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Wildlife Hazard Management at Airports: Fifteen Years of Growth and Progress for Wildlife Services

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ABSTRACT: In the 1990s, major concurrent expansions occurred with commercial aviation and populations of bird and other wildlife species considered hazardous to aviation. These parallel trends resulted in increased numbers of wildlife collisions with aircraft (wildlife strikes) that now cost USA civil and military aviation more than $500 million annually and pose a threat to flight crews and passengers. The USDA Wildlife Services (WS) program responded to these increased conflicts by developing an integrated, science-based program of technical and operational assistance for the aviation industry to reduce wildlife hazards at civil and military airports. This WS Airports Program was based on a foundation of 3 initiatives. The first was Memoranda of Understanding developed in 1989-1990 between WS, the Federal Aviation Administration (FAA), and the Department of Defense (DoD) which state that the FAA, certificated airports, or DoD facilities may request assistance from WS to reduce wildlife hazards to aviation. A second initiative was an interagency agreement between FAA and WS in place since 1991 that charged WS to research new methods to reduce strikes and to develop a National Wildlife Strike Database. A third initiative was an Airports Training Course developed by WS that has certified 247 WS biologists and technicians to work on airports, 1996-2003. As a result of these initiatives, WS provided assistance in assessing hazards and reducing risks posed by wildlife at 565 airports in 2003 compared to only 42 in 1990. Accomplishments of the WS Airports Program since 1990 are discussed through case studies. These studies include: 1) the development of the 57,000-record National Wildlife Strike Database, which provides a scientific foundation for WS work at airports; 2) applied research projects resulting in new information and techniques for reducing strikes; and 3) integrated wildlife damage management programs at airports that have resulted in significant reductions in wildlife strikes.

KEY WORDS: airports, aviation safety, bird strike, deer, USDA, wildlife management, Wildlife Services

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INTRODUCTION

The concurrent expansion of the commercial aviation industry and population growth of many hazardous birds has resulted in increased numbers of aircraft collisions with wildlife (wildlife strikes) that now cost USA civil and military aviation more than $500 million annually and pose a threat to flight crews and passengers (Dolbeer 2000, MacKinnon et al. 2001, Cleary et al. 2003). Since 1990, wildlife strikes have killed at least 156 people and destroyed more than 120 aircraft (Richardson and West 2000; Thorpe 2003; R. A. Dolbeer, USDA WS, unpubl. data).

The expansion in commercial aviation included both an increased number of two-engine aircraft in the passenger fleet and an increase in passenger enplanements. In 1969, 75% of the 2,100 passenger aircraft had 3 or 4 engines. In 1998, the USA passenger fleet had grown to about 5,400 aircraft and only 30% had 3 or 4 engines. It is estimated that by 2008, the fleet will contain 7,000 aircraft and only 10% will have 3 or 4 engines (Cleary and Dolbeer 1999). This reduction in engine redundancy leads to an increased probability of life-threatening situations resulting from wildlife strikes, especially those involving flocks of birds.

As engine redundancy was decreasing, passenger traffic in the USA was substantially increasing. Passenger enplanements increased at a rate of 2.1% per year from about 310 million in 1980 to 627 million in 2002 (Federal Aviation Administration 2003). To accommodate the increase in passenger traffic, commercial aircraft movements also increased at a rate of 2.1% per year during the same time period. USA passenger enplanements and commercial aircraft movements are predicted to continue growing at a rate of about 2% per year.

Many populations of wildlife species considered hazardous to aviation have increased markedly in the last few decades. For example, the North American non-migrating Canada goose (*Branta canadensis*) population increased at an annual rate of 9% from 1970-2002 to over 3.5 million birds (Seubert 2002, Sauer et al. 2003). Dolbeer and Eschenfelder (2002) found that 77% of the 36 bird species in North America with body masses >1.8 kg (4 lbs) had increasing populations. Additionally, 92% of these large birds exhibit some flocking behavior thereby increasing the probability of a strike with multiple birds.

Birds are not the only wildlife hazard for aircraft. Deer (*Odocoileus* spp.), coyotes (*Canis latrans*), and other mammals can wander onto runways and create serious problems for departing and landing aircraft. Additionally, white-tailed deer (*O. virginianus*) popula-

tions across the USA have increased from a low of about 350,000 in 1900 to about 24 million in 1994 (Jacobson and Kroll 1994). This increase is a direct result of recovery efforts by various wildlife agencies and development of habitat attractive to deer in urban areas. Airports often provide attractive habitat that can support deer populations, thereby placing these mammals in close proximity to aircraft movement areas. There have been over 600 civil aircraft collisions with deer in the USA from 1990-2003 (Cleary et al. 2003; S. E. Wright, USDA WS, unpublished data).

BACKGROUND TO WILDLIFE SERVICES AIRPORTS PROGRAMS

The Federal Aviation Administration (FAA) and Department of Defense (DoD) have legal responsibility for enforcement of safety programs at airports and airbases, including programs to manage wildlife hazards. These agencies have limited expertise in dealing with wildlife hazard management. Upon request, however, the U.S. Department of Agriculture's Wildlife Services (WS) program in the Animal and Plant Health Inspection Service (APHIS) is able to provide technical and operational assistance. These requests are formally facilitated through two Memoranda of Understanding (MOUs) developed between the WS and the FAA (in 1989) and the DoD (in 1990). These agreements specifically state that the FAA, certificated airports or DoD facilities may request assistance from WS to reduce wildlife hazards to aviation as required under 14 Code of Federal Regulations Part 139.337 (14 CFR Part 139.337) or DoD regulations.

To meet these requests for assistance, WS developed an integrated, science-based program of technical and operational assistance to reduce wildlife hazards at civil and military airports. As a follow-up to the 2 operational MOUs enacted in 1989 and 1990, an interagency agreement between FAA and WS was developed in 1991 that charged WS's National Wildlife Research Center (NWRC) with two research objectives: 1) to evaluate and develop new methods to reduce wildlife strikes and 2) to develop a National Wildlife Strike Database to obtain more objective estimates of the magnitude and nature of the wildlife strike hazards for aviation.

Wildlife Services also developed an internal 3-day training course to ensure that those WS personnel working at airports provide a standardized level of professional service in assisting the FAA, DoD, and airport operators nationwide with assistance related to wildlife hazard management. From 1996 to 2003, WS certified 247 WS biologists and technicians to work on airports.

EXAMPLES OF WILDLIFE SERVICES PROGRAMS TO ASSIST AIRPORTS AND THE AVIATION INDUSTRY

Development of the National Wildlife Strike Database

The FAA began collecting bird strike data in 1965; however, the data were never entered into a database or submitted to analysis until 1995. In 1995, through the FAA-WS interagency agreement, WS initiated a project to obtain more objective estimates of the magnitude and nature of the national wildlife strike problem for civil aviation by developing a National Wildlife Strike Database. This project involved having a database manager 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 into the 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. The database includes strikes reported by pilots, airline personnel, Air Traffic Control towers, airport operations personnel, and carcasses found within 200 ft of a runway centerline (unless another reason for the animal's death is identified).

As of 23 February 2004, there were over 57,000 strike records in the National Wildlife Strike Database from 1 January 1990 to 30 September 2003. Nearly 7,000 of those records are strikes occurring with military aircraft using joint military/civilian airports. Strikes have been reported from over 1,350 airports including 1,200 in the USA and over 150 foreign airports where USA-based aircraft were involved.

Reports that analyze and summarize the strike data have been published annually since 1995 in a cooperative effort between WS and FAA. The most recent report covered the 13-year period, 1990-2002 (Cleary et al. 2003). Annual analysis of the data is critical to determine 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). These reports have been widely used by the aviation industry and WS to provide a scientific foundation for corrective actions to reduce wildlife hazards to aviation.

On-Line Access to National Wildlife Strike Database

In July 2002, the National Wildlife Strike Database became available on-line as a searchable database maintained by Embry-Riddle Aeronautical University (ERAU) through a grant from the FAA. The website, accessed at http://wildlife-mitigation.tc.faa.gov, provides several options for retrieving strike data. The public access area requires no password and allows the user to obtain strike summaries by wildlife species and state by year. The summaries provide strike data for a species of interest in a particular state with the total reported strikes for that species across the USA. The general public, however, cannot access information from a particular airport, airline, or aircraft type.

There are additional access areas for authorized personnel of various aviation industry agencies and organizations, (FAA, airport operators, airline operators, WS, engine manufacturers, and airframe manufacturers). These personnel must obtain a password from FAA for access to the database. The data are restricted depending on the agency or organization. For instance, WS

personnel must provide a state and associated password that restricts database searches to all airports within that state. The data are further truncated to protect names of airlines, engine manufacturers, and personnel submitting the report. Similarly, airline personnel are able to view only the reports associated with aircraft within their fleet. Only FAA-authorized personnel have full access to the entire on-line database.

The online database processed its 6,000th query on 4 February 2004, 19 months after becoming operational. On average, 15 queries are made through the database each business day.

Research on Methods to Reduce Wildlife Strikes

The 1991 FAA-WS interagency agreement charged WS with the task to research new methods to reduce wildlife strikes at airports. Since that time, WS has become recognized internationally for research in developing ecologically based solutions to conflicts between wildlife and aviation. Wildlife Services personnel have produced 143 publications in peer-reviewed science journals and conference proceedings related to managing wildlife hazards at airports since 1990 (Dolbeer 2003). This extensive research provides the scientific background necessary to support the operational and technical assistance programs conducted by WS personnel at airports throughout the USA. Additionally, WS research findings are used by airport managers to objectively justify and defend wildlife hazard management programs on airports. Selected research studies summarized in Table 1 illustrate the breadth of topics researched by WS personnel to enhance the safety and effectiveness of wildlife hazard management programs at airports.

Technical and Operational Assistance at Airports to Reduce Wildlife Hazards

Managing wildlife hazards at airports is a complex, public-sensitive, endeavor involving many species of wildlife governed by various federal and state regulations. The complexity and sensitivity involved in managing wildlife hazards at airports necessitates that wildlife biologists trained in integrated wildlife damage management techniques are employed to assess hazards and to assist in the development, implementation, and evaluation of wildlife hazard management plans. WS certified airport wildlife biologists are trained with the background, technical information, operational procedures, and guidelines necessary to conduct assessments of wildlife hazards at airports and to develop and implement effective plans for managing those hazards. If implemented effectively, professionally developed, site-specific management plans minimize the likelihood of catastrophic or major-damage wildlife strikes on an airport. An effective plan can also provide crucial support during litigation in the aftermath of any significant strike event that might occur.

In 1990, 42 airports received assistance from WS with wildlife hazard issues. That number increased to 396 airports in 2001. In 2003, WS personnel provided 114 staff years of service at 565 airports (412 civil, 94 joint civil/military, and 59 military) in 49 states, Guam and 3 foreign countries for technical and operational assistance (Dolbeer 2004). Of the 650 airports certificated for passenger traffic by the FAA under 14 CFR Part 139, 327 (50%) received technical or operational assistance from WS personnel in 2003.

Although WS is available to assist the aviation industry in reducing wildlife hazards through the MOUs with FAA and DoD, WS receives no appropriated federal funding to undertake this work. The U.S. Congress has authorized WS to enter into cooperative service agreements with airport authorities and other entities to provide technical and operational services on a cost-reimbursable basis. For example, WS received $7.35 million from 277 of the 565 airports and airbases requesting technical and operational assistance to reduce wildlife hazards in 2003 (Dolbeer 2004). However, WS biologists estimated that at least $6.2 million in additional funding was needed to address significant hazard issues at 275 of these airports where assistance was requested but funding was not available or inadequate. This total funding shortfall of $6.2 million did not include funding to address hazardous wildlife issues at the approximately 325 "Part 139"-certificated airports and numerous non-certificated airports that did not request assistance in 2003. Many of these airports have significant wildlife issues, but assistance was not requested because of lack of funds to address the hazards.

Technical Assistance

WS personnel provided technical consultations with airport authorities regarding wildlife issues at 527 airports nationwide in 2003. Over 1,400 airport personnel at 151 airports received training in wildlife identification and control methods from WS in 2003. In 2003, 141 airports also received assistance with detailed Ecological Studies (required by 14 CFR Part 139.337 if certain hazardous conditions exist at the airport-see below) and 85 airports received assistance with the development of Wildlife Hazard Management Plans (WHMP, required by 14 CFR Part 139.337 if warranted by the Ecological Study).

14 CFR Part 139.337 requires an Ecological Study be completed if an air carrier or aircraft experiences 1) a multiple bird strike or engine ingestion, 2) a damaging collision with wildlife other than birds, or 3) wildlife of a size or in numbers capable of causing an event described above is observed to have access to any airport flight pattern or movement area. Wildlife Services has developed a structured, year-long ecological survey called a Wildlife Hazard Assessment (WHA) to meet this FAA requirement. The WHA is a comprehensive survey of wildlife populations and associated habitats and wildlife attractants found on airport property, within 10,000 ft of all aircraft movement areas at the airport and in the 5-mile approach/departure corridors of the active runways. The methods employed represent a broad combination of qualitative and quantitative techniques commonly used by natural resource professionals in the fields of wildlife biology and wildlife damage management. Through careful examination and analysis of data gathered during the surveys, the WHA identifies the species composition

Table 1. Examples of research publications by U.S. Department of Agriculture, Wildlife Services related to managing wildlife hazards at airports, 1993 - 2004.[a]

Author(s)	Subject	Results
Dolbeer et al. (1993)	Shooting gulls reduces strikes with aircraft at New York airport.	Removal of gulls by shooting reduced gull strikes by 70% in 1991 and 89% in 1992 relative to the previous 3 years. The authors recommend that the gull nesting colony be relocated as a long-term solution.
Seamans et al. (1995)	Determination of body density for 12 bird species.	Among the 11 wild bird species tested, common grackles and starlings were the densest. Ring-billed and herring gulls were the least dense. A 4.8:1 ratio (length to diameter ratio of artificial birds) would most accurately represent the dimensions of birds that strike aircraft. This ratio should be used rather than the 2:1 ratio currently used by engineers using artificial birds in aircraft-strike tests.
Belant et al. (1995)	Methyl anthanilate (MA) repels gulls and mallards from water.	Much lower levels of MA were needed to repel birds from water than from food. Water may be a more effective medium for delivering MA to the trigeminal, olfactory and taste nerve receptors. MA formulations could be effective in reducing bird use of water sources at airports.
Belant et al. (1996)	Propane cannons as deer repellent	Deer habituated within a few days to propane cannons that fired systematically. Habituation was postponed for 6 weeks when cannons were activated by deer presence.
Gabrey (1997)	Bird/ rodent abundance at 4 types of waste-management facilities	Demonstrated that composting facilities and construction-and-demolition landfills did not attract birds numbers above background level and would not increase bird hazards near airports
Ickes et al. (1998)	Disturbance techniques to control gull nesting.	Nest disturbance did not cause abandonment, but did reduce total number of nests present per year. Egg removal resulted in inexpensive, long-term reduction of roof-nesting colonies.
Belant et al. (1998)	Cattle guards reduce white-tailed deer crossings through fence openings.	Deer crossing through openings decreased by 95% after the opening was fitted with a simulated cattle guard. Deer often approached the guards and some tried to leap across them, but few were able to actually cross the guard after installation. The authors conclude that guards should be a viable technique to exclude deer from gates at fenced airports.
Blackwell et al. (1999)	Enhancement of Flight Control to repel Canada geese from grass	There was an 88% reduction in foraging by Canada geese in plots treated with Flight Control and growth regulator. The reduction in goose foraging showed no signs of abating after 22 days.
Dolbeer et al. (2000)	Ranking the hazard level of wildlife species to aviation.	Correlated strike data with body mass to determine the hazard level of wildlife species. Deer and vultures are the two most hazard animals while sparrows and swallows were the least hazardous. The hazard level ranking provides airport operators and biologists a guide to prioritize management actions to reduce strike hazards.
Barras et al. (2000)	Bird and mammal use of mowed and unmowed vegetation at JFK airport, New York.	Regularly-mowed vegetation (15-25 cm in height) did not attract more wildlife or present a higher strike risk than unmowed vegetation (20-70 cm in height). Authors recommend that the airport maintain airside vegetation at 15-25 cm in height which conforms to the European and North American standards for bird management at airports.
Blackwell et al. (2002)	Lasers as nonlethal avian repellents.	Effectiveness of lasers appears to be species specific. Starlings and cowbirds were not affected by a long-wavelength laser. Doves avoided the laser initially, but quickly habituated. Canada geese and mallards showed marked avoidance of the laser. More research is needed to determine the effectiveness of varying wavelengths and powers of the lasers.
Dolbeer & Eschenfelder (2002)	Population increases of large birds.	Populations of most of the 36 bird species in North America >4 lbs in weight are increasing. Current large-bird standards for engines do not consider birds >4lbs and require only that damage from birds ≤4 lbs be contained and that engine can be shut down safely. Airworthiness standards should be revised to address large, flocking birds. Proposals to allow high-speed operations below 10,000 ft. Above Ground Level should be re-evaluated in light of strikes by these large birds. There should be zero tolerance for large birds at airports.
Cleary et al. (2003)	Wildlife strike database	Publication summarizes 46,000 bird and other wildlife strikes to civil aircraft in USA, 1990-2002, providing detailed information on the nature and magnitude of the wildlife strike problem. Wildlife strikes cost USA civil aviation an estimated $489 million/year.
Blackwell &. Bernhardt (2004)	Pulsating landing lights may reduce strikes	Experiments with cowbird flocks in cages indicated pulsating landing lights on aircraft may enhance avoidance behavior and reduce strikes. More research is planned.
Seamans (2004)	Vulture dispersal using effigies	Experiments demonstrated that effigies of dead turkey vultures hung in roosting and perching sites were highly successful in dispersing birds from the sites.

[a] Biologists from USDA Wildlife Services published 143 studies related to managing wildlife at airports, 1990-2003 (Dolbeer 2003).

Table 2. Examples of operational and technical assistance by biologists from U.S. Department of Agriculture, Wildlife Services that have resulted in a reduction in wildlife hazards to aviation at civil and military airports in the USA, 1991 - 2004.[a]

State	Airport	Years	Hazardous situation	Solution	Outcome
AZ	Phoenix Sky Harbor IA	2000 – 2004	Proposed wetland restoration project	Comprehensive TA related to proposed wetland restoration activities	State/ Federal agencies and other NGO acceptance of TA resulting in a redesign of the proposed plan in order to minimize hazards
FL	Pensacola Regional Apt	2000 - 2003	Mixed bird species	Comprehensive IWDMP	75% reduction in overall strike rate
IL	Chicago O'Hare IA	1993 - 2003	Raptor species/ white-tailed deer	Relocation of wildlife/ use of depredation permit	Continued reduction of risk posed by raptors and 100% reduction in white-tailed deer strikes
IN	Indianapolis IA	2002 - 2003	Mixed bird species	Habitat management/ use of depredation permit	84% reduction in overall strike rate
KS	Kansas City IA	1999 - 2001	Raptor species/ white-tailed deer	Comprehensive IWDMP	35% reduction in strike rate by raptors, 75% reduction in observed white-tailed deer abundance
MN	Minneapolis-St. Paul IA	2003	Raptor species	Relocation of wildlife	Reduction of risk posed by raptors; enhanced relations with USFWS and public
MS	Columbus AFB	2003	General BASH issues/ white-tailed deer	Integration of BASH and Natural Resources Dept.	USAF small air base Natural Resources Award
MO	Whiteman AFB	2000 - 2003	Blackbird roost (250,000 birds)	Habitat modification	100% reduction of problems posed by runway over flights of blackbirds
NJ	Atlantic City IA	1991- 2003	Habitat and gulls	Comprehensive IWDMP	86% reduction in strike rate of gulls
NY	John F. Kennedy IA	1991 - 2003	Gulls	Use of depredation permit	97% reduction in strike rate of gulls
NC	Marine Corps Air Station Cherry Point	2001 - 2004	Canada geese/ white-tailed deer	Use of depredation permit	97% reduction in observed abundance and continued 100% reduction in white-tailed deer strikes
NC	Seymour Johnson AFB	2002 - 2003	General BASH issues	Comprehensive IWDMP	98% reduction in maintenance costs resulting from strikes
OK	Altus AFB	2001 - 2003	Mixed bird species	Comprehensive IWDMP	>50% reduction in overall strike rate
PA	Harrisburg IA	2003	Bald eagle	Request for permit	Assisted to secure first Bald Eagle Harassment Permit in Pennsylvania
PA	Philadelphia IA	2001 - 2002	Mixed bird species	Comprehensive IWDMP	28% reduction in overall strike rate
PA	Philadelphia IA, Harrisburg IA, Wilkes/Barre/Scranton IA, Lehigh Valley IA, NE Philadelphia, Washington County, Johnstown, Rostraiver, & Queen City Apts	1995 - 2004	White-tailed deer	Use of depredation permit	100% reduction in white-tailed deer strikes
UT	Brigham City Municipal Apt	2003 - 2004	Waterfowl species	Comprehensive TA related to proposed wetland mitigation location	FAA/airport acceptance of recommendation resulting in selection of less hazardous wetland mitigation location
VA	Langley AFB	1999 - 2004	Mixed bird species/ white-tailed deer	Comprehensive IWDMP and relocation of wildlife	>50% reduction in observed abundance of hazardous bird species and 68% reduction in white-tailed deer abundance
WA	Seattle-Tacoma IA	2001 - 2004	Storm water treatment planning	Comprehensive TA related to proposed storm water treatment planning and design	State/ Federal agencies and other NGO acceptance of TA resulting in a redesign of the proposed plan in order to minimize bird hazards

[a] Abbreviations used: AFB = Air Force Base, Apt = Airport; BASH = Bird Aircraft Strike Hazard, FAA = Federal Aviation Administration, IA = International Airport, IWDMP = Integrated Wildlife Damage Management Program, NGO = Non-Government Organization, TA = Technical Assistance.

and behaviors of hazardous wildlife over time (daily and seasonally) and the geographic occurrence of these factors as they relate to aviation safety at the airport. Subsequent reports following the conclusion of the WHA contain recommendations that satisfy FAA regulations.

14 CFR Part 139.337 also requires certificated airports to develop and implement a WHMP if warranted based on recommendations in the WHA. The recommendations contained in the WHA form the basis for the WHMP. The FAA developed a CertAlert (No. 97-09, Wildlife Hazard Management Plan Outline) which outlines the necessary items to be contained in a WHMP. These items include 1) defined roles and responsibilities for those involved with managing wildlife, 2) habitat modification plans and procedures, 3) applicable federal and state regulations, 4) resources available for managing wildlife, 5) a plan for monitoring and updating the WHMP as necessary, and 6) a training program to provide airport personnel with knowledge and skills to carry out the WHMP.

Operational Assistance

Direct operational assistance from WS in 2003 was provided in the form of lethal control of hazardous wildlife at 165 airports, non-lethal dispersal of wildlife at 136 airports, modification of habitat to discourage use by wildlife at 88 airports, and capture and translocation of wildlife at 56 airports (Dolbeer 2004). In all cases, lethal control of protected species was done under appropriate state and federal permits as a last option after non-lethal options had been determined ineffective or impractical. WS biologists estimated that technical or direct operational assistance resulted in a reduction, suppression, or prevention of wildlife hazards to aviation at 441 of the 565 airports (78%) where some type of assistance was provided in 2003.

Examples of Successful Technical and Operational Assistance

Long-term operational and technical assistance programs involving WS participation to reduce wildlife hazards at airports began in the early 1990s. Through the use of Integrated Wildlife Damage Management Programs (IWDMPs), WS personnel have reduced wildlife strikes at airports across the United States. Examples of the successful programs, some of which are noted below, are summarized in Table 2.

The IWDMPs have resulted in a significant reduction in gull (*Larus* spp.) strikes at John F. Kennedy International Airport in New York (97% reduction) and Atlantic City International Airport in New Jersey (86% reduction). Additionally, techniques deployed in IWDMPs reduced the strike rate of white-tailed deer at Chicago O'Hare International Airport and various airports in Pennsylvania by 100%.

This significant reduction in overall hazards is also noted at several military facilities, most notably Altus Air Force Base (AFB) in Oklahoma, Langley AFB in Virginia, Whiteman AFB in Missouri, and Marine Corps Air Station Cherry Point in North Carolina. Examples of WS work with the DoD is further documented by positive cooperation with on-base natural resource programs at Columbus AFB in Mississippi and through marked savings in maintenance costs resulting from wildlife collisions at Seymour Johnson AFB in North Carolina.

Significant strides in public relations and successful interface with other government agencies are highlighted by work at Kansas City International Airport in Kansas (i.e., innovative work with existing agricultural operations), Minneapolis-St. Paul International Airport in Minnesota (i.e., trapping and relocation of high-profile bird species) and at Phoenix Sky Harbor International Airport in Arizona and Seattle-Tacoma International Airport in Washington where the acceptance of technical assistance resulted in the redesign of habitat restoration plans and storm water drainage systems in order to preclude hazards to aviation.

The methods, procedures, and results of these activities were often communicated during annual meetings of Bird Strike Committee (BSC)-USA/Canada and through meetings of the International BSC, the European counterpart to BSC-USA/Canada. In some cases, peer review journal articles also have resulted from these management activities (see Dolbeer et al. 1993).

SUMMARY

Since its development, the WS Airports Program has provided federal leadership for resolving conflicts between wildlife and people. Wildlife Services is now internationally recognized for its research and management programs in wildlife damage control at airports. The development of the National Wildlife Strike Database has allowed WS biologists and the aviation industry to better understand the nature and magnitude of safety issues associated with wildlife collisions with aircraft. Since 1990, WS personnel have produced 143 publications in peer-reviewed science journals and conference proceedings related to managing wildlife hazards at airports. This research, in combination with the information found in the National Wildlife Strike Database, provides the scientific foundation for the many technical and operational assistance programs developed, implemented, and overseen by WS biologists at airports nationwide.

The WS Airports Program has grown substantially in the past 15 years, with assistance to airports increasing from only 42 in 1990 to 565 in 2003. Assistance in 2003 included 50% of the 14 CFR Part 139 certificated airports. Wildlife Services expects that requests for assistance will continue to increase as populations of hazardous wildlife increase, airports expand, and aircraft movements increase. Currently, the demand for assistance far exceeds WS capacity to mitigate the safety issues and economic losses caused by these expanding populations of state and federally protected wildlife species that pose a hazard to aviation. A major challenge for the aviation industry and WS will be in securing additional funding to meet the needs of airports and the regulatory requirements of FAA and DoD regarding wildlife hazards to aviation.

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