Analysis of the Barriers Found in Reporting Wildlife Strike Incidents to the FAA National Wildlife Strike Database for Civilian Aviation

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Abstract

The research project evaluated people's knowledge regarding the reporting process for the FAA National Wildlife Strike Database for Civilian Aviation. The national average is such that less than 20% of wildlife strikes are reported to the database (Cleary & Dolbeer, 2005). The project looked at pilots and maintenance personnel to see who reports wildlife strikes to the database and who does not. Also, it investigated why those who did not report the strikes acted so. Within the selected population, the research found a lower than average reporting rate. This project also found that the biggest barrier to reporting strikes to the database was the lack of knowledge of the existence of the database. It was recommended that to improve the strike reporting rate, some form of advertisement and education was needed. It was also suggested that further research on the topic be done.

KEYWORDS: wildlife, wildlife strike, bird strike, aviation accident, U.S. Department of Agriculture, bird hazard

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Introduction

Birds took to the skies nearly 150 million years ago. Man's initial venture in the air was just over 100 years ago. Man is the new animal in the system and, as we would expect from adding a new variable, there have been issues with wildlife strikes since the beginning of aviation. The first reported incident occurred in 1905 when Orville Wright struck a bird in flight, in Dayton, Ohio. Although there was no negative impact on the flight, the bird, assumed to have been a red-winged blackbird, was killed. The first fatality occurred in 1912 when an aircraft flying in Long Beach, California struck a gull. The pilot, Calbraith Rodgers, lost control of the aircraft when the gull disabled a set of control cables (Cleary & Dolbeer, 2005). In the earliest days of powered flight, these incidents were not very common; aircraft were still few in number and moved rather slowly. This allowed the pilot to avoid a possible collision, or in the event of a collision, sustain little damage. These incidents were not considered serious and were not often reported (Blokpoel, 1976).

As time has progressed, the hazards of wildlife strikes have continued to rise, and as aircraft speeds have increased, the cost of damages from these strikes has risen. The number of aircraft in the sky has also increased along with the number of species of native animals, increasing the probability of wildlife strikes. Another factor in the rise of wildlife strikes could be that the types of aircraft engines have changed over time. The initial aircraft engines were a reciprocating type and were very large and loud. But, with the advent of the jet age, the turbine engines have become quieter as they are designed to operate with greater efficiency. This improvement in technology has reduced the warning time given to wildlife in the path of an approaching aircraft. With these changes, the threat of wildlife strikes has grown from an uncommon nuisance to a serious problem (Blokpoel, 1976).

As the danger of wildlife strikes has increased, research regarding the interaction of wildlife and the air transportation system in America has become essential. Through a greater understanding of wildlife strikes in the air and on the ground, airport operators, aircraft engineers, and biologists can help reduce the number and the severity of collisions. The data used in this research come, for the most part, from the Federal Aviation Administration (FAA) National Wildlife Strike Database for Civilian Aviation (NWSD). When a wildlife strike occurs, it should be promptly reported to the NWSD. This is highly recommended, though not required, as per FAA Advisory Circular (AC) 150/5200-32A. Depending on the situation, the reporting can be done by the aircraft operator, owner, maintenance personnel, or by airport personnel. The report can be submitted on a standard paper form or by using an electronic form. Both forms provide detailed information regarding the incident (Cleary & Dolbeer, 2005.)

Problem Statement

Incidents involving a strike between an aircraft and native wildlife have been a problem since the early days of aviation. The problem is that these incidents result in significant financial losses to both airlines and general aviation and serve as a potential source for personal injury and fatalities. Research based on these strikes is necessary for the reduction of the number and severity of strikes. The information provided by the FAA NWSD is essential for this research but is incomplete. The FAA Wildlife Strike Database report states that

> Less than 20% of strikes are reported to the database and many reports received by the FAA do not include cost or damage data or were filed before aircraft damage was fully assessed, the number of strikes and associated cost data compiled from the voluntary reporting program greatly underestimate the magnitude of the problem (Cleary & Dolbeer, 2005, p. 9).

This allows valuable data to go unreported. The purpose of this project is to identify any barriers to reporting the necessary information to the NWSD. Recommendations can then be made to increase the amount and quality of incoming data.

Limitations

This project was limited to the incident reporting behaviors of pilots and maintenance personnel. The surveys were distributed among these two populations in the area of Daytona Beach, Florida. Non-maintenance airport personnel were eliminated from the study to moderate the scope of the project. The project is also limited to reporting practices in civilian aviation, as the United States Air Force (USAF), the U.S. Army, and the U.S. Navy each utilize their own wildlife strike reporting systems.

Review of Literature

To best understand the problems associated with wildlife strike hazards, one must approach the problem with a diverse knowledge. It is a problem that exists within the science of aeronautics yet requires an understanding of ecology and biology, and knowing the history of the problem will help to further clarify the current situation. The extensiveness of the species involved must be addressed.

What is a Wildlife Strike?

Simply looking at the term, one can get a basic idea of what constitutes a wildlife strike. In short, it is where one or more birds or other wildlife strike an aircraft, either on the ground or in flight. Note that the term used here and throughout the paper is "wildlife strike" as opposed to "bird strike". While the vast majority of strikes involve birds, the incidents involving mammals, especially terrestrial mammals, and even reptiles cannot be ignored.

A detailed definition of what constitutes a wildlife strike was included in an FAA Advisory Circular from 2004. AC No: 150/5200-32A (FAA, 2004) lists the following five possibilities for the instance of a wildlife strike:

1. A pilot reports striking 1 or more birds or other wildlife.
2. Aircraft maintenance personnel identify aircraft damage as having been caused by a wildlife strike.
3. Personnel on the ground report seeing an aircraft strike 1 or more birds or other wildlife.
4. Bird or other wildlife remains, whether in whole or in part, are found within 200 feet of a runway centerline, unless another reason for the animal's death is identified.
5. An animal's presence on the airport had a significant negative effect on the flight (i.e., aborted takeoff, aborted landing, high speed emergency stop, aircraft left pavement area to avoid collision with animal).

Figure 1, below, shows the number of wildlife strikes reported to the FAA NWSD from 1990 to 2005 and includes terrestrial mammals and birds involved in the strikes. Due to the relatively small numbers, the chart does not include the 150 bats and 79 reptiles involved in strikes during that time period.

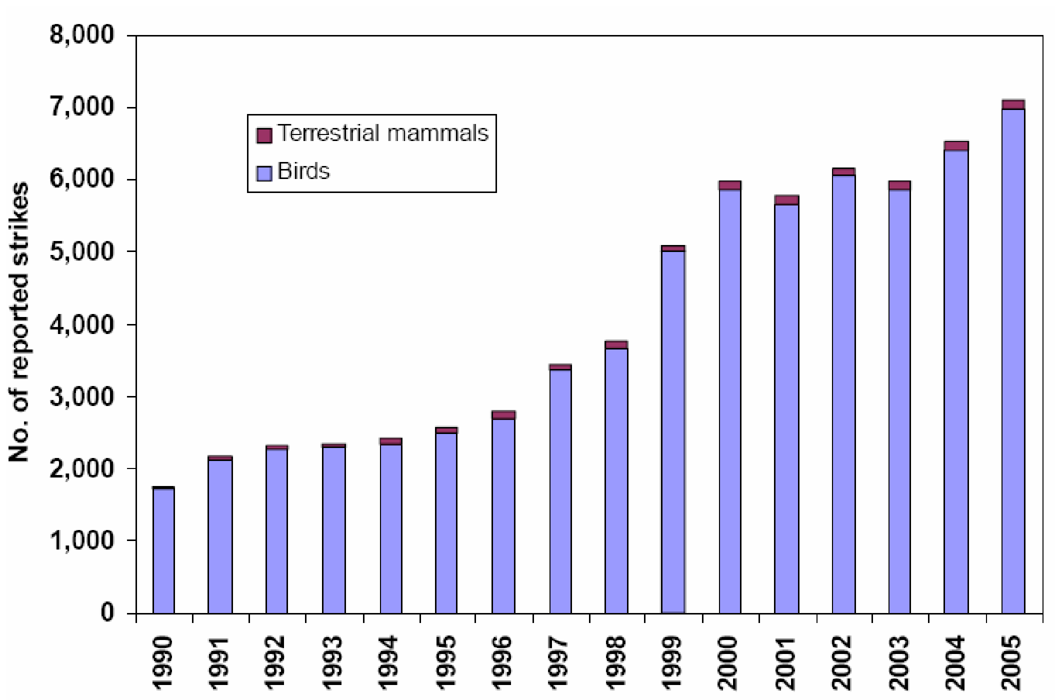

Figure 1. Increasing Wildlife Strikes Reported to the FAA NWSD (Adapted from Cleary, Wright & Dolbeer, 2006).

Chronology of Wildlife Strikes

The first human fatality reported due to a wildlife strike occurred in 1912; since then, thousands more have occurred over the years. Some of these strikes have been of such significance as to warrant changes in the aviation industry, but many have just been indicative of a continuing problem.

The worst accident as a result of wildlife strikes in the U.S. occurred in 1960, and involved a Lockheed Electra taking off from Logan Airport in Boston, Massachusetts. The aircraft encountered a large flock of European starlings, ingesting birds into all four turbo-prop engines. The aircraft plunged into Boston Harbor, killing 62 people and injuring nine others. This accident resulted in the FAA developing minimum turbo-prop engine bird ingestion standards (Cleary & Dolbeer, 2005).

In February of 1973, a Learjet 24 encountered a flock of brown-headed cowbirds as it departed from Dekalb-Peachtree Airport in Atlanta. The resulting engine failure caused the aircraft to crash, killing eight people and injuring one on the ground. The birds had been attracted to a nearby trash transfer station. This incident spurred the FAA to develop standards on the location of animal attractants, including the minimum allowable distance for landfills near airports (Cleary & Dolbeer, 2005).

In November, 1975, at John F. Kennedy International Airport in New York City, a DC-10 ingested gulls into an engine and had to abort takeoff. The aircraft ran off the end of the runway, burst into flames, and was destroyed. Fortunately, all of the 138 people on board escaped safely. This incident caused the FAA to begin data collection on bird strikes and engine ingestions (Cleary & Dolbeer, 2005).

In February, 1992, a Piper Cherokee departing Sandstone Municipal Airport in Minnesota struck a deer. The pilot attempted to return to the airport but was unsuccessful. The aircraft impacted with trees south of the airport and was destroyed and the pilot was seriously injured (Cleary, Wright, & Dolbeer, 2002).

In June, 1995, an Air France Concorde was landing at John F. Kennedy International Airport in New York when it ingested either one or two Canada geese in the #3 engine causing an uncontained failure. Shrapnel was ejected from the #3 engine, penetrated the #4 engine, and cut control cables and hydraulic lines. The aircraft was at an altitude of approximately 10 feet during the incident and landed safely, but the runway had to be shut down for several hours. Over $9 million in damage was caused to the Concorde. Over $5.3 million in compensation was paid to the French Aviation Authority by the Port Authority of New York and New Jersey (Cleary et al., 2002).

In February, 1999, a Boeing-757 had to return to Cincinnati/Northern Kentucky International Airport after takeoff when it encountered a large flock of starlings. Extensive damage was done to both engines and one wing. The bodies of approximately 400 starlings were found on the runway area after the event (Cleary & Dolbeer, 2005).

Worldwide, 400 people have been killed and 420 aircraft have been destroyed due to wildlife strikes. In the U.S., in the 15 year period between 1990 and 2004, 59,196 wildlife strikes were reported to the FAA with 31 aircraft destroyed, 163 injuries, and nine fatalities. The number of strikes per year has increased during that 15-year period. These reported strikes resulted in over $214 million in losses and over 533,000 hours in aircraft downtime (Cleary & Dolbeer, 2005).

The National Wildlife Strike Database for Civilian Aviation

The FAA began collecting data on wildlife strikes in 1965. This data was used to determine some basic trends in wildlife strikes, but was never used for in-depth analysis. A program was initiated in 1995 to more accurately determine the scope of the wildlife strike situation in the United States. Through an interagency agreement, the FAA and the United States Department of Agriculture, Wildlife Services (USDA/WS) were brought together on the problem. Specialists from the USDA/WS review and edit strike reports to be entered into the NWSD and compile annual statistical reports to be submitted to the FAA. These analyses provide valuable information to the FAA including the costs involved with wildlife strikes and the magnitude of the safety issue. Most importantly, these reports address the very nature of the wildlife strike problems. This information can then be used in research to help mitigate strike problems (Cleary et al., 2002).

In the event of a wildlife strike, there are multiple ways for the information to enter into the NWSD. The most common method is the traditional mail-in report form, FAA Form 5200-7, although the electronic version of this form, which can be accessed through the wildlife mitigation homepage (http://wildlife-mitigation.tc.faa.gov), is rapidly gaining in popularity. Both of these versions ask for detailed information to be submitted to the NWSD. Aside from the basic questions of who, when, and where, the form also asks what part of the aircraft was struck, the effect on the flight, the cost of repairs, other costs, and some questions about the wildlife involved. It is important to include as much information as possible in the strike report. Other ways for information to get to the NWSD include airline reports, reports from engine manufacturers, aircraft incident reports, reports from the National Transportation Safety Board (NTSB), and reports from the USAF Bird Aircraft Strike Hazard (BASH) program (Cleary & Dolbeer, 2005).

Most of the questions in FAA Form 5200-7 can be answered with little effort, but wildlife identification after a strike may sometimes prove difficult. Not every pilot and mechanic will know a bluebird from a blue jay, and after a strike, identification may be nearly impossible. Thus the Smithsonian Institution's Feather Laboratory has been drawn into the wildlife strike problem. Since 1999, the FAA has been sending seemingly unidentifiable remains to the Smithsonian Institute for analysis. The remains are compared to samples of birds in the institute's 150 year old collection of more than 620,000 birds ("FAA working with Smithsonian," 2002). If feather samples are not available, other wildlife remnants may be sent to the Smithsonian Institution for identification, including beaks, bones, feet, and talons. The Smithsonian Institution is also building a DNA database to make the identification of birds and mammals even simpler. These services are offered free of charge. As an example of the importance of bird identification in a wildlife strike, consider that there are over 600 species of birds living in North America and each may behave differently. Gulls, which appear very physically similar to a few other species of birds, tend to be a nuisance bird at airports. Each species may react differently in a panic situation. Thus the identification of the species is crucial for proper understanding of the situation and for the implementation of control methods (Rossier, 2001).

The NWSD can be accessed by anybody and the information can be used for many purposes. The general public can access the database and analyze a limited number of variables, sorting strikes by year, state, and species. The database can also be accessed by engine manufacturers, airlines, and airports. The data can be analyzed for national and seasonal trends, and also for trends at the regional level or even for individual airports (Cleary & Dolbeer, 2005).

Wildlife Hazards on the Rise

Analyzing the data in the NWSD shows increasing trends in wildlife strikes, both in frequency and in severity. This has been attributed to three different factors. First, the design of aircraft used in the United States is changing. Aircraft, especially jet aircraft, are getting quieter. Noise abatement requirements at airports have spurred the development of quieter engines and operational procedures. This leaves birds less able to detect moving aircraft.

Also, the number of engines per aircraft has also been decreasing as airlines abandon the older three and four engine aircraft for more efficient two engine models. In 1969, the U.S. passenger fleet was comprised of 2,100 aircraft, 75% of which had three or more engines. By 1998, the fleet had increased to 5,400 aircraft, but only 30% had three or four engines. It is predicted that by 2008 the fleet will contain nearly 7,000 aircraft, only 10% of which will have three or four engines. This decrease in redundancy leaves aircraft more susceptible to dangerous or life-threatening situations in the event of a wildlife strike. This is especially true when an aircraft encounters a large flock of birds (Cleary & Dolbeer, 2005).

The second factor has to do with changes in wildlife populations, because the threat of wildlife strikes increases with changes in wildlife populations. Many bird species have experienced population growths in the past decades. This is most significant among bird species that have larger body mass averages and species that have a natural tendency to gather in flocks. Aircraft design standards, set by the FAA, are based on strikes involving wildlife ranging from four to eight pounds, depending on the aircraft component. For example, transport category aircraft must endure the strike of a single four-pound bird at cruise speed to the airframe and to the windscreen. The empennage must be able to sustain an eight-pound bird strike at cruise speed and turbine engines must be able to ingest a four to eight pound bird, depending on engine inlet diameter (Cleary & Dolbeer, 2005).

In the United States for example, 13 of the 14 species that are native have an average body mass that exceeds the minimum impact design standards and have had significant population increases. Furthermore, many other species exhibit limited or strong flocking tendency behaviors that can also pose a threat to aircraft (Dolbeer & Eschenfelder, 2002).

The population increases of many bird species are, in part, a result of unprecedented conservation actions in the United States. The efforts of public and private wildlife management groups have managed to revitalize the populations of some native wildlife that were over-hunted in the 19th and early 20th centuries. These efforts resulted in population increases among other potentially hazardous wildlife including alligators and some species of deer. Adaptation to the suburban and urban habitats has also allowed for population growths among some species (Cleary & Dolbeer, 2005).

The third factor affecting the rate of wildlife strikes is the dramatic increase in air traffic. Between 1980 and 2004, annual passenger enplanements more than doubled, increasing from 310 million to 686 million. In that same time frame, aircraft movements increased from 17.8 million aircraft movements per year to 29 million aircraft movements per year (Cleary & Dolbeer, 2005).

Hazardous Wildlife

All types of wildlife can be hazardous when impacting an aircraft, although several species are more common in the airport environment than others and result in a higher strike probability. Strikes involving other species aside from the ones listed below are not as common but can provide a greater risk to an aircraft and its occupants. The greatest risk to aircraft comes from birds, mammals, and to a lesser extent, some species of reptiles.

Birds. Birds at an airport are a very common sight. One can usually see starlings, blackbirds, or crows hopping about on the airport grounds. Egrets, herons, and storks may congregate around large ponds of standing water. Gulls, hawks, or vultures may be soaring overhead. All of these species are common both in the U.S. and at airports, and are a hazard to aircraft. Of all reported wildlife strikes between the years 1990 and 2000, birds were involved in 97.4% of the incidences. Among these strikes, the most common types of birds were gulls, doves, raptors, and waterfowl, with the most damaging strikes resulting from the waterfowl (Cleary et al., 2002).

As mentioned earlier, of the 14 species of North American birds with a body mass greater than eight pounds, 13 had a significant population increase between the years 1970 and 2002. One example is the Canada goose. In 1970 the population of Canada geese in the U.S. was estimated to be 250,000 (Cooper, Parker, Eschenfelder, & Kelly, 2000). This slowly increased to 1 million in 1990 and then exploded to 3.6 million birds in 2003 ("Climate change seems," 2004). Canada geese are involved in only 5% of the reported bird strikes, but account for 20% of the bird strikes resulting in damaged aircraft ("Bird strikes: A widespread," 2004). From 1968 to 1998, another large bird, the red tailed hawk, doubled its population in the US from (Cooper et al., 2000).

Starlings also comprise a large portion of the bird strike hazard. There are two species of starlings living in the U.S., neither one native to the continent. In 1890, 100 European starlings were released in Central Park, New York City. Since then the species has spread to cover the entire lower 48 states and the southern half of Canada year round. The birds only grow to about 8 inches in length, but they tend to form huge flocks in open fields outside of the breeding season. It is these large flocks that pose a major risk to aircraft (Bull & Farrand, 1995).

*Mammals***.** Mammal strikes are not nearly as common as strikes involving birds. Nevertheless, they pose a danger to aircraft on the ground and in the air. At 2.4% of the total strikes between 1990 and 2004 (Cleary & Dolbeer, 2005), the number of reported mammal strikes is far lower than that of birds but the potential for costly damage is just as great. In reported strikes, mammals most often caused damage to aircraft landing gear, engines, propellers, and wing/rotors. Anyone who has witnessed or experienced an automobile accident involving a white-tailed deer or mule deer can easily imagine the results of an aircraft striking a deer on a runway.

The greatest threat among the mammals is the ungulates, or hoofed mammals including deer. Along with deer, this group includes elk, moose, pronghorn sheep, caribou, horse, and cattle. Obviously, the threat associated with striking these animals is due to their large size. Moose can grow to over six feet tall at the shoulders and an adult can average 1,000 pounds. All of the aforementioned species of mammals have been reported as striking and damaging aircraft in the U.S. since 1990 (Cleary et al., 2002).

These animals have also learned to adapt to man encroaching on their natural habitat. For a displaced deer, the vast expanses of greenery and the oft found pools of standing water at an airport are very appealing. *Environmental Concerns* states that "…the deer has exhibited the ability to adapt to any obstacle which man has thrust into its normal habitat" (American Association of Airport Executives, 1984, p. 1). Furthermore, the number of white-tailed deer in the U.S. has increased since 1900 from a population of 100,000 to at least 26 million in 2000 ("Airport Wildlife Mitigation," n.d.).

Although large mammals can cause significant aircraft damage, we should not overlook the danger posed by smaller mammals. There have been several reported instances of strike damage involving carnivores including coyotes, foxes, skunks, and raccoons. Strikes resulting in little or no damage have also been reported involving woodchucks, rabbits, opossums, and armadillos (Cleary et al., 2002).

Bats also pose some risk to aircraft. They can cause the same damage to an aircraft as a bird strike, damaging the nose or the cockpit windscreen of the aircraft or being ingested by the engines. The risk is not so great in the U.S., as the native species of bats tend to remain small, but is prevalent with American carriers operating in foreign countries. In Asia there are some types of fruit bats that can grow to a wingspan of six feet and weigh over two pounds (Peurach, 2004). From 1990 to 2004, 124 bat strikes were reported to the FAA, and two strikes resulted in aircraft damage (Cleary & Dolbeer, 2005).

***Reptiles*.** The smallest threat comes from reptiles. From 1990 to 2004, twelve strikes were reported with alligators but only one aircraft was reported as damaged. Strikes that did not result in damage but did have a negative effect on the flight were also reported involving several species of turtles and six strikes with green iguanas (Cleary & Dolbeer, 2005).

Habitats

Airports usually offer the three things any type of wildlife seeks for survival: food, water, and cover. Many airports have expansive grass habitats or wooded habitats on the premises that attract a variety of wildlife. These may be naturally occurring or man-made landscaping, but understanding these attractants is the first step in reducing the hazard of wildlife strikes (Rossier, 2001).

Most airports provide an abundance of food for wildlife. Grass, seeds, and berries draw in geese, deer, and other smaller ground dwelling mammals and birds. As airport grounds are usually free of much human interference, these smaller animals will draw in carnivores such as raptors, foxes, and coyotes. Airports may also draw in scavenging wildlife because of an inadequate garbage disposal process. Such a situation would draw in crows and gulls in large flocks (Goodin, 1994).

Lakes and retaining ponds provide a source of water for wildlife, drawing in gulls, waterfowl, and shorebirds. These pools can also serve as a source of food, providing aquatic plants, frogs, and small fish. Bodies of freshwater are especially appealing to wildlife in a coastal environment (Goodin, 1994).

Finally, wildlife requires some form of cover for protection. This can be provided at an airport by areas of tall unkempt grass, landscaped bushes, or shrubbery, as well as wooded areas on or adjacent to the airport grounds. Airport buildings and aircraft kept outdoors are sometimes used as shelter by certain species of birds as well (Goodin, 1994).

Methods of Control

There are several methods being used to control wildlife at airports and to lower the probability of a wildlife strike. These methods include data collection, habitat modification, frightening, the use of repellents and finally, wildlife removal by trapping or by lethal means. Not all of these methods are completely effective and work best in combinations.

In habitat modification, those elements that drew wildlife to the airport are altered to make the grounds less desirable or uninhabitable. Fescue grass can be planted along runways and serves several purposes. First, the grass has a natural fungus which tends to cause illness when eaten. It also has a tendency to drive off deer and geese, and it inhibits the reproduction of rodents, driving off raptors and carnivores. It is no more expensive than other types of grasses and is becoming popular ("Airports look to techniques," 2004). Surfaces where birds tend to perch can be altered with sticky gels, nets, or protruding spikes to eliminate some of the safe havens found at airports (Avery & Genchi, 2004).

Frightening is the easiest method of wildlife control; it is very common, although not very effective in the long term. One method of frightening is to use audible means. Many species of birds use different calls for different situations. A recording of a distress call or alarm can be effective in clearing birds of different species from an area temporarily. Pyrotechnics can be used in conjunction with calls to some effect but must be used carefully and can be complex (Booth, 1994). Visual methods can also be used, incorporating flashing lights, lasers, and decoys (Blackwell & Bernhardt, 2004; "Lasers being deployed," 2004). Combinations of audible and visual methods can be used along with airport personnel or dogs trained to frighten wildlife away from the airport (Schwartz, 2000).

The last measure in wildlife control is the removal of the wildlife. Relocation can be effective on some mammal species that keep to a limited range but is not effective with most birds, especially migratory birds and raptors. Cooper et al. (2000) says, "It may be better to deliberately kill a few birds than to have one or more birds accidentally kill an airplane" (p. 1). This method is more difficult than one might expect with a maze of legal standings for certain animals. Of course all endangered and threatened species are covered by the Endangered Species Act of 1973, making it unlawful for anyone to capture, pursue, kill, or otherwise harass these species. Migratory birds fall under the protection of the Migratory Bird Treaty Act of 1918. Furthermore, certain species of wildlife may fall under state laws, which vary from state to state. These regulations may be overridden on a case-by-case basis by the appropriate governing body, including the Department of the Interior or applicable state agency, if the animals are causing or have the potential to cause harm once non-lethal actions have proven ineffective. Lethal methods may work with smaller populations but do not work effectively with large groups of problem species (Goodin, 1994).

Research Questions

A review of the relative literature has served as an overview of the current wildlife strike situation and has shown the rationale behind further research. This leads to the following research questions:

1. Why are only 20% of wildlife strikes reported to the NWSD?
2. What are the specific barriers that are preventing individuals from reporting to the NWSD?
3. What is the popular understanding of the NWSD?
4. How can the reporting process be improved?

Research Methodology

The research began with an in-depth review of the history of aviation wildlife strikes. A review was conducted to find out what draws wildlife to airports, causing strikes; what can be done to prevent or mitigate strikes; and what effects these strikes can have, physically and economically. An investigation into the relevant aviation trends and biological trends was performed. A cursory review of the legislation regarding aviation and wildlife was also completed.

A survey was designed to collect information regarding past submissions to the NWSD and general knowledge of the NWSD. Most importantly, the instrument was used to find any barriers in the reporting process for the NWSD.

Participants

The problem of aviation wildlife strikes affects people at all points in the aviation community. Accordingly, the participants in the study cover two large parts of this population. Pilots, with a wide range of experience, made up the bulk of the participants. The survey was also distributed to many aircraft maintenance personnel, as they will often see the strike damage that a pilot might not.

All participants came from the community in Daytona Beach, FL. The population included university students and employees with long histories in aviation.

Survey Instrument

The instrument was constructed as a survey to gather demographic data, data regarding previous actions when dealing with wildlife strike reporting, and data indicating basic knowledge of the wildlife strike database. The instrument was also put together such that, with a brief explanation, it would not take a participant more than five minutes to complete. The survey consisted of 14 questions in the form of multiple choice, Likert scale questions, and open ended response questions. Questions 1 to 5 were demographic questions included to determine the respondent's level of experience. Questions 6 to 11 were designed for respondents who had dealt with a wildlife strike in the past. Questions 12 to 14 were designed for respondents who had not dealt with a wildlife strike. A copy of the complete instrument, with introductory letter, can be seen in the Appendix.

The instrument was distributed among the flight and maintenance personnel. This allowed for a sample of students and faculty members with varying levels of experience, knowledge, and skill.

The returned surveys were numbered and the quantitative data entered into a spreadsheet using Microsoft Excel. The data was checked repeatedly to eliminate any incorrect data entries. From there, the data was transferred into SPSS to develop the appropriate graphs.

Results

One hundred and ninety-seven surveys were distributed in two different populations, pilots and mechanics. A total of 172 surveys were distributed to the pilot population. One hundred and twenty-five of those surveys were completed and returned to the researcher. This resulted in a participation rate of 73%. Twenty-five surveys were distributed to the maintenance personnel population. Three of those surveys were returned to the researcher and in a usable state. This is a participation rate of 12%. Combining the two populations, 128 surveys of 197 were returned (65%).

Demographic Results

There were 119 male and 9 female participants. Most participants were in the lowest age range, with 108 (84.4%) in the 17-22 range. There were 14 responses (10.9%) in the 23-29 range. Only two participants (1.6%) were in the 30-39 age range. There were three responses (2.3%) in the over 50 range. One participant did not respond to the question about age.

Because the survey was distributed to two populations, pilots and mechanics, the third question was used to differentiate between the two. The overwhelming majority of respondents stated that they were pilots (97.7%). There were 125 pilot responses and three mechanic responses. Two of the maintenance personnel stated they were pilots as well, but the wildlife strikes they had witnessed were while working in a maintenance capacity.

The three maintenance personnel participants also listed their pilot ratings. Of the 128 respondents, 74 (57.8%) were private pilots, 31 (24.3%) were commercial pilots, 10 (7.8) were student pilots and three (2.3%) were Certified Flight Instructor (CFI). There were 10 missing responses.

The pilots were ranked by their hours of flight time. Of the 125 pilot respondents, the largest portion (49.2%) had between 100 and 199 hours of flight time. There were 29 responses for those with less than 99 hours of flight time. There were 63 responses for those between 100 and 199 hours of flight time. There were 24 with between 200 and 299 hours, seven with between 300 and 399 hours, and five with more than 400 hours of flight time. Maintenance personnel were ranked by years of work experience. One responded with less than nine years of maintenance experience, while another responded with more than 30 years. The third did not list the length of maintenance experience.

Results of Wildlife Strike Experiences

Of the 128 participants, most had not been involved in wildlife strikes (86.7%). There were 111 respondents who had not been involved in a wildlife strike and 17 who had been involved in at least one wildlife strike. Of the 17 who had experienced strikes, two reported more than five incidents, three reported two incidents, and the remaining 12 reported one strike each. Three of the participants indicated they had mammal strikes and the rest responded with bird strikes. No reptile or amphibian strikes were reported.

Seven of the participants (41%) said they were able to identify the wildlife remains. The remaining 10 participants were not able to identify the species. One question asked if those involved in bird strikes used the Smithsonian Bird ID program for identifying the remains of birds from wildlife strikes. None of the participants reported using this program.

Questions concerning the results of what aircraft components were struck in the incidents showed that three of the participants reported strikes on the aircraft windscreen, two reported prop strikes, and three more reported engine or engine cowling strikes. The remaining strikes were reported as wing strikes.

Wildlife Strikes Reported to the NWSD

Less than 6% of the participants reported a strike to the NWSD even though they were involved in a wildlife strike. Of the 17 participants who reported being involved in a wildlife strike, only one responded as having reported the strike incident to the NWSD. The one participant who responded as having reported a strike used the mail-in version of FAA Form 5200-7. None of the participants reported using the electronic submission method or any other method to report to the NWSD. The only one respondent who reported using the NWSD responded to the level of difficulty in accessing the database. On a scale of 1 to 5, with 5 being the easiest and 1 being most difficult, the participant rated the reporting process as a 4 in difficulty.

The respondents who were involved in a wildlife strike but had not reported to the NWSD were asked to outline their barriers to reporting to the database. The responses came in a few similar forms. The most common response was "Did not know about the database" or a similar variation. This came from eight of the participants. Also, quite common were the responses, "Did not think to report it" or "Did not think it was a big deal." Three of the participants noted not reporting the strikes because the strikes did not cause damage to the aircraft. Finally, one of the participants simply wrote “Too lazy.”

The respondents were also asked to note any ways that could make the reporting process easier. Nine of the 17 participants who had been involved in a wildlife strike left this question unanswered. The remaining eight participants offered a few possibilities. Five of the participants suggested better education regarding the reporting process. One suggested a form of advertisement within the industry. Four participants stated that no improvements could be made.

Results of Respondents without Wildlife Strike History

The respondents were asked whether they were aware of the NWSD. This question was meant solely for those participants who had not been involved in a wildlife strike, but was answered by nearly all of the participants. Of the 128 participants, there were 24 who were aware of the database. This represents 20.3% of the participants who responded to the question. There were 94 participants who were not aware of the database and 10 missing responses.

The respondents were also asked whether or not they had ever received instruction on how to make a report to the NWSD. It was also meant solely for those participants who had not been involved in a wildlife strike, but was answered by nearly all of the participants. Seven of the 128 participants (5.9%) stated that they had received instruction on how to report to the NWSD. One hundred and eleven of the participants stated that they had not received any instruction. Again, there were 10 missing responses.

The final question asked if the participants knew what information would be needed to properly complete a strike report. This was also meant solely for those participants who had not been involved in a wildlife strike, but was answered by nearly all of the participants. Seven of the 128 participants (5.9%) stated that they were aware of what information was needed for a strike report. Furthermore, 111 of the participants stated that they had not received any instruction. Again, there were 10 missing responses.

Discussion

The most notable result came from Question 12 in the survey. The participants were asked if they were aware of the NWSD. Of the 118 participants who responded to that question, 94 said “no”. That is an astounding 80% of the participants. Just from this question, it is clear that the biggest barrier to responding to the NWSD is a lack of knowledge of its very existence. The results from Question 13 were also a concern, as 94% of the participants stated that they had not received instruction on how to report to the NWSD.

The strike reporting rate observed in this project was lower than the national average. According to the FAA Wildlife Strike Database report, less than 20% of strikes are reported to the NWSD (Cleary & Dolbeer, 2005). In this project there were at least 28 strikes involving 17 participants, with only one strike being reported to the NWSD. That equates to a report rate of 3.6%. In actuality, this figure is lower because two of the participants experienced "five or more" wildlife strikes.

The observed low reporting rate could possibly be explained by two things. The majority of the survey data came from university students. This would indicate an age level lower than the average in aviation. In this study, the majority of participants were in the 17 to 22 year old age range. It would also indicate a lower than average level of flight experience. In this study, half of the participants had between 100 and 200 hours of flight experience. A greater number of participants had more than 200 hours experience than those that had less than 100 hours. Unfortunately, with such a low strike report rate, it is impossible to draw any significant correlations between the age and strike report rate or experience and the strike report rate of the participants.

The feedback received and level of participation in the survey was very positive. The survey was distributed to 172 pilots and was returned by 125. This is a participation rate of 73% and was far better than expected. The response of the maintenance personnel was lower than desired. Twenty-five surveys were distributed but only three were returned, representing a 12% rate of participation. This may indicate a difference in the levels of interest regarding this topic in the two groups. This project could have been improved with the inclusion of airport operations personnel and by sampling wider group in the pilot population.

Conclusion

Wildlife strikes are a threat to aviation safety and should be of concern to researchers. As stated by Cooper, et al. (2000, p. 3), "More people have died in airplane collisions with wildlife than have been killed by icing or encounters with volcanic ash. Other than CFIT (Controlled Flight into Terrain), wildlife is [the] number one" cause of collisions. Now is the time for more research, as many factors, technological, cultural, and biological, point towards increasing wildlife strikes in probability and severity in the future.

Previous research has shown, and this project has reinforced the idea, that there are three ways to reduce the effects of wildlife strikes: (1) More effective wildlife control methods, (2) changing aircraft design standards to match the changes in aviation trends and wildlife population trends, and (3) more wildlife strike research. One of the greatest tools for improvement in all three areas is the FAA National Wildlife Strike Database for Civilian Aviation. This is the best source of knowledge for aviation researchers in this field. Of course, the information that can be drawn from the database is dependant on both the quality and the quantity of the information that is submitted.

This study has identified the biggest obstacle for aviation personnel in submitting the needed information to the NWSD: a lack of knowledge of the database. This must be remedied. Once the database is more widely known, this issue of data quantity will be addressed.

The second largest obstacle deals with the data quality. This study found that few of the participants had been instructed on how to make a report to the NWSD and what information should be included in that report. Those submitting information to the NWSD must be able to supply as much information as possible about the strikes to ensure the quality of the data.

With better data in the NWSD, more accurate research can be performed. This can help lead us to a safer operation of aircraft in a world of wildlife in the United States.

Recommendations

This research project identified many obstacles involved in the reporting of wildlife strikes. Three things are recommended which will result in improving the NWSD system.

First, to resolve the issue regarding the lack of knowledge of the NWSD, some form of advertisement and/or education is necessary. This could be in print through the publication of an article in any aviation trade journal or periodical. It could even be in an Advisory Circular like that of AC 150/5200-32A which, in 2004, stressed the importance of reporting wildlife aircraft strikes.

Second, once the NWSD is more widely known by the aviation community, the issue of education can be addressed. As this study was performed at a University specializing in aviation, it should be suggested that the use of the database be inserted into the curriculum at an early stage. Wildlife strikes can occur to any aviator, regardless of age or experience, so being prepared to properly report this information early in your aviation career is an excellent idea.

Finally, more research on this topic should be done. There are several ways where this study could have been more comprehensive. The population of pilots surveyed was at the lower end of the age and experience spectrum. A better sampling could be done involving more pilots, with more diverse backgrounds and levels of expertise. Maintenance personnel are important in the wildlife strike situation. The response of the maintenance population in this study was disappointing and could be improved in a future research project. The inclusion of airport operations personnel would be a large improvement in this study also. This group might be more aware of the evidence of wildlife strikes than the members of the other populations. Obtaining a better sample of these three populations could improve the importance of the outcomes of future wildlife strike research projects.

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Appendix

Data Collection Instrument

1. Gender:
   - ☐ Male
   - ☐ Female

2. Age: ☐ 17-22 ☐ 23-29 ☐ 30-39 ☐ 40-49 ☐ 50+

3. Role: ☐ Pilot ☐ Maintenance ☐ Operations

4. Pilot Certificate(s): (Check all that apply)
   - ☐ Student
   - ☐ Private
   - ☐ Commercial
   - ☐ ATP
   - ☐ CFI

5. Experience:
   Pilots – Current Flight Hours: ☐ 0-99 ☐ 100-199 ☐ 200-299 ☐ 300-399 ☐ 400+
   Maintenance/Operations – Years of experience: ☐ 0-9 ☐ 10-19 ☐ 20-29 ☐ 30+

6. Have you ever been involved in a wildlife strike or been witness to the damage of such an incident? ☐ Yes ☐ No

   a. How many incidents? ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5+

   b. Type(s) of animal (If more than one strike, please indicate the number of each type): ☐ Bird ☐ Mammal ☐ Reptile/Amphibian

   c. Were you able to identify the species? ☐ Yes ☐ No

   d. Did you need to use the Smithsonian Bird ID program? ☐ Yes ☐ No

   e. What part of the aircraft was struck? ______________________

If you answered <u>yes</u> to Question 6, please answer Questions 7 – 11, if no, please answer Questions 12 – 14.

<u>YES</u>

7. Have you ever made a report to the FAA Wildlife Strike Database?
☐ Yes ☐ No

8. If so, what method did you use to report to the database?
   - ☐ Electronic submission (http://wildlife-mitigation.tc.faa.gov)
   - ☐ Mail submission (FAA Form 5200-7)
   - ☐ Other

9. How difficult was the reporting process (Please circle one)?

   Easiest → 5 4 3 2 1 ← Most Difficult

10. If you did not report the strike, what were your barriers to doing so?

____

11. Are there any ways to make the reporting process easier?

____

<u>NO</u>

12. Are you aware of the FAA Wildlife Strike Database?
☐ Yes ☐ No

13. Have you been instructed how to make a report to the database?
☐ Yes ☐ No

14. Do you know what information is needed in a strike report?
☐ Yes ☐ No

List of Acronyms

AC:	Advisory Circular
BASH:	Bird Aircraft Strike Hazard
CFI:	Certified Flight Instructor
CFIT:	Controlled Flight into Terrain
ERAU:	Embry-Riddle Aeronautical University
NTSB:	National Transportation Safety Board
NWSD:	National Wildlife Strike Database (for Civilian Aviation)
USAF:	United States Air Force
USDA:	United States Department of Agriculture
USDA/WS:	United States Department of Agriculture/Wildlife Services

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