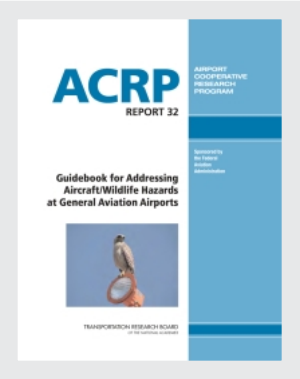

Guidebook for Addressing Aircraft/Wildlife Hazards at General Aviation Airports

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AIRPORT COOPERATIVE RESEARCH PROGRAM

ACRP REPORT 32

Guidebook for Addressing Aircraft/Wildlife Hazards at General Aviation Airports

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AIRPORT COOPERATIVE RESEARCH PROGRAM

Airports are vital national resources. They serve a key role in transportation of people and goods and in regional, national, and international commerce. They are where the nation's aviation system connects with other modes of transportation and where federal responsibility for managing and regulating air traffic operations intersects with the role of state and local governments that own and operate most airports. Research is necessary to solve common operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the airport industry. The Airport Cooperative Research Program (ACRP) serves as one of the principal means by which the airport industry can develop innovative near-term solutions to meet demands placed on it.

The need for ACRP was identified in *TRB Special Report 272: Airport Research Needs: Cooperative Solutions* in 2003, based on a study sponsored by the Federal Aviation Administration (FAA). The ACRP carries out applied research on problems that are shared by airport operating agencies and are not being adequately addressed by existing federal research programs. It is modeled after the successful National Cooperative Highway Research Program and Transit Cooperative Research Program. The ACRP undertakes research and other technical activities in a variety of airport subject areas, including design, construction, maintenance, operations, safety, security, policy, planning, human resources, and administration. The ACRP provides a forum where airport operators can cooperatively address common operational problems.

The ACRP was authorized in December 2003 as part of the Vision 100-Century of Aviation Reauthorization Act. The primary participants in the ACRP are (1) an independent governing board, the ACRP Oversight Committee (AOC), appointed by the Secretary of the U.S. Department of Transportation with representation from airport operating agencies, other stakeholders, and relevant industry organizations such as the Airports Council International-North America (ACI-NA), the American Association of Airport Executives (AAAE), the National Association of State Aviation Officials (NASAO), and the Air Transport Association (ATA) as vital links to the airport community; (2) the TRB as program manager and secretariat for the governing board; and (3) the FAA as program sponsor. In October 2005, the FAA executed a contract with the National Academies formally initiating the program.

The ACRP benefits from the cooperation and participation of airport professionals, air carriers, shippers, state and local government officials, equipment and service suppliers, other airport users, and research organizations. Each of these participants has different interests and responsibilities, and each is an integral part of this cooperative research effort.

Research problem statements for the ACRP are solicited periodically but may be submitted to the TRB by anyone at any time. It is the responsibility of the AOC to formulate the research program by identifying the highest priority projects and defining funding levels and expected products.

Once selected, each ACRP project is assigned to an expert panel, appointed by the TRB. Panels include experienced practitioners and research specialists; heavy emphasis is placed on including airport professionals, the intended users of the research products. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, ACRP project panels serve voluntarily without compensation.

Primary emphasis is placed on disseminating ACRP results to the intended end-users of the research: airport operating agencies, service providers, and suppliers. The ACRP produces a series of research reports for use by airport operators, local agencies, the FAA, and other interested parties, and industry associations may arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by airport-industry practitioners.

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Ed Cleary, WASHMan LLC
Archie Dickey, Biozone Inc.

FOREWORD

By Marci A. Greenberger
Staff Officer
Transportation Research Board

ACRP Report 32: Guidebook for Addressing Aircraft/Wildlife Hazards at General Aviation Airports presents the different wildlife challenges that airports may face and the techniques and strategies for addressing them. The Guidebook discusses for airport mangers and other airport personnel at general aviation airports with limited resources (1) the different species that can be found at airports and specific information that will be helpful in identifying and controlling them, (2) the various wildlife attractants and best management practices that can be employed by airport operators to minimize wildlife activity at and around airports, (3) wildlife control strategies and techniques that are most appropriate at general aviation airports, and (4) how to develop a wildlife control program.

General aviation airports are usually resource constrained, and because of limited staff, there is very little specializing that occurs. Airport personnel often handle many different areas of airport management, and rely on easy-to-read, all encompassing materials to help them be as effective as possible in their different responsibilities in operating and maintaining the airport. *ACRP Report 32* is a guidebook for general aviation airport personnel in the area of wildlife management designed to assist them in providing the safest environment possible in an efficient manner.

Wildlife hazards and the safety concerns associated with them have always been a concern for airport operators, and with the January 2009 ditching of a US Airways aircraft into the Hudson River after colliding with Canadian geese after take-off, this has put the issue in the public spotlight. However, there isn't as much data on wildlife collisions with aircraft at general aviation airports as there is at Part 139 airports, possibly due to the lack of general understanding of the issue and the reporting process.

Under ACRP Project 04-06, Biozone Inc. and WASHMan LLC were asked to develop a guidebook that could be used by airport personnel at general aviation airports to help them identify and understand the nature of wildlife hazards and provide practical ways in which they can be addressed. To develop the Guidebook, the research team reviewed known relevant materials and spoke directly to general aviation airport operators to obtain information on the primary issues affecting them, and used this information and their expertise to identify best management practices at general aviation airports.

CONTENTS

PART 2 Activities for General Aviation Airport Managers Concerned About Hazardous Wildlife Problems

PREFACE

As part of the preparation for writing this guidebook, questionnaires were sent to a random selection of approximately half (1,120) of the general aviation (GA) airports in the Federal Aviation Administration's National Plan of Integrated Airport Systems (NPIAS); approximately 15% of the airports that received questionnaires responded. On-site evaluations were conducted at 13 GA airports selected from various geographic regions of the United States and ranging in size from 19,000 operations per year to over 505,000 operations per year.

Information gathered from the surveys and the site visits was used to verify and provide insight into the approach and direction of this guidebook. The surveys also brought to light several facts that have a major influence on how most GA airports operate.

Many GA airports are found in rural areas and are managed by local city or county aviation boards. About 21% of GA airports have urban development next to the airport, 17% have development within a half mile, 27% have urbanization within 1 to 1.5 miles, and 33% of the airports are more than 2 miles from the closest urban development.

GA airports operate with minimal budgets and staffing. Lack of funding forces many airports to not take actions toward minimizing aircraft/wildlife hazards or to allow activities that exacerbate the problem rather than correcting or lessening it. About 35% of GA airports have adequate (chain link) fencing. Over 30% of GA airports do not have perimeter fencing. About 33% allow on-airport agriculture. The majority of these airports have indicated that on-airport agriculture is necessary for financial viability of the airport.

The majority (59%) of GA airports reported they had never had a wildlife strike reported at their airport. For those airports that acknowledged having had at least one wildlife strike, the most commonly reported struck animals were deer (12%), birds (22%), geese (6%), and coyotes (3%). When asked about wildlife being seen at the airport, 39% indicated that wildlife was not often seen, and 61% indicated that it was often seen. The most commonly reported wildlife seen were birds (41%), mammals (14%), birds and mammals (43%), and birds, mammals, and domestic animals (21%).

Little if any research directed specifically at wildlife problems at GA airports has been conducted. The FAA sponsors a great deal of research directed at the wildlife aircraft strike problem. However, that research is directed at broad application to certificated airports. It is not directed specifically at GA airports.

How to Use This Guidebook, and an Introduction to Controlling Hazardous Wildlife at General Aviation Airports

Wildlife aircraft strikes have been occurring almost since the beginning of powered flight. The first reported bird strike occurred September 7, 1905. The first fatality (Calbraith Rogers) due to a bird strike occurred April 3, 1912. (Photo courtesy National Air and Space Museum, Smithsonian Institution, SI Neg. No. 2003-44325)

Guidebook Purpose and Design

This guidebook specifically addresses the following issues:

- Identifying hazardous wildlife, the problems they cause at general aviation (GA) airports, and methods for dealing with those problems; and
- Establishing wildlife hazard control programs at GA airports, evaluating the effectiveness of a wildlife hazard control program, and training airport personnel.

This Cessna 206 struck a single vulture on takeoff from a southern U.S. airport. The bird penetrated the windshield, severely injuring the pilot.

The guidebook is organized into three sections:

Part 1 (Chapters 1, 2, and 3) is designed for airport personnel who want to know:

- What kind of wildlife they are seeing at the airport,
- What is attracting problem wildlife to the airport, and
- How to get rid of problem wildlife.

Part 2 (Chapters 4 to 8) is intended for airport managers who need information about how to set up and evaluate a wildlife hazard management program. Included in this section is a discussion of state and federal government agencies and regulations that can impact wildlife hazard control at GA airports.

The appendices contain information such as:

- Contact information for the Federal Aviation Administration's Office of Airports, Airports Division, Washington, DC, Headquarters and Regional Offices, and the U.S. Department of Agriculture's Wildlife Services program, Washington, DC, Headquarters, Regional Offices, and State Directors. Both of these federal agencies can provide information and assistance for dealing with airport wildlife problems.
- Web links to applicable FAA Advisory Circulars (ACs) and Certalerts.
- Federal Aviation Administration Form 5200-7 Bird/Wildlife Strike Report.

Introduction to the Problem

The January 15, 2009, crash landing of US Airways flight 1549 in the Hudson River following ingestion of Canada geese into both of the plane's engines graphically illustrates the importance of wildlife aircraft strike hazard management. The incident also raised the public's awareness of the threat to aviation safety posed by wildlife at or near airports. For the first time, many people both in and out of the aviation community have become aware that birds can bring down an aircraft. However, this threat is not new. The first recorded bird strike occurred September 7, 1905, and the first recorded human death due to a bird strike occurred April 3, 1912.

Experts within the civil aviation community have long recognized that the threat to aviation safety and economic repercussions from collisions between aircraft and wildlife (commonly referred to as "wildlife aircraft strikes" or "strikes") is increasing (see for example Dolbeer 2000, Allan and Orosz 2001, MacKinnon, Sowden, and Dudley, 2001, Dolbeer and Eschenfelder 2003, Cleary and Dolbeer 2005, and Cleary et al. 2007).

Several factors contribute to this increasing threat. The two most significant factors are:

1. There are a large number of GA aircraft and a high number of hours that GA aircraft are flown. GA aircraft account for approximately 75% of the U.S. civil aircraft fleet (The National Economic Impact of Civil Aviation 2002). GA air traffic has remained fairly steady over the last several years. Between 1991 and 2005, GA aircraft flew an average of 25.8 million hours per year. This ranged from a low of 22.2 million hours flown in 1994 to a high of 29.1 million hours in 2000 (Nall Report Accident Trends and Factors for 2000, Nall Report Accident Trends and Factors for 2005).
2. Populations of many wildlife species commonly involved in wildlife aircraft strikes are increasing. For example, white-tailed deer populations increased from a low of 0.3 million in 1900 to a conservatively estimated 20 million in 2006 (McCabe and McCabe 1997, Dolbeer personal communication 2008). The nonmigratory Canada goose population quadrupled in the United States between 1986 and 2002 (Sauer et al. 2006).

Between January 1, 1990, and December 31, 2008, wildlife strikes caused damage to 10,352 U.S. civil aircraft; 2,700 of the strikes caused substantial damage, and 49 U.S. civil aircraft were destroyed due to wildlife strikes. Of the 49 strikes that resulted in loss of the aircraft, 33 (67%) occurred at a GA airport.

Between January 1, 1990, and October 31, 2008, the FAA received 72 reports of wildlife strikes involving GA aircraft that resulted in 87 human injuries. During the same period, the FAA received six reports of wildlife strikes involving GA aircraft that resulted in 13 human deaths. The three most recent strikes causing human fatalities are:

1. The instructor pilot of a Cessna 172 and his student both died when the leading edge of the left wing of their aircraft hit what is believed to have been a black vulture at 800 ft above ground level (AGL) on July 8, 2003, in central Texas. The aircraft was not able to maintain lift and crashed.

Birds are not the only animals to cause problems at GA airports. Between 1990 and 2007, mammal strikes accounted for 14% of all reported strikes occurring at GA airports. (Photo courtesy Royal Canadian Air Force)

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Five people died March 4, 2008, in northwest Oklahoma City when their Cessna 500 Citation I struck an unknown number of white pelicans. (Photo P. Robinson)

2. A University of North Dakota instructor pilot and student pilot died October 23, 2007, when their Piper PA-44 Seminole crashed after striking what is believed to have been one or more Canada geese near Browerville, Minnesota.
3. Five people died March 4, 2008, in northwest Oklahoma City when their Cessna 500 Citation I struck an unknown number of white pelicans.

These three fatal strikes occurred off the airport, while the aircraft was en route.

All airports—GA and commercial—have a legal responsibility to provide a safe aircraft operating environment. This includes controlling hazardous wildlife problems as well as signing, marking and lighting, and removing ice and snow where required.

In the United States, most funding, research, and regulatory efforts directed toward addressing the civil aviation wildlife strike problem come from the federal level, specifically the FAA. Congress has not given the FAA authority to inspect or license GA airports. Most of the FAA's wildlife hazard research efforts are directed toward certificated airports. Little, if any, work has been done to analyze and understand the hazardous wildlife problems faced by the GA community.

This guidebook presents information for airport personnel responsible for the day-to-day operations of a GA airport's wildlife hazard control program. It also provides guidance for GA airport operators trying to develop and manage a wildlife hazard control program at their airport.

Applicability

Throughout this document reference is made to various federal regulations, in particular Title 14 Code of Federal Regulations Part 139, Certification of Airports (14 CFR 139), and Federal Aviation Administration Advisory Circulars that deal with managing hazardous wildlife at or near airports. (See Appendix C for a list of applicable ACs.) It is recognized that GA airports are not bound by Part 139. However, many states use 14 CFR 139 and FAA Advisory Circulars as the basis of their civil aviation regulations. GA airport managers may find it beneficial to be familiar with these regulations and ACs.

Crows attracted to fresh water trapped in berms next to a runway. These berms were caused by snow removal. (Photo E. Cleary)

Airports that have accepted Airport Improvement Program (AIP) monies or other federal grants-in-aid (obligated airports) are bound by the Airport Grant Assurances, particularly, Assurance 19, *Operation and Maintenance;* Assurance 20, *Hazard Removal and Mitigation;* and Assurance 21, *Compatible Land Use.* These three Assurances have a direct bearing on addressing hazardous wildlife problems at a GA airport. Also, FAA AC 150/5200-33*, Hazardous Wildlife Attractants on or near Airports,* was added to the FAA Airport Improvement Program's list of Grant Assurances in July 1999. Therefore, obligated GA airports are bound by the AC requirements. Non-obligated GA airports may also find these recommendations helpful for dealing with wildlife problems.

The FAA lacks congressional authority to issue operating licenses or to inspect GA airports. Inspection and licensing of GA airports is a state responsibility. An obligated airport's requirement to meet all applicable Airport Grant Assurances and Advisory Circulars is a contractual obligation. It is not a regulatory requirement. GA airports that do not meet the Airport Grant Assurances can be found to be "in noncompliance with the Grant Assurances." This is a breach of contract, not a violation of federal law or regulation.

PART 1

For General Aviation Airport Personnel

Part 1 is intended for GA airport personnel who have day-to-day responsibilities for dealing with hazardous wildlife problems at the airport. It covers the following topics:

- Identification, control methods, and legal status of the wildlife species posing the greatest hazard to GA aircraft (Chapter 1);
- Recognizing hazardous wildlife attractants at or near general aviation airports (Chapter 2); and
- Wildlife control strategies and techniques at general aviation airports (Chapter 3).

CHAPTER 1

The Most Hazardous Species of Wildlife

This Learjet 36 struck an elk on departure from Astoria, OR, December 3, 2002. Elk were frequently seen at and around the airport. A 10-ft fence was installed around most of the airport prior to the incident. The airport was seeking permits from the Army Corp of Engineers to allow work in wetlands to complete the fence. The four people on board escaped without injuries. The aircraft cost $5.14 million new in 1997.

Introduction

Many species of wildlife can pose a direct or indirect threat to aviation safety. However, not all wildlife species are equally hazardous. This chapter discusses the wildlife species posing the greatest threat to aviation safety. Mammals and birds are listed separately, and species within each group are listed alphabetically. Refer to the Ranking Wildlife Species Hazardous to General Aviation Aircraft section of Chapter 4 for a discussion of how the rankings for the various species posing the greatest threats to aviation safety were developed.

The wildlife species listed in Table 4.1 and Figure 7.1 are ranked on the relative "severity of outcome" if they are involved in a strike. Deer, the species having the greatest potential to cause aircraft damage when struck, are ranked highest (100), and all other species are ranked relative to deer. Raptors and vultures are about half as hazardous as deer (half as likely to cause damage), and bats are about one-tenth as hazardous.

With the necessary depredation permits in place, shooting problem wildlife is always an option. Anytime wildlife is shot as part of a program to control hazardous wildlife, every effort must be made to retrieve and dispose of dead animals. Federal depredation permits frequent specify the disposal method for federally protected species, generally deep burial or donation to a scientific institution.

Only general control methods, specific for each species, are presented in this chapter; detailed discussions of all control methods are presented in Chapter 3.

Similar species have been combined into groups (such as all of the gulls, all of the ducks, and all of the deer). Control techniques, legal statuses, and general biology are very similar if not identical for the species within each group.

Much of the information presented is adapted from *Prevention and Control of Wildlife Damage* (Hygnstrom et al. 1994). This publication can be accessed, and articles downloaded free of charge, at icwdm.org/handbook/index.asp.

Many of the photos are from the U.S. Fish and Wildlife Service's National Digital Library found at http://www.fws.gov/digitalmedia.

Most Hazardous Mammals

Coyotes

Control

- Mow airside vegetation short to eliminate rabbit and field mouse habitat.
- Install 8- to 10-ft chain link fencing with a 4-ft skirt and 3-strand barbed wire outriggers.
- Use gas cartridges for den fumigation.
- Use leg-hold traps (Nos. 3 or 4) or snares.
- Shoot coyotes.

Once limited to the western states, coyotes now range throughout most of North America. [Photo courtesy U.S. Fish and Wildlife Service (U.S. FWS)]

Legal Status

Laws regulating coyote control are not uniform among states or even among counties within a state. Contact the state natural resources management agency to determine the coyote's status and legal take methods.

General Biology

Coyotes (*Canis latrans*) often include many items in their diets. Rabbits top the list of their dietary components. Carrion and rodents are also consumed. Coyotes readily eat fruits such as watermelons, berries, and other vegetative matter when they are available.

Coyotes are most active at night and during early morning hours (especially where human activity occurs and during hot summer weather). Where there is minimal human interference and during cool weather, they may be active throughout the day.

Coyotes bed in sheltered areas but do not generally use dens except when raising young. Their physical abilities include good eyesight and hearing and a keen sense of smell. Documented recoveries from severe injuries are indicative of coyotes' physical endurance. Although not as fleet as greyhound dogs, coyotes have been measured at speeds of up to 40 miles per hour (64 km/hr) and can sustain slower speeds for long distances.

Coyotes usually breed in February and March, producing litters about 9 weeks (60 to 63 days) later in April and May. Average litter size is 5 to 7 pups, although up to 13 in a litter has been reported. More than one litter may be found in a single den; at times these may be from females mated to a single male. Coyotes are capable of hybridizing with dogs and wolves (Green, Henderson, and Collinge 1994).

Deer

Control

- Use pyrotechnics to chase deer away from airports.
- Where legal and safe, shoot problem deer at or near airports.
- Eliminate all stands of trees and brush in which deer can hide at the airport.
- Install 8- to 12-foot chain-link fencing with 3-strand barbed wire outriggers and a 4-foot skirt. This is the best (and most expensive) method for keeping deer away from airports.

Mule deer buck and doe (left); white-tailed deer buck (right). (Photos courtesy U.S. FWS National Digital Library)

Legal Status

Deer are protected in all states. Persons wishing to take deer outside of the normal hunting season must have a state depredation permit. Depredation permits are generally issued by the state natural resources management agency.

General Biology

There are two species of deer in North America: white-tailed deer (*Odocoileus virginianus*) and mule deer (*O. hemionus*). White-tailed deer are the deer species most commonly struck by aircraft. The white-tailed deer is the most common and widely distributed deer in North America. There are at least 30 recognized subspecies of the white-tailed deer. The peak of breeding season (rut) is generally mid-November. The fawning season is mid-May to late June. Very young females will have only one fawn. However, on good deer range, twins are the rule rather than the exception. Mule deer generally occur in the western half of North America. The breeding and fawning seasons of the mule deer are very similar to that of the white-tailed deer. Single births are most common, and twins are the exception for mule deer. Deer prefer to feed on brush and tender twigs rather than on grass.

Dogs

Control

- Install 8- to 10-foot chain link fencing with a 4-foot skirt and 3-strand barbed wire outriggers.
- Use cage traps or steel leg-hold traps (No. 3 or 4).
- Shoot feral dogs (where legal and safe).
- Use good sanitation, particularly food waste control, around airport.
- Do not allow airport employees to feed feral animals.

Legal Status

State and local laws concerning feral and free-ranging dogs vary considerably, but most states have some regulations. Most cities have animal control agents to pick up abandoned and free-ranging domestic dogs.

This feral dog, living on a southwestern desert airport, was feeding on food scraps from the airport's cafeteria and drinking from a broken water line. (Photo E. Cleary)

General Biology

Feral dogs (*Canis familiaris)* are the most widespread of the wild canids. In appearance, most feral dogs are difficult, if not impossible, to distinguish from domestic dogs. Like domestic dogs, feral dogs (sometimes referred to as wild or free-ranging dogs) manifest themselves in a variety of shapes, sizes, colors, and even breeds. The primary feature that distinguishes feral from domestic dogs is the degree of reliance or dependence on humans, and in some respects, their behavior toward people.

They are active during dawn, dusk, and at night, much like other wild canids. They often travel in packs or groups and may have rendezvous sites like wolves. Like coyotes, feral dogs will eat almost anything.

The only areas that do not appear to be suitable for feral dogs are places where food and escape cover are not available, or where large native carnivores, particularly wolves, are common and prey on dogs (Green and Gipson 1994).

Foxes

Control

- Obstruct foxes with fencing similar to deer fencing.
- Exclude the use of frightening tactics as they are generally not effective for foxes.
- Use toxicants; the M-44™ is registered for control of red and gray foxes nationwide.
- Fumigate fox dens (only in North Dakota, South Dakota, and Nebraska).
- Trap foxes using nos. 1½, 1¾, and 2 double coil spring traps and nos. 2 and 3 double long spring traps.
- Shoot foxes.
- Eliminate trees, brush, and other cover within the AOA.
- Control rodent prey base on airport property.

The gray fox (left) is slightly smaller than the red fox (right). (Gray fox photo courtesy D. Schaffer/U.S. FWS; red fox photo courtesy J. Thiele/U.S. FWS)

Legal Status

In the United States, foxes are listed as furbearers or given some status as game animals by most state governments. Most states allow for the taking of foxes to protect private property. Check with your state wildlife agency for regulations before undertaking fox control measures.

General Biology

Foxes are most active during the early hours of darkness and the very early hours of the morning. However, they do move about during the day, especially when it is overcast. Foxes are solitary animals except from the winter breeding season through midsummer, when mates and their young associate closely. Foxes are opportunists, feeding mostly on rabbits, mice, bird eggs, insects, and native fruits. Foxes usually kill animals smaller than a rabbit.

- The red fox (*Vulpes vulpes*) is the most common of the foxes native to North America. Except in a few isolated areas, red foxes occur over most of North America, north and east from southern California, Arizona, and central Texas.
- Gray foxes (*Urocyon cinereoargenteus*) are found throughout the eastern, north central, and southwestern United States. They are found throughout Mexico and most of the southwestern United States from California northward through western Oregon.
- Kit foxes (*V. macrotis*) are residents of arid habitats. They are found from extreme southern Oregon and Idaho south along the Baja Peninsula and eastward through southwestern Texas and northern Mexico.
- The present range of swift foxes (*V. velox*) is restricted to the central high plains. They are found in Kansas, the Oklahoma panhandle, New Mexico, Texas, Nebraska, South Dakota, Wyoming, and Colorado.
- As its name indicates, the arctic fox (*Alopex lagopus*) occurs in the arctic regions of North America and was introduced on a number of islands in the Aleutian Islands Chain (Phillips and Schmidt 1994).

Raccoons

Control

- Secure trash cans inside buildings or wire lids down.
- Use dumpsters with lids that lock down.

Raccoon. (Photo courtesy D. Menke, U.S. FWS National Digital Library)

- Trap raccoons using no. 1 long spring and no. 1½ coil spring leg-hold traps, 160s through 220s bodygrip traps, and 10 × 12 × 32 (minimum size) single door cage traps.
- Shoot raccoons using a .22 caliber rifle or a 16 or 12 gauge shotgun.

Legal Status

Raccoons (*Procyon lotor*) are protected furbearers in most states, with seasons established for running, hunting, or trapping. Most states, however, have provisions for landowners to control furbearers that are damaging their property. Check with your state wildlife management agency before using any lethal controls. Many states do not allow live trapping and relocating of raccoons because of the potential spread of rabies. Check with the local game warden or state wildlife management agency before live trapping and relocating raccoons.

General Biology

Raccoons are found throughout the United States, with the exception of the higher elevations of mountainous regions and some areas of the arid Southwest. Raccoons are more common in the wooded eastern portions of the United States than in the more arid western plains.

Raccoons are omnivorous, eating both plant and animal foods. Plant foods include all types of fruits, berries, nuts, acorns, corn, and other types of grain. Animal foods are crayfish, clams, fish, frogs, snails, insects, turtles and their eggs, mice, rabbits, muskrats, and the eggs and young of ground-nesting birds and waterfowl. Contrary to popular myth, raccoons do not always wash their food before eating, although they frequently play with their food in water (Boggess 1994).

Most Hazardous Birds

American Crows

Control

- Do not allow cereal grain crops on or near airports.
- Thin branches from specific roost trees or thin individual trees from dense groves.
- Repel crows using recorded crow distress calls, propane exploders, battery-operated alarms, or pyrotechnics.
- Use Avitrol™ (active ingredient: 4-aminopyridine). Birds that ingest Avitrol go into violent distress behavior. One or two reacting birds can frighten many other birds away.
- Hunt and shoot crows where legal.
- Trap crows with an Australian Crow Trap, a type of decoy trap.

Legal Status

Crows are protected by the Migratory Bird Treaty Act. However, crows may be controlled without a federal permit when found "committing or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner to constitute a health hazard or other nuisance" (50 CFR 21.43). States may require permits to control crows and may regulate the method of take. Check with local wildlife officials if there is any doubt regarding legality of control methods.

General Biology

The American crow (*Corvus brachyrhynchos*) is one of America's best known birds. Males and females are outwardly alike. Their large size [17 to 21 in. (43 to 53 cm) long], completely coal-black plumage, and familiar "caw caw" sound make them easy to identify. They are fairly common in areas near people, and tales of their wit and intelligence have been noted in many stories.

American crow. (Photo courtesy U.S. FWS National Digital Library)

Three other crows occur in the continental United States; the fish crow (*Corvus ossifragus*), the northwestern crow (*Corvus caurinus*), and the Mexican crow (*Corvus imparatus*). Fish crows are primarily inhabitants of the eastern and southeastern coastal United States. Fish crows are somewhat smaller than American crows, but in the field they appear much alike. Northwestern crows, as their name implies, occur in the northwest along the coastal strip from Washington to Alaska. They are most often seen foraging along beaches. Northwestern crows are smaller than American crows, but in Washington State these two species may hybridize. Mexican crows occur in south Texas (Brownsville area) primarily during fall and winter and are fairly small for crows.

Crows are omnivorous, eating almost anything, and they readily adapt food habits to changing seasons and available food supply.

Crows begin nesting in early spring (February to May, with southern nests starting earlier than northern ones) and build a nest of twigs, sticks, and coarse stems. Crow pairs appear to remain together throughout the year, at least in nonmigratory populations, and pairs or pair bonds are likely maintained even within large winter migratory flocks. The average clutch is four to six eggs that hatch in about 18 days. Young fledge in about 30 days. Usually there is one brood per year, but in some southern areas there may be two broods. Both sexes help build the nest and feed the young, and occasionally offspring that are one or more years old (nest associates) help with nesting activities. The female incubates the eggs and is fed during incubation by the male and nest associates. The young leave the nest at about 5 weeks of age and forage with their parents throughout the summer. Later in the year, the family may join other groups that in turn may join still larger groups. The larger groups often migrate in late fall or winter (Johnson 1994).

Blackbirds

Control

- Do not allow cereal grain, corn, and sunflower crops on or near airports.
- Repel blackbirds using pyrotechnics, propane cannons, distress calls, electronic noise systems, helium-filled balloons tethered in fields, radio-controlled model planes, reflecting

Male red-winged blackbird (left), female yellow-headed blackbird feeding young (right). (Photos courtesy U.S. FWS National Digital Library: left, D. Dewhurst; right, P. Norton)

tapes made of Mylar, tape-recorded distress calls for birds, various types of scarecrows, and green lasers.
- Shoot blackbirds.
- Use a toxicant; the only one registered is Starlicide™.
- Manage turf grass on airside property as dense monoculture and cut to intermediate heights.
- Remove or thin roost trees.

Legal Status

Blackbirds are protected by the Migratory Bird Treaty Act. However, a federal depredation permit is not needed to take blackbirds when they are found "committing or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance" (50 CFR 21.43). Some states have additional restrictions on the killing of blackbirds.

General Biology

There are about ten species of "blackbirds" in North America. The various species have several traits in common. The males are predominantly black or iridescent in color. All blackbirds have an omnivorous diet consisting primarily of grains, weed seeds, fruits, and insects. The relative proportions of these food groups, however, vary considerably among species. Outside of the nesting season, blackbirds generally feed in flocks and roost at night in congregations varying from a few birds to several million birds. These flocks and roosting congregations are sometimes comprised of a single species, but often several species mix together. Sometimes they are joined by non-blackbird species, notably European starlings (*Sturnus vulgaris*). Some of the most commonly seen blackbirds include the following:

- Red-winged blackbirds (*Agelaius phoeniceus*) are abundant nesters throughout much of North America. The red-winged blackbird nests in hayfields, marshes, and ditches. Large flocks feed in fields and bottomlands. Redwings winter in the southern United States.
- Common grackles (*Quiscalus quiscula*) are common nesters throughout North America east of the Rockies. Flocks feed in fields, lawns, woodlots, and bottomlands. These birds

winter in the southern United States, often in association with redwings, cowbirds, and starlings.

- Great-tailed grackles (*Quiscalus mexicanus*) are abundant year-round residents in coastal and southern Texas. The great-tailed grackle nests in colonies in shrubs or trees, sometimes in association with herons and egrets. The flocks feed around farms, pastures, and parks.
- Boat-tailed grackles (*Quiscalus major*) are abundant along the southeastern seaboard, gulf coast, and throughout Florida. They behave similarly and replace the great-tailed grackle in their range.
- Brown-headed cowbirds (*Molothrus ater*) occur in spring and summer throughout much of North America. Flocks feed in pastures and feedlots, and they are often associated with livestock. Cowbirds winter in the central to southern United States, often roosting with redwings, grackles, and starlings.
- Yellow-headed blackbirds (*Xanthocephalus xanthocephalus*) are locally abundant nesters in deep-water marshes of the northern Great Plains and western North America. They feed in agricultural fields, meadows, and pastures during late summer and fall, sometimes in association with redwings or other blackbirds. They winter farther south than other blackbirds, primarily in Mexico.
- Brewer's blackbirds (*Euphagus cyanocephalus*) are a familiar bird in the northern Great Plains and western North America. The Brewer's blackbird nests in a diversity of habitats. It prefers pastures, lawns, and agricultural lands for feeding. It is a winter migrant in the central and southern Great Plains, sometimes roosting with other blackbird species.
- Rusty blackbirds (*Euphagus carolinus*) nest in northern swamps and muskegs (bogs) throughout Canada, Alaska, and northern New England. They migrate in winter to the southern United States from the Atlantic Coast to east Texas.
- Tri-colored blackbirds (*Agelaius phoeniceus)* overlap ranges and may replace red-winged blackbirds in their restricted range primarily in central California. They are abundant in their range, but are afforded much higher protections than redwings and thus care must be taken in identification prior to management strategies being employed (Dolbeer 1994).

Cormorants

Control

- To the extent practicable, eliminate all fish-bearing water at or near airport.
- Repel using propane exploders, battery-operated alarms, pyrotechnics, Mylar reflective tape, scarecrows, or Bird Gard Laser™.

Cormorants are fish-eating birds. To the extent practicable, eliminate all fish-bearing water at or near the airport. (Photo courtesy S. Hillebrand, U.S. FWS National Digital Library)

- Place netting over ponds, or install bird balls.
- Shoot cormorants.

Legal Status

Cormorants are protected by the Migratory Bird Treaty Act. This act strictly prohibits the capture, killing, or possession of these birds without a special permit. No permits are required to scare depredating migratory birds except for endangered or threatened species, including bald and golden eagles (50 CFR 21.41).

General Biology

Cormorants are fish-eating birds that dive from the surface and swim underwater. They often perch with their wings half open to dry. The double crested cormorant (*Phalacrocorax auritus*) is the most common cormorant in North America. It is the only cormorant that occurs in large numbers inland as well as on both coasts. The sexes are similar in appearance. Adults are entirely black, with small white plumes on their heads during breeding season. Adult cormorants can weigh 4.5 to 5.5 pounds.

Cormorant populations have increased tremendously since DDT was banned in the early 1970s. In 1974 there were less than 100 breeding pairs of cormorants on the Great Lakes. Now there are over 120,000 breeding pairs on the Great Lakes, and the population is continuing to increase.

In breeding colonies where the nests are placed on the ground, young cormorants leave their nests and congregate in groups with other youngsters (creches). They return to their own nests to be fed.

Ducks

Control

- Repel ducks using pyrotechnics or propane exploders.
- Repel ducks using guard dogs.
- Repel ducks using scarecrows.
- Haze ducks using red or green laser lights.
- Repel ducks using chemical repellents such as methyl anthranilate or anthraquinone. (This is very expensive.)
- Institute a feeding ban. Feed bans are also better for the waterfowl.
- Install overhead wires stretched over water areas.
- Install netting over ponds or install bird balls.
- Live capture and relocate ducks (easiest late June to late July).
- Shoot ducks.
- Destroy duck nests and eggs.
- Eliminate or minimize water and wetland habitat on airport property.

Legal Status

All waterfowl are protected by the Migratory Bird Treaty Act. This act strictly prohibits the capture, killing, or possession of these birds. A federal depredation permit and in some cases a state depredation permit is needed before any ducks can be taken. No permits are required to scare depredating migratory birds except for endangered or threatened species, including bald and golden eagles (50 CFR 21.41).

General Biology

The food of individual waterfowl species ranges from fish to insects to plants, in various combinations, depending on availability. Waterfowl bills have evolved to allow the exploitation

Top to bottom: American wigeon, mallard duck, northern pintail. (Photos courtesy U.S. FWS National Digital Library; top to bottom: L. Karney, E. and P. Bauer, D. Menke)

of a wide variety of food sources and associated habitats. Even though many species are adapted to feeding in the water, most will readily come on land to take advantage of available food.

Ducks are normally monogamous and solitary nesters. The size of the nesting territory is determined by the aggressiveness of the particular pair of birds. Ducks seek a new mate each year.

Studies indicate many species have a first-year mortality rate of 60% to 70% and a 35% to 40% mortality rate in subsequent years. Life spans of 10 to 20 years for captive ducks and 20 to 30 years for captive geese and swans are not uncommon (Cleary 1994).

European Starlings

Control

- Repel using pyrotechnics, recorded distress or alarm calls, propane exploders, battery-operated alarms, hawk kites, and Mylar flags.
- Use green lasers to help disperse starling roosts. (Starlings do not respond to red lasers.)
- Close all hangar openings larger than 1 in.
- Install porcupine wires (AKA bird spikes—Nixalite™ and Cat Claw™) to prevent roosting on ledges or roof beams.
- Use Avitrol, a restricted-use pesticide that is available in several bait formulations for use as a chemical frightening agent.
- Use Roost-No-More™, Bird Tanglefoot™, or 4-The-Birds™ to discourage starlings from roosting on sites such as ledges, roof beams, or airport signs.
- Use Starlicide toxicant, which is commercially available as pelletized bait.
- Set decoy traps for starlings.
- Shoot starlings.
- Manage airside turf grass as dense uniform monoculture and cut to intermediate heights.
- Remove individual roost trees or trim interior tree branches to eliminate roosting starlings on airport property.

Legal Status

European starlings (*Sturnus vulgaris)* are not protected by federal law and in most cases not by state law. However, laws vary among states so check with state wildlife officials before beginning

European starlings were introduced into a park in New York in the 1880s. Today they range throughout the United States. (Photo courtesy D. Menke, U.S. FWS National Digital Library)

a control program. In addition, state or local laws may regulate or prohibit certain control techniques such as shooting or the use of toxicants.

General Biology

Starlings are robin-sized birds weighing about 3.2 ounces (90 g). Adults are dark with light speckles on the feathers; however, the speckles may not show at a distance. The tail is short, and the wings have a triangular shape when outstretched in flight. Starling flight is direct and swift, not rising and falling like the flight of many blackbirds. The bill of both sexes is yellow during the reproductive cycle (January to June) and dark at other times.

Starlings are found in a wide variety of habitats including cities, towns, farms, ranches, open woodlands, fields, and lawns. Ideal nesting habitat includes areas with trees or other structures that have cavities suitable for nesting and short grass (turf) areas or grazed pastures for foraging. Ideal winter habitat includes areas with structures and/or tall trees for daytime loafing (resting) and nighttime roosting.

Starlings consume a variety of foods, including fruits and seeds of both wild and cultivated varieties. Insects, especially beetle and butterfly lawn grubs, and other invertebrates total about one-half of the diet overall, and are especially important during the spring breeding season. Other food items—including livestock rations and food in garbage cans—become an important food base for wintering starlings (Johnson and Glahn 1994).

Gulls

Control

- Use pyrotechnics and distress calls to chase gulls away.
- Sweep earthworms and other invertebrates from operating surfaces following heavy rains.
- Destroy nests and eggs of gulls nesting at or near airport.
- Shoot gulls to reinforce repellent effects of pyrotechnics and distress calls.
- Display dead gull effigies (lifelike model).
- Install wire grids over ponds to stop roosting.
- Improve general sanitation at the airport by ensuring proper disposal of all garbage and trash.
- Eliminate open garbage dumpsters.
- Cut infield turf to intermediate height (6–14 in.).
- Eliminate off-airport landfills within designated separation criteria.

Legal Status

All species of gulls are protected by the Migratory Bird Treaty Act. These laws strictly prohibit the capture, killing, or possession of these birds. Persons wishing to take gulls must obtain a federal depredation permit, and in some cases a state depredation permit. No permits are required to scare depredating migratory birds except for endangered or threatened species, including bald and golden eagles (50 CFR 21.41).

General Biology

There are about 15 species of gulls regularly found in North America. Gulls are the most frequently reported birds struck by civil aircraft in the United States. From 1990 to 2007, about 20% of all identified bird strikes involved gulls. Gulls range in weight from 0.5 pounds for Bonaparte's gull (*Larus philadelphia)* to 4 pounds for the great black-backed gull *(Larus marinus).* The sexes are identical in plumage but males are generally slightly larger than females. Gulls normally nest near water; however, some species will readily nest on rooftops and similar areas. Gulls will eat almost anything. Fish and insects may be the preferred food, but gulls are not averse to dining at the local landfill (Cleary and Dolbeer 2005).

Top to bottom: laughing gulls, great black-backed gulls, herring gull, ring-billed gull. (Photos: top and middle courtesy D. Dewhurst, U.S. FWS National Digital Library; bottom courtesy U.S. FWS National Digital Library)

Herons, Egrets, and Cranes

Control

- Repel using propane exploders, battery-operated alarms, pyrotechnics, Mylar reflective tape, scarecrows, or green lasers.
- Eliminate prey species such as field mice and large insects.
- To the extent practicable, eliminate all fish-bearing water at or near airport.
- Harass with border collies or another suitable type of dog.
- Place netting over ponds.
- With all necessary federal and state depredation permits in place, shoot herons, egrets, and cranes.

Legal Status

All herons, egrets, and cranes are protected by the Migratory Bird Treaty Act. This act strictly prohibits the capture, killing, or possession of these birds without a special permit. No permits are required to scare depredating (causing damage) migratory birds except for endangered or threatened species (50 CFR 21.41). **However, Florida sandhill cranes (*Grus canadensis pratenis*) and whooping cranes (*Grus americana*) are classified as threatened or endangered species. These species may not be harassed without a special permit.**

General Biology

Herons, egrets (Order Ciconiiformes), and cranes (Order Gruiformies) are primarily wading birds and spend much of their time in shallow water hunting for food. They all share certain physical characteristics: extremely long legs and long bills in comparison to the rest of their body.

Herons. Herons will normally avoid landing directly in the water to avoid scaring their prey. Instead, they land on the edge and stalk toward the water. These birds prey on a variety of live food such as insects, crustaceans, fish, and amphibians. Generally they are found near wet marshy areas.

Great blue herons (*Ardea herodias*) stand about 70 in. tall and have a 38-in. wingspan. The sexes are similar in appearance. They usually hold their neck in an "S" curve when at rest and in flight. They have a long, thick, yellow bill, and a white crown and face.

Egrets.

- Great egrets (*Ardea alba*) have yellow legs and a single head plume coming from behind the eye. They stand about 32 in. tall and have a 55-in. wingspan. This long-legged, long-necked wading bird usually holds its neck in an "S" curve in flight. Its legs are yellow with black feet. The yellow bill is thick and long. Great egrets frequently feed along streams, ponds, rice fields, and saltwater and freshwater marshes.
- Snowy egrets (*Egretta thula*) are smaller than great egrets and have a black bill and yellow feet. They stand about 29 in. tall. Snowy egrets like both freshwater and saltwater marshes and ponds and rice fields for feeding.
- Cattle egrets (*Bubulcus ibis*) are a relatively new emigrant from Africa. They were first sighted in Florida in the late 1950s. Since that time they have spread throughout the United States and Mexico. They are the smallest egret in North America—about 18 to 24 in. tall. They often hunt and feed in agricultural fields and pastures. Items commonly eaten by cattle egrets include small mammals, insects, and amphibians.

Cranes. Sandhill cranes (*Grus canadensis*) are long-legged, long-necked, gray heron-like birds with a patch of bald red skin on top of their heads. They are slightly taller than great egrets. The sandhill crane stands 40 to 45 in. tall with a wingspan of 5 to 7 ft when fully grown. Cranes

Top to bottom: great blue heron, great egret, Florida sandhill cranes. (Photos: top courtesy J. Cossick, U.S. FWS National Digital Library; middle courtesy L. Karney, U.S. FWS National Digital Library; bottom courtesy J. Metcalf, GOAA)

fly with powerful, rhythmic wing beats and necks outstretched like geese, whereas herons fly with necks tucked in on their backs. For positive identification, look for reddish skin on top of the crane's head. Cranes are quite omnivorous, feeding on seeds, grains, berries, insects, earthworms, mice, small birds, snakes, lizards, frogs, and crayfish. These large birds can be found in both rural and urban areas. The Florida sandhill crane (*Grus canadensis pratenis*) is a subspecies of the North American sandhill crane. Sandhill cranes will normally mate for life and yearly will lie on or in their nest, which is often on the edge of the water for protection from predators.

Mourning Doves

Control

- Repel doves by using pyrotechnics.
- Eliminate feeding, watering, roosting, and nesting sites.
- Discourage people from feeding doves.
- Exclude doves by using either heavy duty netting or hardware cloth so that birds cannot use the area for nesting or perching.
- Clean up spilled grain around grain elevators near airports.
- Eliminate pools of standing water that doves use for watering.
- Change roost ledges to an angle of 45° or more.
- Screen the underside of rafter areas with netting.
- Live trap doves.
- Shoot doves.
- Destroy dove nests and eggs at 2-week intervals.

Legal Status

Mourning doves are protected by the Migratory Bird Treaty Act. Most if not all states also protect mourning doves. Mourning doves may not be taken outside of the legal hunting season without a federal depredation permit, and in some cases, a state depredation permit. A federal depredation permit is not required to scare depredating migratory birds except for endangered or threatened species, including bald and golden eagles (50 CFR 21.41).

General Biology

Mourning doves (*Zenaida macroura*) can cause similar problems to pigeons as they will nest in public structures, underground parking lots, and residential buildings creating the same

Mourning dove. (Photo courtesy D. Menke, U.S. FWS National Digital Library)

unsanitary conditions and damage to property. As they are seed and grain feeders they can cause substantial damage to agricultural crops.

Mourning doves are a long, slim, gray-brown bird with a small head and long pointed tail. The dove's crown, nape, and hind-neck are slate in color, turning grayish, and brown over the rest of the upperparts. They live from southern Canada, throughout the United States, and south to Panama. Mourning doves are found year-round throughout most of their range but northern populations migrate south during the winter. Mourning doves are highly adaptable birds and are found in a wide variety of habitats. They are more common in open woodlands and forest edges near grasslands and fields. They are most abundant in agricultural and suburban areas where humans have created large areas of suitable habitat.

The dove is the most widely hunted game bird in North America. Flocks form year round except in breeding season when the birds pair off. Annual adult mortality is about 55%. In the wild the average life span is about 1.5 years. Adult mourning doves weigh between 3.4 to 6 ounces; males are generally larger than females.

Female mourning doves generally lay two small, white eggs in an open nest. The young leave the nest about 15 days after hatching but remain nearby until they are more accomplished at flying, usually at about 30 days old. Young are able to breed by 85 days old. Mourning doves have the longest breeding season of all North American birds (Emiley and Dewey 2007; Mirarchi and Baskett 1994).

Pigeons

Control

- Repel pigeons by using pyrotechnics or green lasers. Pigeons show little or no response to red lasers.
- Repel pigeons by using chemical repel Avitrol (4-aminopyridine).
- Eliminate feeding, watering, roosting, and nesting sites.
- Discourage people from feeding pigeons.
- Clean up spilled grain around grain elevators near airports.

Rock pigeons were brought to North America by early European settlers for food and to carry messages. Escaped or abandoned birds quickly adapted to conditions in the New World and now can be found in cities and the countryside throughout the Americas. (Photos courtesy USDA)

- Eliminate pools of standing water that pigeons use for watering.
- Exclude pigeons from buildings by blocking access to indoor roosts.
- Change roost ledges to an angle of 45° or more.
- Screen the underside of rafter areas with netting.
- Install porcupine wires (Cat Claw, Nixalite™) on flat surfaces wherever pigeons are prone to roost.
- Reduce pigeon roosting using various nontoxic chemical repellents (polybutenes) such as 4-The-Birds, Hotfoot™, Bird Tanglefoot, Roost-No-More, and Bird-Proof™.
- Use toxicants DRC-1339 (3-chloro-p-toluidine hydrochloride).
- Trap pigeons.
- Shoot pigeons.
- Destroy pigeon nests and eggs at 2-week intervals.

Legal Status

Feral pigeons (rock pigeons) (*Columba livia*) are not protected by federal law and most states do not afford them protection. State and local laws should be consulted, however, before any control measures are taken. Some cities are considered bird sanctuaries that provide protection to all species of birds.

General Biology

Pigeons are found throughout the United States (including Hawaii), southern Canada, and Mexico. Pigeons typically have a gray body with a whitish rump, two black bars on the secondary wing feathers, a broad black band on the tail, and red feet. Body color can vary from gray to white, tan, and black. The average weight is 13 ounces (369 g), and the average length is 11 in. (28 cm).

Pigeons are monogamous. Eight to 12 days after mating, the females lay one or two eggs, which hatch after 18 days. The male provides nesting material and guards the female and the nest. The young are fed pigeon milk, a liquid-solid substance secreted in the crop of the adult (both male and female) that is regurgitated. The young leave the nest at 4 to 6 weeks of age. More eggs are laid before the first clutch leaves the nest. Breeding may occur at all seasons, but peak reproduction occurs in the spring and fall. A population of pigeons usually consists of equal numbers of males and females (Williams and Corrigan 1994).

Raptors – Hawks, Owls, and Eagles

Control

- Repel raptors using propane exploders, battery-operated alarms, pyrotechnics, Mylar reflective tape, or scarecrows.
- Eliminate perch sites at the airport.
- Cap utility poles with sheet metal cones, porcupine wire, or Daddi Long Legs™.
- Cut airside grass short to eliminate habitat for rabbits and field mice.
- Live trap raptors.
- Control rodents and other small mammals at airport to reduce prey base.
- Shoot raptors. (You must have a federal depredation permit and, in some cases, a state depredation permit.)

Legal Status

All hawks, owls, and eagles are protected by the Migratory Bird Treaty Act. These laws strictly prohibit the capture, killing, or possession of hawks, owls, or eagles without a special permit. No permits are required to scare depredating migratory birds **except for endangered or threatened**



Left to right: peregrine falcon, barn owl, golden eagle. (Photos: peregrine, E. Cleary; owl, C. F. Zeillemaker, U.S. FWS National Digital Library; eagle, G. Gentry, U.S. FWS National Digital Library)

species, including bald and golden eagles (50 CFR 21.41). Bald and golden eagles may not be harassed without a special permit issued by the U.S. Fish and Wildlife Service.

General Biology

Hawks, owls, and eagles are birds of prey and are frequently referred to as raptors. Food habits vary greatly among the raptors. Raptors are highly specialized predators that take their place at the top of the food chain.

Hawks. There are two main groups of hawks: accipiters and buteos. Accipiters are forest-dwelling hawks. Accipiters are rarely seen except during migration because they inhabit forested areas and are more secretive than many of the buteos.

The buteos are known as the broad-winged or soaring hawks. They are the most commonly observed raptors in North America. All buteos have long, broad wings and relatively short, fan-like tails. These features enable them to soar over open country during their daily travels and seasonal migrations.

The red-tailed hawk (*Buteo jamaicensis*) is one of our most widely distributed and commonly observed raptors. Red-tailed hawks can be found over the entire North American continent south of the treeless tundra and in much of Central America. Typical eastern red-tailed hawks nest in mature forests and woodlots, while in the Southwest they often nest on cliffs or in trees and cacti. Their diet usually contains large numbers of rodents and other small mammals.

Owls. Owls, unlike hawks, are almost entirely nocturnal. Thus, they are far more difficult to observe, and much less is known about them. They have large heads and large, forward-facing eyes. Their flight is described as noiseless and moth-like. There are 19 species of owls in the continental United States. They range in size from the tiny, 5- to 6-in. (12- to 15-cm) elf owl (*Micrathene whitneyi*) that resides in the arid Southwest, to the large, 24- to 33-in. (60- to 84-cm) great gray owl (*Strix nebulosa*) that inhabits the dense boreal forests of Alaska, Canada, and the northern United States (Hygnstrom and Craven 1994).

Eagles. There are two species of eagles in the United States, bald eagles (*Haliaeetus leucocephalus)* and golden eagles *(Aquila chrysaetos)*. Golden eagles generally hunt small mammals, and bald eagles prefer fish. However, both will readily take whatever is available. In some areas bald eagles are commonly seen feeding at the local garbage dump (O'Gara 1994).

The resident Canada goose population is increasing at about 13% a year. (Photo E. Cleary)

Resident Canada Geese

Control

- Repel geese using pyrotechnics or propane exploders.
- Repel geese using the chemical repellents methyl anthranilate or anthraquinone.
- Repel geese using border collies.
- Repel geese using scarecrows.
- Haze geese with a red or green laser.
- Install physical barriers such as wire grids or netting over ponds.
- Shoot geese.
- Destroy geese nests and eggs.
- Live capture and relocate geese (easiest late June to late July).
- Eliminate water and wetland vegetation on airport property.
- Eliminate agriculture on airport property.

Legal Status

Resident Canada geese (*Branta canadensis*) are Canada geese that nest within the lower 48 States in the months of March, April, May, or June, or reside within the lower 48 States and the District of Columbia in the months of April, May, June, July, or August (50 CFR 21.3). Resident Canada geese may be taken within a 3-mile radius of National Plan of Integrated Airport Systems' airports. Airports and/or their agents must first obtain all necessary authorizations from landowners for all management activities conducted outside the airport's boundaries, and they must be in compliance with all state and local laws and regulations [50 CFR Part 21.49 d (5)]. Resident Canada geese may be taken between April 1 and September 15. The destruction of resident Canada goose nests and eggs may take place between March 1 and June 30 [50 CFR Part 21.49 d (3)].

General Biology

Canada geese are normally monogamous and solitary nesters. Pair formation in geese tends to be permanent until one of the pair dies; the remaining bird will often re-mate. Canada geese lay an egg every other day until the clutch is complete. Incubation is not started until the last or next-to-the-last egg is laid; thus all the eggs hatch at about the same time. Life spans of 20 years for captive geese are not uncommon (Cleary 1994).

CHAPTER 2

Recognizing Hazardous Wildlife Attractants at or near General Aviation Airports

This Beachcraft Baron struck an 80 lb chow dog that ran in front of it during a night departure. The center landing gear collapsed and both propellers struck the ground. (Photo courtesy FAA)

Introduction

Land use practices and habitat are the key factors determining the wildlife species and the size of wildlife populations that are attracted to airport environments. The recognition and control of these land use practices and habitats at or near airports that attract hazardous wildlife are fundamental to effective wildlife hazard management plans.

The FAA has published a number of Advisory Circulars and CertAlerts that provide guidance to airports certificated under 14 CFR 139 on dealing with management of hazardous wildlife at or near airports. A list of these ACs and CertAlerts can be found in Appendix C, along with Web links to sites where these documents can be read and/or downloaded at no charge. Much

Landfills that do not accept putrescible waste are not as attractive to birds as those that do. (Photo E. Cleary)

of the material presented in this chapter was derived from these various ACs and CertAlerts. The information contained in them is intended for certificated airports. However, operators of non-certificated airports may find the information useful in dealing with wildlife problems at their airports as well. Through the Grant Assurances, obligated GA airports are required to meet the standards established in some of the ACs.

Separation Criteria for Hazardous Wildlife Attractants at or near Airports

The minimum separation criteria outlined below are recommended for land use practices that attract hazardous wildlife to the vicinity of airports. Please note that these criteria include land uses that cause movement of hazardous wildlife onto, into, or across the approach or departure airspace, air operation area (AOA), loading ramps (apron areas), or aircraft parking areas of airports.

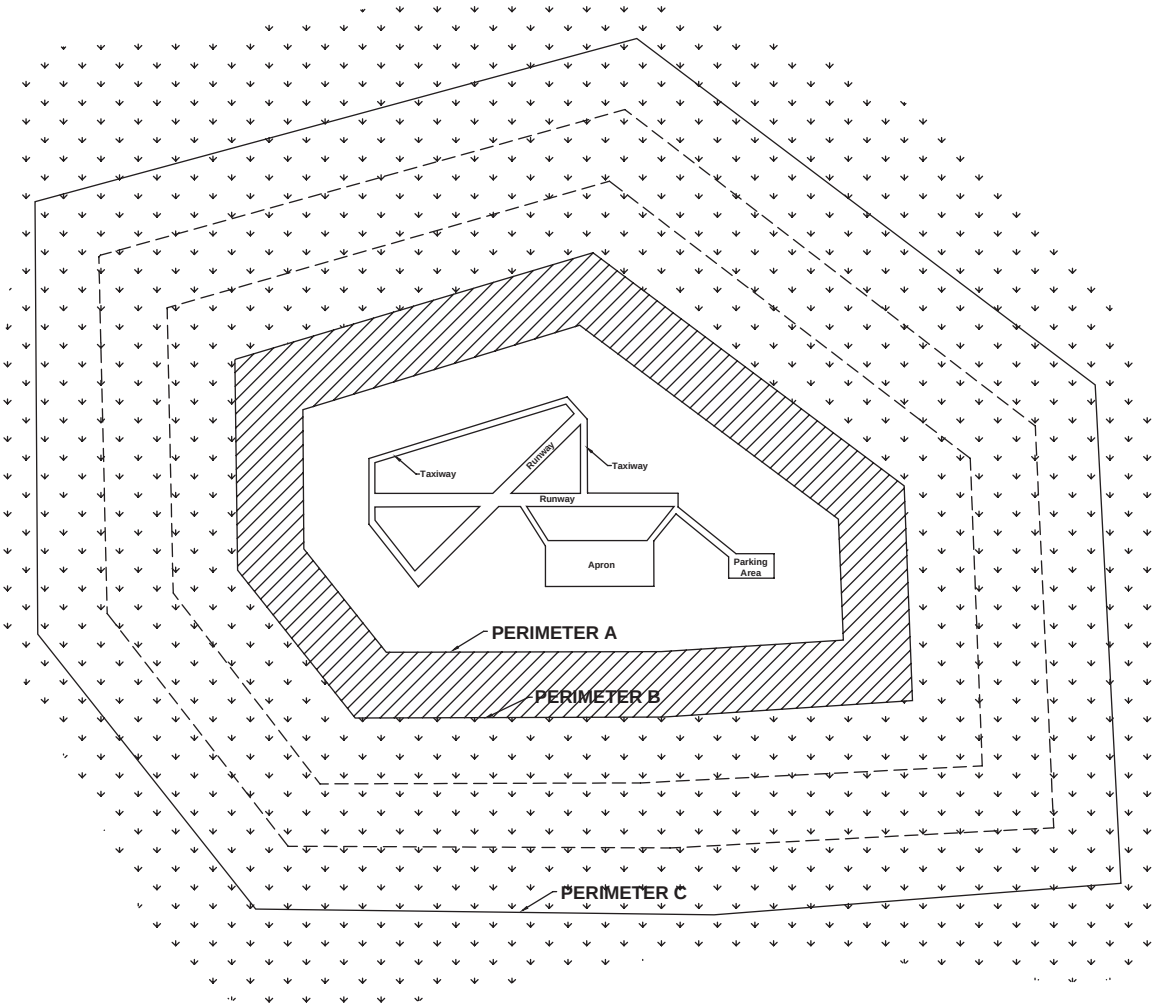
The basis for the separation criteria contained in this section can be found in existing FAA regulations. The separation distances are based on:

1. The flight patterns of piston-powered aircraft and turbine-powered aircraft.
2. The altitude at which most strikes happen (81% occur at under 1,000 ft AGL and 92% occur at under 3,000 ft AGL).
3. National Transportation Safety Board (NTSB) recommendations.

The recommended separation distances are diagramed in Figure 2.1.

Airports Serving Piston-Powered Aircraft

Airports that do not sell Jet-A fuel normally serve piston-powered aircraft. Notwithstanding more stringent requirements for specific land uses, a minimum separation distance of 5,000 ft is recommended at these airports for known hazardous wildlife attractants or for new airport development projects meant to accommodate aircraft movement. This distance is to be maintained between an airport's AOA, loading ramps (apron areas), and aircraft parking areas and the hazardous wildlife attractant. Figure 2.1 depicts this separation distance measured from the nearest AOA.



Perimeter A:

For airports serving piston-powered aircraft, hazardous wildlife attractants must be 5,000 ft from the nearest air operations area.

Perimeter B:

For airports serving turbine-powered aircraft, hazardous wildlife attractants must be 10,000 ft from the nearest air operations area.

Perimeter C:

This is a 5-statute-mile range to protect approach, departure, and circling airspace.

Figure 2.1. Separation distances within which hazardous wildlife attractants should be avoided, eliminated, or mitigated. (Diagram taken from FAA AC 5150/5200-33,* Hazardous Wildlife Attractants on or near Airports*.)

In the late fall and winter, blackbirds and starlings will form large nighttime roosts. Here over 10,000 blackbirds are roosting near a large southern U.S. airport. (Photo R. Dolbeer)

Airports Serving Turbine-Powered Aircraft

Airports selling Jet-A fuel normally serve turbine-powered aircraft. Notwithstanding more stringent requirements for specific land uses, a minimum separation distance of 10,000 ft is recommended at these airports for known hazardous wildlife attractants or for new airport development projects meant to accommodate aircraft movement. This distance is to be maintained between an airport's AOA, loading ramps (apron areas), and aircraft parking areas and the hazardous wildlife attractant. Figure 2.1 depicts this separation distance measured from the nearest AOA.

Protection of Approach or Departure Airspace

For all airports, a minimum separation distance of 5 statute miles is recommended between the farthest edge of the airport's AOA and a known hazardous wildlife attractant if the attractant could cause movement of hazardous wildlife into or across the approach or departure airspace. Figure 2.1 depicts this separation distance measured from the nearest AOA.

Land Use Practices That Potentially Attract Hazardous Wildlife

The wildlife species and the size of the populations attracted to the airport environment vary considerably, depending on several factors, including land use practices at or near the airport. This section discusses land use practices having the potential to attract hazardous wildlife and threaten aviation safety.

Waste Disposal Operations

Municipal solid waste landfills (MSWLF) are known to attract large numbers of hazardous wildlife, particularly birds. Because of this, these operations, when located closer than the recommended separation distances (see the previous section entitled "Separation Criteria for Hazardous Wildlife Attractants at or near Airports" and Figure 2.1), are considered incompatible with safe airport operations.

Over 3,000 black vultures were counted at this landfill. Many of the birds soared to over 1,500 ft AGL. (Photo E. Cleary)

Siting New Municipal Solid Waste Landfills

Do not locate new MSWLFs closer than the recommended separation distances. Measure the separation distances from the closest point of the airport's AOA to the closest planned MSWLF cell.

Considerations for Existing Waste Disposal Facilities within the Limits of Separation Criteria

Do not locate airport development projects that would increase the number of aircraft operations or accommodate larger or faster aircraft near MSWLF operations within the separation distances identified in AC 150/5200-33 (see Figure 2.1). In addition, in accordance with 40 CFR 258.10, owners or operators of existing MSWLF units that are closer than the recommended separation distances must demonstrate that the unit is designed and operated in such a way that it does not pose a bird hazard to aircraft.

Well over 5,000 gulls were attracted daily to this landfill. In addition, vultures, pigeons, and other birds were also attracted. (Photo courtesy USDA)

To claim successfully that a waste-handling facility sited closer than the recommended separation distances does not attract hazardous wildlife and does not threaten aviation, the developer must establish convincingly that the facility will not handle putrescible material (organic matter) other than in fully enclosed transfer stations (see the section entitled "Trash Transfer Stations" later in this chapter).

In their effort to satisfy the United States Environmental Protection Agency (U.S. EPA) requirement, some putrescible waste facility proponents might offer to undertake experimental measures to demonstrate that their proposed facility will not be a hazard to aircraft. To date, no such facility has been able to demonstrate an ability to reduce and sustain hazardous wildlife to levels that existed before the putrescible waste landfill began operating. For this reason, the FAA does not consider the demonstration of experimental wildlife control at putrescible waste landfills within the separation distances specified in AC 150/5200-33 to be an acceptable alternative to locating the landfill beyond the separation distances.

Trash Transfer Stations

Enclosed waste-handling facilities that receive garbage behind closed doors; process it via compaction, incineration, or a similar manner; and remove all residue by enclosed vehicles generally are compatible with safe airport operations, provided they are not located on airport property or within the runway protection zone (RPZ). Putrescible waste cannot be handled or stored outside or in a partially enclosed structure accessible to hazardous wildlife at these facilities. Trash transfer facilities that leave the main doors open during normal operations, are open on one or more sides, temporarily store uncovered quantities of municipal solid waste outside, use semi-trailers that leak or have trash clinging to the outside, or do not control odors by ventilation and filtration systems (odor masking is not acceptable) do not meet the FAA's definition of fully enclosed trash transfer stations. The FAA considers these facilities incompatible with safe airport operations if they are located closer than the recommended separation distances (see the section entitled "Separation Criteria for Hazardous Wildlife Attractants at or near Airports" and Figure 2.1).

Composting Operations on or near Airport Property

The FAA recommends against locating composting operations on airport property even though composting operations that accept only yard waste (e.g., leaves, lawn clippings, or

Fully enclosed trash transfer stations, such as the one shown here, generally do not attract birds. (Photo courtesy USDA)

Composting operations that do not accept putrescible waste generally will not attract birds. (Photo E. Cleary)

branches) generally do not attract hazardous wildlife. Sewage sludge, woodchips, and similar material are not municipal solid wastes and may be used as compost bulking agents. The compost, however, must never include food or other municipal solid waste. Do not locate composting operations that are off of airport property closer than the greater of the following distances: 1,200 ft from any AOA, loading ramp (apron areas), or aircraft parking space, or the distance called for by airport design requirements (see AC 150/5300-13, Airport Design). This spacing is meant to prevent material, personnel, or equipment from penetrating any object free area (OFA), obstacle free zone (OFZ), threshold siting surface (TSS), or clearway. Monitor composting operations located in proximity to the airport to ensure that steam or thermal rise does not adversely affect air traffic. On-airport disposal of compost by-products is not recommended.

Underwater Waste Discharges

The underwater discharge of any food waste (e.g., fish processing offal) closer than the recommended separation distances (see the section entitled "Separation Criteria for Hazardous Wildlife Attractants at or near Airports" and Figure 2.1) is not recommended because it could attract scavenging hazardous wildlife.

Recycling Centers

In most cases, recycling centers that accept previously sorted nonfood items, such as glass, newspaper, cardboard, or aluminum, are not attractive to hazardous wildlife and are acceptable.

Construction and Demolition Debris Facilities

Construction and demolition (C&D) debris landfills do not generally attract hazardous wildlife and are acceptable if they are maintained in an orderly manner, they admit no putrescible waste, and they are not co-located with putrescible waste disposal operations. C&D landfills have similar visual and operational characteristics to putrescible waste disposal sites. When co-located with putrescible waste disposal operations, C&D landfills are more likely to attract hazardous wildlife because of the similarities between these disposal facilities. Site C&D landfills co-located with putrescible waste disposal operations outside of the recommended separation distances (see the section entitled "Separation Criteria for Hazardous Wildlife Attractants at or near Airports" and Figure 2.1).

Trash collection stations, if clean and well maintained, generally do not attract hazardous wildlife. (Photo E. Cleary)

Fly Ash Disposal

The incinerated residue from resource recovery power/heat-generating facilities that are fired by municipal solid waste, coal, or wood is generally not a wildlife attractant because it no longer contains putrescible material. Landfills accepting only fly ash are generally not considered to be wildlife attractants and are acceptable as long as they are maintained in an orderly manner, they admit no putrescible waste of any kind, and they are not co-located with disposal operations that attract hazardous wildlife.

Since varying degrees of waste consumption are associated with general incineration (not resource recovery power/heat-generating facilities), the FAA considers the ash from general incinerators a regular waste disposal by-product and, therefore, a hazardous wildlife attractant if disposed of closer than the recommended separation distances.

Water Management Facilities

Drinking water intake and treatment facilities, storm water and wastewater treatment facilities, associated retention and settling ponds, ponds built for recreational use, and ponds that result from mining activities often attract large numbers of potentially hazardous wildlife. To prevent wildlife hazards, land use developers and airport operators might need to develop management plans, in compliance with local and state regulations, to support the operation of storm water management facilities on or near public-use airports to ensure a safe airport environment.

Existing Storm Water Management Facilities

On-airport storm water management facilities allow the quick removal of surface water, including discharges related to aircraft deicing, from impervious surfaces such as pavement and terminal/hangar building roofs. Existing on-airport detention ponds collect storm water, protect water quality, and control runoff. Because they slowly release water after storms, they create standing bodies of water that can attract hazardous wildlife [14 CFR 139.337(a)]. Using appropriate wildlife hazard mitigation techniques, airport management should take immediate corrective actions to address any wildlife hazards arising from existing storm water or other such

Storm water detention basins should be designed to drain completely within 48 hours following the design storm. See next photo. (Photo courtesy USDA)

facilities located on or near an airport. In consultation with a qualified airport wildlife biologist, airport management should develop measures to minimize attraction of hazardous wildlife. The FAA established the standards for a qualified airport wildlife biologist in 2007. These qualifications are published in AC 150/5200-36.

Where possible, modify storm water detention ponds to allow a maximum 48-hour detention period for the design storm. Avoid the use of or remove retention ponds and detention ponds featuring long-term storage to eliminate standing water. Design or modify detention basins to remain totally dry between rainfalls. Where constant flow of water is anticipated through the basin, or where any portion of the basin bottom may remain wet, include a concrete or paved channel or gravel lined ditch/swale in the bottom to prevent vegetation that may provide cover and food for wildlife.

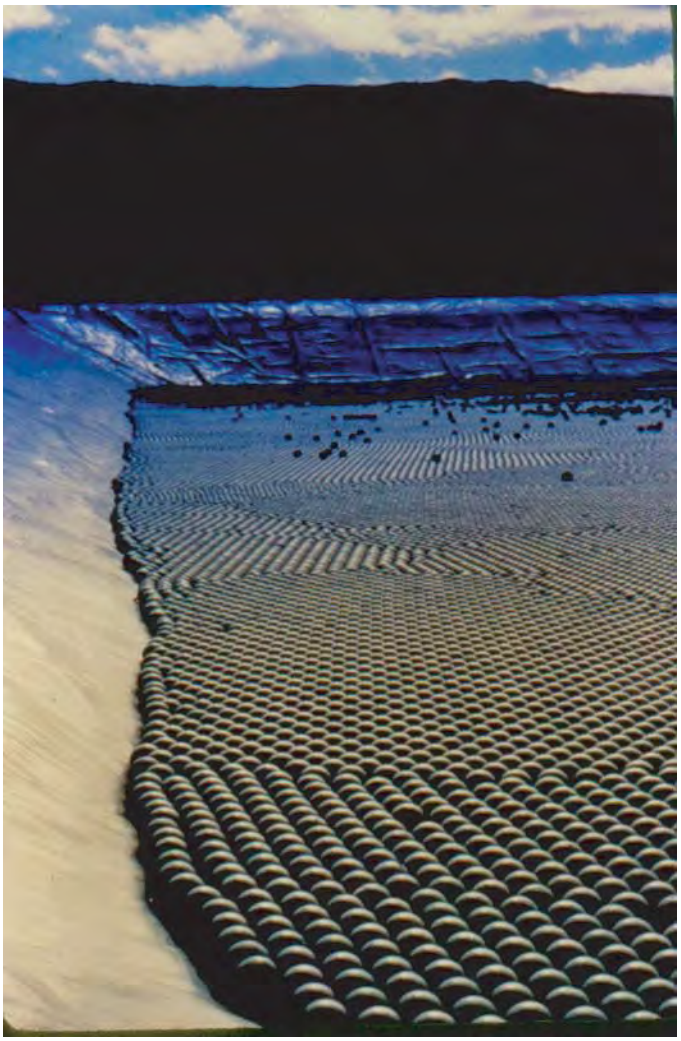
This is the storm water detention pond shown in the previous photo, almost completely drained following an early spring rainstorm. (Photo courtesy USDA)

When it is not possible to drain a large detention pond completely, use physical barriers, such as bird balls, wire grids, pillows, or netting, to deter birds and other hazardous wildlife. When physical barriers are used, carefully evaluate their use and ensure that they will not adversely affect water rescue. Before installing any physical barriers over detention ponds on Part 139 certificated airports, obtain approval from the appropriate FAA Regional Airports Division Office.

Encourage off-airport storm water treatment facility operators to incorporate appropriate wildlife hazard mitigation techniques into storm water treatment facility operating practices when their facility is closer than the recommended separation distances (see the section entitled "Separation Criteria for Hazardous Wildlife Attractants at or near Airports" and Figure 2.1).

New Storm Water Management Facilities

Design and operate off-airport storm water management systems located closer than the recommended separation distances so as not to create aboveground standing water. Design, construct, and maintain on-airport storm water detention ponds for a maximum 48-hour detention period for the design storm so the ponds remain completely dry between storms. Use steep-



Bird balls in use near an airport. (Photo J. Allan, Central Science Laboratory, UK)

sided, narrow, linearly shaped water detention basins to facilitate the control of hazardous wildlife. When it is not possible to place these ponds away from the AOA, use physical barriers, such as bird balls, wire grids, pillows, or netting, to prevent access of hazardous wildlife to open water and minimize aircraft-wildlife interactions (refer to Chapter 3 for a discussion of these methods). When using physical barriers, ensure that they will not adversely affect water rescue. States or local jurisdictions may have regulations governing the installation of some types of physical barriers on wetlands. Eliminate all vegetation in or around detention basins that provides food or cover for hazardous wildlife. If soil conditions and other requirements allow, use underground storm water infiltration systems, such as French drains or buried rock fields, because they are less attractive to wildlife.

Existing Wastewater Treatment Facilities

Immediately correct any wildlife hazards arising from existing wastewater treatment or similar facilities located at or near the airport (14 CFR 139.337). Encourage wastewater treatment facility operators to incorporate measures developed in consultation with a qualified airport wildlife biologist to minimize hazardous wildlife attractants. Encourage wastewater treatment facility operators to incorporate these mitigation techniques into their standard operating practices. In addition, consider the existence of wastewater treatment facilities when evaluating proposed sites for new airport development projects and avoid such sites when practicable.

New Wastewater Treatment Facilities

Do not construct new wastewater treatment facilities or associated settling ponds closer than the recommended separation distances (see the section entitled "Separation Criteria for Hazardous Wildlife Attractants at or near Airports" and Figure 2.1). Consider the potential to attract hazardous wildlife during the site location analysis for wastewater treatment facilities if an airport is in the vicinity of the proposed site. Work with local governing bodies and zoning boards to oppose such facilities if they are closer than the recommended separation distances.

Artificial Marshes

In warmer climates, wastewater treatment facilities sometimes employ artificial marshes and use submergent and emergent aquatic vegetation as natural filters. These artificial marshes may be used by various species of birds, such as blackbirds and waterfowl, for nesting, feeding, or roosting. Do not establish artificial marshes closer than the recommended separation distances.

Over 10,000 cattle egrets were seen around this wastewater treatment facility. (Photo E. Cleary)

Wastewater Discharge and Sludge Disposal

Do not discharge wastewater or sludge on airport property because it may improve soil moisture and quality on unpaved areas and lead to improved turf growth that can be an attractive food source for many species of grazing animals such as deer and geese. Also, the turf requires more frequent mowing, which in turn might mutilate or flush insects or small animals and produce thatch, both of which can attract hazardous wildlife. Problems might also occur when discharges saturate unpaved airport areas. The resultant soft, muddy conditions can severely restrict or prevent emergency vehicles from reaching accident sites in a timely manner.

Before starting any wetland modification project, contact the state department responsible for environmental issues (such as DEQ, DEP, or DNR) to obtain guidance on wetland classifications, mitigation and wetland fill permitting requirements, and mitigation banking opportunities.

Wetlands

Wetlands provide a variety of functions and can be regulated by local, state, and federal laws. Wetlands typically attract diverse species of wildlife, including many that rank high on the list of hazardous wildlife species (Figure 7.1).

If questions exist as to whether an area qualifies as a wetland, contact the local division of the U.S. Army Corps of Engineers, the Natural Resources Conservation Service, or a wetland consultant qualified to delineate wetlands. A Memorandum of Agreement (MOA) among six federal agencies was signed in 2003 to facilitate, among other things, resolution of wetland management issues at airports without compromising aviation safety related to wildlife hazards. A copy of the MOA can be downloaded at http://wildlife-mitigation.tc.faa.gov/public_html/index.html.

This wetland is less than 500 ft from a major airport runway. A Canada goose nest is situated at the base of the middle large tree. (Photo E. Cleary)

Existing Wetlands on or near Airport Property

If wetlands are located on or near airport property, be alert to any wildlife use or habitat changes in these areas that could affect safe aircraft operations. Working in cooperation with local, state, and federal regulatory agencies, airports should immediately correct any wildlife hazards arising from existing wetlands located at or near airports. Develop measures to minimize attraction of hazardous wildlife in consultation with a qualified airport wildlife biologist (AC 150/5200-36).

New Airport Development

Whenever possible, locate new airports using the separation criteria from wetlands identified in AC 150/5200-33 (see Figure 2.1). Where alternative sites are not practicable, or when expanding an existing airport into or near wetlands, in consultation with a qualified airport wildlife biologist, the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, and the state wildlife management agency, evaluate the wildlife hazards and develop a plan for eliminating or minimizing the hazards.

Mitigation for Wetland Impacts from Airport Projects

Wetland mitigation might be necessary when wetland disturbances result from new airport development projects or projects required to correct wildlife hazards from wetlands. Wetland mitigation must be designed so it does not create a wildlife hazard. Locate wetland mitigation projects that may attract hazardous wildlife outside of the separation criteria identified in AC 150/5200-33 (Figure 2.1).

On-Site Mitigation of Wetland Functions

The FAA may consider exceptions to locating mitigation activities outside the separation criteria identified in AC 150/5200-33 if the affected wetlands provide unique ecological functions, such as critical habitat for threatened or endangered species or for groundwater recharge, which cannot be replicated when moved to a different location. Using existing airport property is sometimes the

This mitigation site on a large western airport creates habitat for an endangered species. However, it also attracts waterfowl and other birds that pose a threat to aircraft safety. (Photo courtesy USDA)

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This Army Corps of Engineers wetland mitigation site is adjacent to taxiways and runways on a major U.S. airport. Airport operators should actively oppose locating mitigation sites next to airports. (Photo courtesy USDA)

only feasible way to achieve the mitigation ratios mandated in regulatory orders and settlement agreements with the resource agencies. Conservation easements are an additional means of providing mitigation for project impacts.

Mitigation must not inhibit the airport operator's ability to effectively control hazardous wildlife on or near the mitigation site or effectively maintain other aspects of safe airport operations. Avoid enhancing such mitigation areas to attract hazardous wildlife. A qualified airport wildlife biologist should review any onsite mitigation proposals to determine compatibility with safe airport operations. In cooperation with a qualified airport wildlife biologist, evaluate any wetland mitigation projects that are needed to protect unique wetland functions and that must be located in the separation criteria in AC 150/5200-33 before the mitigation is implemented. Develop a wildlife hazard management plan (WHMP) to reduce any identified wildlife hazards. (Also see CertAlert 06-07 regarding state-listed threatened and endangered species.)

Off-Site Mitigation of Wetland Functions

Site wetland mitigation projects that might attract hazardous wildlife outside of the separation criteria identified in AC 150/5200-33 unless they provide unique functions that must remain on site [AC 150/5200-33, § 2-4c(1)]. Agencies that regulate impacts to or around wetlands recognize that it may be necessary to split wetland functions in mitigation schemes. Therefore, regulatory agencies may, under certain circumstances, allow portions of mitigation to take place in different locations.

Mitigation Banking

Wetland mitigation banking is the creation or restoration of wetlands in order to provide mitigation credits that can be used to offset permitted wetland losses. Mitigation banking benefits wetland resources by providing advance replacement for permitted wetland losses; consolidating small projects into larger, better-designed and managed units; and encouraging integration of wetland mitigation projects with watershed planning. This last benefit is most helpful for airport projects because wetland impacts mitigated outside of the separation criteria identified in AC 150/5200-33 can still be located within the same watershed. Wetland mitigation banks meeting the separation criteria offer an ecologically sound approach to mitigation in these situations.

When this Army Corps of Engineers dredge spoil containment area (right) first opened, over 20,000 Bonaparte's gulls wintered on it. The runway of a midwestern airport (left) is less than 100 ft from the containment area. (Photo E. Cleary)

Working with local watershed management agencies or organizations, develop mitigation banking for wetland impacts on airport property.

Dredge Spoil Containment Areas

Do not locate dredge spoil containment areas (also known as confined disposal facilities) within the separation criteria identified in AC 150/5200-33 if the containment area has standing water or the spoils contain material that would attract hazardous wildlife.

Agricultural Activity

Most, if not all, agricultural crops can attract hazardous wildlife during some phase of production. Do not use airport property for crop production, including hay crops, within the separation criteria identified in AC 150/5200-33.

Crop Production

If the airport has no financial alternative to agricultural crops to produce income necessary to maintain the viability of the airport, then the airport must follow the crop distance guidelines listed in the table titled "Minimum Distances between Certain Airport Features and Any On-Airport Agricultural Crops" found in AC 150/5300-13, *Airport Design.* Avoid production of cereal grains and sunflowers. Weigh the cost of wildlife control and potential accidents against the income produced by the on-airport crops when deciding whether to allow crops on the airport.

Livestock Production

Confined livestock operations (i.e., feedlots, dairy operations, hog or chicken production facilities, or egg-laying operations) often attract flocking birds, such as starlings, that pose a hazard to aviation. Therefore, keep such facilities outside of the separation criteria identified in AC

Hundreds of pigeons were attracted to this cattle feedlot. Feedlots should be outside the recommended separation distances. (Photo courtesy U.S. FWS)

150/5200-33. Develop a program to reduce the attractiveness of any livestock operation within these separation distances. Do not graze free-ranging livestock on airport property because the animals might wander onto the AOA. Livestock feed, water, and manure might also attract hazardous wildlife.

Aquaculture

Aquaculture activities (such as catfish, trout, and bait fish production) conducted outside of fully enclosed buildings are inherently attractive to a variety of birds. Existing aquaculture facilities/activities within the separation criteria listed in AC 150/5200-33 must have a program developed to reduce the attractiveness of the sites to species that are hazardous to aviation safety. Oppose the establishment of new aquaculture facilities/activities within the separation criteria listed in AC 150/5200-33.

Alternative Uses of Agricultural Land

Some airports are surrounded by vast areas of farmed land within the distances specified in AC 150/5200-33. Seasonal uses of these agricultural lands for activities such as waterfowl hunting can create a hazardous wildlife situation. Rice farmers, for example, might flood their land during waterfowl hunting season and obtain additional revenue by renting out duck blinds. The duck hunters, using decoys and calls, draw in large numbers of birds, creating a threat to aircraft safety. It is recommended that a qualified airport wildlife biologist review, in coordination with local farmers and airport management, these types of seasonal land uses. Restrictions to seasonal land uses that are incompatible with aviation safety should be incorporated into the WHMP.

Airside Vegetation Management

Managing the airside vegetation to minimize the area's attractiveness to hazardous wildlife is the best way of reducing the strike risk at an airport. Properly managed turf grass can be highly effective in deterring a variety of hazardous wildlife species. Research conducted by the U.S. Department of Agriculture–Wildlife Services (USDA/WS) National Wildlife Research Center has shown that no one grass management regime will deter all species of hazardous wildlife in

A mix of grass, brush, and trees provide near ideal habitat for many birds and mammals that can pose a threat to aircraft. Whenever possible, manage the airside vegetation to eliminate all brush and trees. (Photo E. Cleary)

all situations. Since airports rarely deal with only one species of hazardous wildlife, a compromise regime to affect the collective majority of species is necessary. Managing for only one species will generally cause other species to be attracted in its place. Research from around the world has shown that a dense, uniform stand of grass without broad-leaved weedy vegetation or openings will effectively deter the majority of species since most wildlife cannot digest grass or subsist on a grass diet. (However, there are exceptions such as geese.) In addition to maintaining turf grass, the height of the grass is important to further deter birds and other wildlife, especially flocking species. Intermediate height is recommended and generally should be maintained between 6 and 12 in. The Department of Defense has conducted numerous studies on several continents and most of the United States and mandates that grass be maintained between 7 and 14 in. to

Do not landscape airports with plants that produce fruits, nuts, or berries. The berries on these bushes are highly attractive to cedar waxwings and other small birds. (Photo R. Dolbeer)

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It is extremely important to keep the airside as unattractive as possible to hazardous wildlife, especially when there are other hazardous wildlife attractants such as lakes and dense vegetation close to the airport. (Photo E. Cleary)

accomplish these goals. Such research has found that flocking bird species are effectively deterred because the intermediate height:

- Disrupts visual communication systems;
- Prevents predator detection;
- Obscures invertebrate food sources in the soil and on vegetation;
- Requires additional energy expenditure for movement;
- Limits weed growth; and
- Slows vegetative growth rates.

It is important to recognize that the intermediate height recommendation encompasses a range, as some species will begin to seed below the upper threshold and should be mown before seed head development. Seeds will attract birds, rodents, and other animals and if the vegetation becomes too tall, mower operation becomes difficult and other vegetation may begin to encroach on turf grasses. The intermediate turf height should be maintained over the entire infield, including to the edges of operating surfaces. Elevated lights and signs can remain visible above the lower threshold of recommended grass height, and airports should not mow the edges of these surfaces at lower standards as hazardous wildlife can be attracted to the most vulnerable areas of the field if shorter grass is supported along these surfaces.

In cooperation with a qualified airport wildlife biologist, develop airport turf grass management plans and appropriate seed mixtures to meet the objective of uniform turf species at proper heights and adapted to the local environment and climate conditions.

Ensure that plant varieties attractive to hazardous wildlife are not used on the airport. Do not plant disturbed areas or areas in need of re-vegetating with seed mixtures containing millet or any other large-seed producing grass. On airport property already planted with seed mixtures containing millet, rye grass, or other large-seed producing grasses, prevent plant maturation and seed head production by the use of disking, plowing, or another suitable agricultural practice. Follow the specific recommendations for grass management and seed and plant selection made by the state university cooperative extension service, the local office of USDA/WS, or a qualified airport wildlife biologist. In addition, wherever possible, eliminate broad-leaved weeds, brush,

trees, and wetland vegetation anywhere within the AOA to reduce attractiveness to hazardous birds and other wildlife.

Some airports exist in areas of the country where turf grasses cannot be supported due to adverse soil or climate conditions, and other vegetation species may be considered. In extreme cases such as desert environments, alternate cover such as sealed gravel may be effective at deterring hazardous wildlife species. Where necessary, develop alternate management strategies in cooperation with a qualified airport wildlife biologist.

Landscaping, Golf Courses, and Other Land Use Considerations

Landscaping and Landscape Maintenance

Depending on geographic location and plant selection and spacing, airport landscaping can attract hazardous wildlife. Approach landscaping with caution, and confine it to airport areas not associated with aircraft movements. In cooperation with a qualified airport wildlife biologist review all landscaping plans. Monitor all landscaped areas on a continuing basis for the presence of hazardous wildlife. If hazardous wildlife is detected, take corrective action immediately.

Consider developing and implementing a preferred/prohibited plant species list, reviewed by a qualified airport wildlife biologist, which has been designed for the geographic location to reduce the attractiveness to hazardous wildlife for landscaping airport property. Avoid installation of ponds, fountains, reflecting pools, and other water bodies as part of an airport's landscaping scheme.

Golf Courses

The large grassy areas and open water found on most golf courses are attractive to hazardous wildlife, particularly Canada geese, mallards, and gulls. These species can pose a threat to aviation safety. Do not site new golf courses within the separation criteria identified in AC 150/5200-33. Existing golf courses located within these separation distances must develop a program to reduce the attractiveness of the sites to species that are hazardous to aviation safety. Ensure that these

Golf courses offer resident Canada geese ideal habitat: food, water, and shelter. (Photo courtesy USDA)

These laughing gulls are drinking in a rainwater puddle at a coastal airport's parking lot. At coastal airports, rainwater puddles may be the only source of fresh water, and as such are highly attractive to birds. (Photo courtesy USDA)

golf courses are monitored on a continuing basis for the presence of hazardous wildlife. If hazardous wildlife is detected, take corrective action immediately.

Other Hazardous Wildlife Attractants

Other unique land uses or activities (such as sport or commercial fishing, or shellfish production and harvesting) have the potential to attract hazardous wildlife. Regardless of the source of the attraction, when hazardous wildlife is noted on a public-use airport, airport operators must take prompt remedial action to protect aviation safety.

Synergistic Effects of Surrounding Land Uses

There may be circumstances where two or more different land uses that would not, by themselves, be considered hazardous wildlife attractants or that are located outside of the separation criteria identified in AC 150/5200-33 are in such an alignment with the airport as to create a wildlife corridor directly through the airport and/or surrounding airspace. An example of this situation could involve a lake located outside of the separation criteria on the east side of an airport and a large hayfield on the west side of an airport—land uses that together could create a flyway for Canada geese directly across the airspace of the airport. There are numerous examples of such situations; therefore, airport operators and the qualified airport wildlife biologist must consider the entire surrounding landscape and community when developing any plan to minimize the hazards.

CHAPTER 3

Wildlife Control Strategies and Techniques at General Aviation Airports

Areo County Airport, Frisco, Texas, July 8, 2003. The instructor pilot and student suffered fatal injuries when their aircraft hit what was believed to be a black vulture at 800 ft AGL. (Photo courtesy FAA)

Introduction

Wildlife is attracted to an airport because the airport offers something the wildlife wants or needs. Most often the attractants are food, water, or shelter. Therefore, controlling wildlife problems at or near an airport requires carrying out measures to deny wildlife access to the attractants or reducing their availability. Occasionally it may be necessary to reduce or eliminate specific wildlife species or populations to protect aircraft safety.

Properly installed and maintained fencing will keep most large mammals out of an airport. Places where drains run under the fence should have guards installed to prevent animals from crawling under the fence. (Photo E. Cleary)

Basic Control Strategies

There are five basic strategies airport managers can use to manage hazardous wildlife at or near the airport:

- Repelling techniques: Use of various audio, visual, or chemical repellents to harass and repel problem wildlife.
- Habitat modification: Elimination or reduction of food, water, or shelter attractive to wildlife at or near the airport.
- Exclusion: Use of physical barriers to stop wildlife from gaining access to food, water, or shelter at or near the airport.
- Population management: Reduction or elimination of wildlife populations that are posing a hazard to aircraft at or near the airport by either capturing (live capture and relocation) or killing the problem animals.
- Notices to Airmen (NOTAM) of potential wildlife hazards: Delaying or advancing takeoff and landing times; changing or closure of active runways.

The following presents a general discussion of these control strategies that are applicable to both birds and mammals. After that, specific control strategies for birds and mammals are presented. To be effective, airports need to use a combination of control strategies to deal with wildlife, based upon available resources, including funding, staff, and specific wildlife issues.

Repelling Techniques

Repelling and harassment techniques create psychological barriers by making the area or resource unattractive to wildlife or by making the wildlife uncomfortable or fearful. Long-term, the cost-effectiveness of repelling wildlife usually does not compare favorably with habitat modification or exclusion techniques. No matter how many times wildlife are driven from an area that attracts them, they or other individuals of their species will return as long as the attractant is accessible. However, because habitat modifications and exclusion techniques will not rid an airport of all problem wildlife, repelling techniques are a key part of any GA airport's control efforts for hazardous wildlife.

Dead bird effigies have proven effective repellents. **Remember, depredation permits must be in place before state or federally protected birds can be obtained and used as bird deterrents.** (Photo T. Seamans)

Repellents work by affecting the animal's senses through chemical, auditory, or visual means. When used repeatedly without added reinforcement, wildlife soon learn that the repellent devices or techniques are harmless. The devices become a part of the "background noise," and wildlife ignore them. Habituation of birds and mammals to most repellent devices or techniques is a major problem.

When using repellents, recognize these critical facts:

1. There are no "silver bullets" that will solve all problems. Airport managers will need to implement adaptive control strategies to address the ever-changing threat and risk levels.
2. There is no standard protocol or set of procedures that is best for all situations. Repelling wildlife is an art as much as a science. To be successful, employ motivated, trained, and properly equipped personnel who understand the wildlife situation at their airport.
3. Each wildlife species is unique and will often respond differently to various repellent techniques. Even within a group of closely related species, such as gulls, the various species will often respond differently to various repellent techniques.
4. Minimize habituation to repellent techniques by using each technique sparingly and correctly when the target wildlife is present, by using various repellent techniques in an integrated fashion, and by reinforcing repellents with occasional lethal control (with necessary permits in place) directed at plentiful problem species such as gulls or geese.

Habitat Modification

Habitat modification means changing the environment to make it less attractive to the problem wildlife. All wildlife require food, water, and shelter to survive. Any action that reduces or removes one or more of these elements will result in a proportionate reduction in wildlife population. Habitat modifications to make the airport and surrounding area as unattractive as possible to hazardous wildlife must be the foundation of every GA airport's effort to deal with wildlife problems.

Initially, management actions to reduce or remove food, water, and shelter from an airport might be expensive. However, when costs are spread over several years, these actions could be

This ultrasonic sound generator is not effective. The gulls are using it as a perch and to keep their feet warm. (Photo R. Dolbeer)

the least expensive approach to reducing wildlife populations at the airport. Once a habitat modification is done correctly, it should not be necessary to go back and do it again. Also, these control methods are well accepted by the public and lessen the need to harass or use lethal control.

Some habitat modification projects, such as draining wetlands, may require a permit from either the state department of environmental protection or the U.S. Army Corps of Engineers. Refer to the Chapter 2 section "Mitigation for Wetland Impacts from Airport Projects" for a more detailed discussion of wetland mitigation.

Exclusion Techniques

When food, water, or shelter cannot be removed by habitat modification, then try to exclude the wildlife from the desired resource. Exclusion involves the use of physical barriers—screening, netting, and grid wires—to deny wildlife access to a particular area. As with habitat modification, exclusion techniques, such as installing a covered drainage ditch instead of an open ditch, can initially be costly. However, exclusion provides a permanent solution that is environmentally friendly, and when amortized over many years, the cost is relatively inexpensive.

Population Management Techniques

As previously indicated, repellent techniques, habitat modification, and exclusion are the first lines of action in any GA airport's effort to address problem wildlife. However, these actions will not solve every problem; therefore, hazardous wildlife sometimes must be removed from an airport. Remove hazardous wildlife by lethal means or by capturing and relocating the target animals.

Plastic strips were hung over this drain to stop swallows form nesting in it. (Photo P. Robinson)

Caution:

- **With few exceptions, a federal Migratory Bird Depredation Permit, and often a state permit, is required before taking any migratory birds. As used here, "taking" means either "to capture or kill" or "to attempt to capture or kill" a migratory bird.**
- **A state permit is necessary before taking any state-protected birds or mammals.**
- **Any capturing or killing must be done humanely and only by people who are trained in identification of wildlife species and appropriate techniques for taking.**

The management of wildlife problems at GA airports often generates interest from the public and news media, especially when lethal control methods are to be used. GA airport managers and public relations personnel, employed by the airport or airport sponsor, must be prepared to explain and defend actions taken to protect the flying public from wildlife hazards. If necessary,

Removal of problem wildlife is often necessary as part of an overall wildlife hazard management program. This hawk, captured at a large airport, will be relocated. (Photo courtesy USDA)

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GA airport managers can, and should, seek help from qualified airport wildlife biologists when dealing with the news media on this subject.

Notices to Airmen of Potential Wildlife Hazards

Pilots are the final decision makers as to whether or not to take off or land. They need up-to-date information concerning potentially hazardous conditions at or near the airport to intelligently make such decisions.

Airport managers have a responsibility to advise pilots of potentially hazardous situations, through NOTAMs or other normal channels.

At controlled airports, air traffic control (ATC) personnel have a responsibility to notify pilots of any known hazards, including wildlife at or near the airport.

Strategies and Techniques for Controlling Birds

Repelling Techniques

Repelling problem wildlife involves the use of various audio, visual, or chemical tools designed to make the wildlife feel uncomfortable, apprehensive, or fearful so that they will leave the area. Because most repellents are not lethal, wildlife will quickly habituate to them if they are used repeatedly without occasional lethal reinforcement.

Audio Repellents

Pyrotechnics. There are various projectiles that can be fired from breech-loaded shotguns or from specialized launchers to provide an auditory blast or scream, as well as smoke and flashing light, to frighten birds. Some of the newer cartridges have ranges of up to 300 yards. These pyrotechnics, when used skillfully in combination with other harassment techniques and limited lethal control (shooting with shotgun), can be useful in driving birds away from an airport. An advantage of these pyrotechnic devices is that they require a person to fire the projectile, thus ensuring that they are used on the target birds, and the birds associate the pyrotechnic with a threat (person).

This Navy T-44 trainer struck a turkey vulture while conducting low-level training exercises near Corpus Christi, TX. The student pilot was able to land safely.

All wildlife will quickly habituate to propane cannons and other noise scaring devices if they are used constantly without lethal reinforcement. (Photo E. Cleary)

Propane cannons. Propane cannons (exploders) produce a shotgun-sounding blast. In general, birds quickly habituate to cannons that detonate at fixed or random intervals throughout the day. Thus, to ensure they remain effective, use cannons sparingly and only when birds are in the area. Reinforcement by targeting common species such as gulls and Canada geese, under authority of a suitable depredation permit, and occasionally killing a few birds will improve effectiveness. Systems designed with cannons placed around an airport are a useful means of reducing habituation if they can, on demand by radio signal, be detonated remotely when birds are in the area.

Distress call and electronic noise-generating systems. Recorded distress calls are available for common birds at airports, such as gulls, crows, and starlings. Such calls, broadcast from speakers mounted on a vehicle, will often initially draw the birds toward the sound source to investigate the threat. Disperse the birds using pyrotechnics or using a shotgun to remove an occasional bird. Without lethal reinforcement, birds will quickly learn that distress calls and other electronic noise-generating devices are harmless and will ignore them.

Ultrasonic devices. Ultrasonic (that is, above the sound range detected by humans) devices are not effective bird repellents. Most birds hear in a narrower range of sound frequencies than humans. If a high-frequency sound cannot be heard by humans, chances are good that it cannot be heard by birds either. Use of these devices in hangars or other airport settings to deter birds is not recommended. If the sound pressure is high enough, even if humans cannot hear it, such devices can cause hearing damage to airport personnel and customers.

Visual Repellents

Most visual repellents are simply a variation on an ancient theme—the scarecrow. In general, visual repellents, such as plastic owls and similar devices, eye-spot balloons, flags, and Mylar reflecting tapes, have shown only short-term effectiveness and are inappropriate for use as a long-term solution to bird problems. Most short-term success achieved with these devices is likely attributable to "new object reaction" rather than to any frightening effect produced by them. For example, in a test in Ohio, researchers exposed a flag with a large eyespot to pigeons in an abandoned building. As soon as the flag was put up, the pigeons left the building, giving the impression the eyespot was repellent to the birds. However, within 24 hours, the pigeons returned. From then on, the pigeons behaved in a normal fashion and showed no interest in, or reaction to, the flag.

Under low light conditions, specially designed lasers can be effective in repelling geese, cormorants, and other birds. (Photo courtesy USDA)

One visual deterrent successfully used in recent years is displaying dead birds in a "death pose." Several experiments and field demonstrations have shown that a dead turkey vulture (freeze-dried taxidermy mount with wings spread), hung by its feet in a vulture roosting or perching area, will cause vultures to abandon the site. Early trials using dead gulls and ravens suspended from poles have also shown promising results in dispersing these species from feeding and resting sites. Hang the dead bird in a "death pose" to be effective. Dead birds lying supine on the ground or in the roost are ignored and might even attract other birds. Research is underway to determine if artificial effigies (dead bird models) can be developed that will be just as effective as the taxidermy mounts.

Another new idea in visual repellency that has shown utility in recent years is the use of handheld lasers that project a 1-in. diameter red or green beam. These devices have been used successfully to disperse birds such as Canada geese, double-crested cormorants, and crows from nighttime roosting areas in reservoirs and trees. Advantages include effectiveness at long ranges (over ¼ mile) and lack of noise. Lasers have also shown some effectiveness in dispersing birds from hangars. Lasers are not effective in full sun conditions but are very effective at night and during overcast cloudy conditions. Personnel using lasers in an airport environment should be trained in the safe use of lasers and should coordinate their activity with ATC and airport management.

Chemical Repellents

Chemical repellents, toxicants, and capturing agents must be registered with the U.S. EPA or U.S. Food and Drug Administration (FDA) before being used to manage wildlife at airports. Products must also be registered in each state. The chemical repellents discussed below are available for use at airports (as of 2009). A more detailed discussion of these and other chemicals for use in controlling airport wildlife can be found in *Prevention and Control of Wildlife Damage* (Hygnstrom et al. 1994). This handbook is available on the web at icwdm.org/handbook/index.asp.

Perching structures (polybutenes). Several commercial anti-perching products are available in liquid or paste form. These sticky formulations make birds uncomfortable when they alight on them, encouraging the birds to look elsewhere to perch or roost. To be effective, treat all perching

Left: A technician applies anti-perching paste to a building ledge to stop birds from roosting on it. Right: The anti-perching paste was applied over duct tape to facilitate cleanup. (Photos: left courtesy Bird Proof®, right E. Cleary)

surfaces in a problem area or the birds will move a short distance to an untreated surface. Under normal conditions, the effective life of these materials is 6 months to 1 year. Dusty environments can substantially reduce the life expectancy. Use in high temperatures also causes material to become more fluid and run off surfaces and can be extremely difficult to clean. Once the material loses effectiveness, it is necessary to remove the old material and apply a fresh coat. Applying the material over duct tape, rather than directly to the building ledge or rafter surface, will ease cleanup.

Turf feeding (anthraquinone, methyl anthranilate). There are two chemicals registered (2008) as bird repellents for turf (grass).

Anthraquinone is registered for repelling geese from turf. Anthraquinone seemingly acts as a conditioned-aversion repellent with birds. Birds eating food treated with anthraquinone become slightly ill and develop a post-ingestion aversion to the treated food source. Birds visually identify anthraquinone in ultraviolet light (which they can see) and become conditioned to avoid the treated food source. Because of its conditioned-aversion properties, anthraquinone use does not require treatment of the entire airfield, but only areas where birds are grazing and/or higher risk

A methyl anthranilate formulation is available for use in fogging machines (thermal or mechanical) to disperse birds from hangars, lawns, and other areas. (Photo courtesy USDA)

Methyl anthranilate can be applied to standing water at airports to repel gulls. (Photo courtesy USDA)

areas such as runway approaches. However, due to large areas that may require coverage at airports, and the non-persistent nature of the chemicals, these techniques can be very costly.

Methyl anthranilate is a commercial grade artificial grape flavoring commonly used in foods and drinks. Birds have a taste aversion to methyl anthranilate, seemingly reacting to it in much the same way that mammals react to concentrated ammonia (smelling salts). Methyl anthranilate is registered as a feeding repellent for geese and other birds on turf. Again, because of the non-persistence of this chemical and the large areas that may require coverage, use of this method can be costly.

Both anthraquinone and methyl anthranilate are sprayed on the vegetation. Effectiveness of these sprays in repelling geese can be variable, depending on growing conditions, rainfall, mowing, and availability of alternate feeding areas. In general, repellency based on conditioned aversion is longer lasting than repellency based on taste.

Water (methyl anthranilate). Methyl anthranilate formulations are also available for application to pools of standing water on airports and at other locations to repel birds from drinking and bathing. This application is best for temporary pools of water after rainfall, where repellency of only a few days is needed.

Frightening agent [Avitrol™ (4-aminopyridine)]. Avitrol is registered for repelling pigeons, house sparrows, blackbirds, grackles, cowbirds, starlings, crows, and gulls from feeding, nesting, loafing, and roosting sites. Birds eating Avitrol-treated baits react with distress symptoms and calls, behaviors that frighten away other birds in the flock. Avitrol, although registered as a "frightening agent," is lethal. Therefore, recognize that Avitrol is a toxin to the birds that consume treated bait. Avitrol-treated bait is diluted with untreated bait so most birds in the flock do not eat treated bait. The primary use of Avitrol at airports has been in pigeon control around buildings. The use of Avitrol requires knowledge of:

- The feeding patterns of the birds,
- Proper prebaiting procedures to ensure bait acceptance and avoidance of nontarget species, and
- Removal of dead birds after treatment.

Trained Falcons and Dogs

Trained falcons and other birds of prey have been used intermittently at various airports in Europe and North America to disperse birds since the late 1940s. The advantage of falconry is

Many airports are using trained dogs to chase away birds. Because of the cost, this may not be practical for small airports. (Photo E. Cleary)

that the birds at the airport are exposed to a natural predator for which they have an innate fear. The disadvantage is that a falconry program is expensive, requiring several birds that must be kept and cared for by a crew of trained, motivated personnel. Also, the effectiveness of falconry programs in reducing strikes has been difficult to evaluate.

The use of trained dogs, especially border collies, to chase geese and other birds from golf courses, airports, and other sites is a recent development. As with falcons, the advantage is exposure to a natural predator. The disadvantages are that the dog must be under the control of a trained person, and the dog must be cared for and exercised 365 days a year. A dog will also have little influence on birds that are flying over the airport.

Radio-Controlled Model Aircraft

Radio-controlled (RC) model aircraft, which provide both visual and auditory stimuli, occasionally have been used to harass birds at airports. One advantage is the RC aircraft is under the control of a person and can be directed precisely to herd the birds away from the airport runway. A second advantage is the RC aircraft can be used on an "as needed" basis with little maintenance required between flights. Some RC aircraft have been designed to appear like a falcon and even to remotely fire pyrotechnics. The disadvantage is that a trained person is required to operate the RC aircraft in an airport environment. Before using RC aircraft, ensure that the radio frequencies used are compatible with other radios used in the airfield environment.

Nonlethal Projectiles

Use paint balls and rubber or plastic projectiles, fired from paint-ball guns and 12-gauge shotguns, respectively, to reinforce other dispersal techniques employed to repel Canada geese, roosting vultures, and perhaps other species of birds. Use a high-quality paintball gun to provide enough accuracy and velocity (typically fired 20 to 100 ft from bird). The proper distance for firing varies by projectile and species of bird. The objective is to shoot from enough distance so that the projectile induces temporary pain, but no injury, in the bird struck. There are several types of rubber or plastic projectiles (slugs, buckshot, pellets, and beads) for use in a shotgun. Personnel using these techniques need to be trained in firearm use and in the use of the particular projectiles being used.

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As part of their training program, these students are learning how to safely use paintball guns to disperse problem wildlife. (Photo E. Cleary)

Habitat Modification

Habitat modification means changing the environment to make it less attractive or inaccessible to the problem wildlife. All wildlife require food, cover, and water to survive. Any action that reduces, eliminates, or excludes one or more of these elements will result in a proportional reduction in the wildlife population at the airport. Habitat modifications to make the airport and surrounding area as unattractive as possible to hazardous wildlife must be the foundation of every airport's wildlife hazard management program.

Initially, management actions to reduce food, cover, and water at an airport might be expensive. However, when costs are amortized over several years, these actions could be the least expensive approach to reducing wildlife populations at the airport. Once a habitat modification is done correctly, it is generally not necessary to go back and do it again. Also, these control meth-

Gulls and cattle egrets are attracted to mowing operations that flush insects and expose small rodents. Conduct mowing operations at night to prevent this. (Photo E. Cleary)

ods are generally well accepted by the public and minimize the need to harass or use lethal means to remove wildlife on the airport.

Food

Be aware of food attractants for birds that exist at and in proximity to the airport. At the airport, require bird-proof storage of food waste, ban bird feeding, and promote good sanitation and litter control programs.

Some of the more common urban food sources for birds at and near airports include handouts from people in taxi stands and parks, grain elevators, feed mills, sewer treatment plants, and improperly stored food waste around grocery stores, restaurants, and catering services. Rural food sources attractive to birds include sanitary landfills, feedlots, certain agricultural crops (especially cereal grains and sunflower), and spilled grain along road and rail rights-of-way.

Because most, if not all, agricultural crops can attract hazardous wildlife during some phase of production, the FAA recommends against the use of airport property for agricultural production, including hay crops. For nearby off-airport areas, work closely with local governmental entities and landowners to discourage land use practices and activities that provide food sources for problem bird species. If the airport has no financial alternative other than to produce income with agricultural crops to maintain the viability of the airport, then the airport should follow the crop distance guidelines listed in the table entitled "Minimum Distances between Certain Airport Features and Any On-Airport Agricultural Crops" found in FAA AC 150/5300-13, Airport Design. Weigh the cost of wildlife control and potential accidents against the income produced by the on-airport crops when deciding whether to allow crops on airport grounds.

Do not use trees and other landscaping plants that produce fruits or seeds attractive to birds for the street side of airports. On airside areas, the large expanses of grass and forbs can sometimes provide ideal habitat for rodent and insect populations that attract raptors, gulls and other bird species, and mammalian predators such as coyotes. In addition, grasses allowed to produce seed heads can provide a desirable food source for doves, blackbirds, and other flocking species. Managing airside vegetation to minimize rodents, insects, and seeds might be complex, requiring insecticide, herbicide, and rodenticide applications; changes in vegetation cover; and adjustments in mowing schedules (for example, mowing at night to minimize birds feeding on insects exposed by the mowing). Such management plans will need to be developed with professional wildlife biologists and horticulturists knowledgeable about the local wildlife populations, vegetation, and growing conditions.

Water

Water acts as a magnet for birds; therefore, eliminate standing water at the airport to the greatest extent possible. Fill or modify depressions in paved and vegetative areas as well as disturbed areas at construction sites that collect standing water after rain to allow rapid drainage. This is important at coastal airports where freshwater is attractive to birds for drinking and bathing. Do not build retention ponds, open drainage ditches, outdoor fountains, and other wetland sites at or near airports. The FAA recommends either a 5,000-ft separation (for airports that serve primarily piston-powered aircraft) or a 10,000-ft separation (for airports serving turbine-powered aircraft) between known attractants of hazardous wildlife and an airport's AOA, loading ramps (apron areas), and aircraft parking areas. Refer to FAA AC 150/5200-33, *Hazardous Wildlife Attractants on or near Airports,* for a more detailed discussion of the recommended separation distances.

Where possible, modify storm water detention ponds to allow a maximum 48-hour detention period for the design storm. Avoid or remove retention ponds and detention ponds featuring dead storage to eliminate standing water. Design detention basins to remain dry between rainfalls. Where constant flow of water is expected through the basin, or where any portion of the basin bottom might remain wet, design the detention facility to include a concrete or paved pad and/or ditch/swale in the bottom to prevent vegetation that might provide nesting habitat.

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Fish-bearing water attracts birds because it provides both a food source and a water source. Here, a great egret and an anhinga hunt for fish next to the runway at a southern airport. (Photo E. Cleary)

When it is not possible to drain a large detention pond, use physical barriers, such as bird balls, wire grids, pillows, or netting, to deter birds and other hazardous wildlife. Evaluate the use of physical barriers and ensure that they will not adversely affect water rescue.

Encourage off-airport storm water treatment facility operators to incorporate suitable wildlife hazard mitigation techniques into their operating practices when the facility is located within the separation criteria specified in FAA AC 150/5200-33.

Shelter

All wildlife require shelter for resting, roosting, escape, and reproduction. Nonmigratory Canada geese in urban areas, left undisturbed, will establish territories on corporate lawns, golf courses, and even building roofs associated with nearby ponds. Pigeons, house sparrows, and

Even though this detention pond was originally designed to drain within 48 hours following the design storm, additional work is needed to ensure it drains completely. (Photo courtesy FAA)

While Canada geese prefer to forage in shorter grass, they can sometimes be found in taller vegetation and require harassment efforts to disperse them. (Photo E. Cleary)

European starlings use building ledges, abandoned buildings, open girders and bridgework, and dense vegetation for shelter. Blackbirds use marsh vegetation, such as cattails, for nesting and roosting. Solve many bird problems by removing such areas or by excluding birds from them.

Take care when selecting and spacing plants for airport landscaping. Avoid plants that produce fruits, nuts, berries, or seeds wanted by birds. Also avoid creating areas of dense shelter for roosting, especially by European starlings and blackbirds. Thinning the canopy of trees, or selectively removing trees to increase their spacing, can help eliminate bird roosts that form in trees at airports.

Managing an airport's airside ground cover to minimize bird activity is a controversial subject in North America due to confusing and inconsistent guidelines and narrow research protocols. The general recommendation, based on studies in England and Canada in the 1960s and 1970s, has been to maintain a uniform stand of grass at a height of 6 to 10 in. (recommended by Transport Canada), 6 to 12 in. (by numerous European nations), or 7 to 14 in. (mandated by the U.S. Air Force). Grass height maintained in the range of 6 to 12 in. is recommended whenever conditions allow. Intermediate height grass, by interfering with visibility and ground movements, may discourage many species of flocking birds such as blackbirds, starlings, gulls, and others from loafing and feeding. However, the limited studies on single species preferences conducted in North America have not provided a consensus on the utility of tall-grass management for all species. For example, though not preferred by most species, taller grass may not always discourage larger birds such as Canada geese, cattle egrets, and herons, and other methods may be needed to disperse these birds from airport property. In addition, grass must be mown before it reaches the upper threshold height to prevent increased rodent populations, a food source for raptors. Finally, maintenance of uniform stands of intermediate height grass is difficult for some airports because of varying soil conditions and the need for fertilizer or herbicide applications. Arid regions in the western United States also cannot maintain grass without irrigation.

Consult with professional wildlife hazard management biologists and horticulturists to develop a vegetation type and mowing schedule suitable for the growing conditions and wildlife at your airport location. The main principle to follow is to use a vegetation cover and mowing

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Recommendations about airport infield grass height must be made on a prescription basis. Among other considerations, the prescription must take into account the species of birds causing problems, the general environment of the airport, and the local and regional climate. (Photo courtesy USDA)

regime that does not result in a buildup of rodent numbers or the production of broad-leaved vegetation, seeds, forage, or insects desired by birds.

Exclusion Techniques

Architects should consult with biologists during the design phase of buildings, hangars, bridges, and other structures at airports to minimize exposed areas that birds can use for perching and nesting. For example, tubular steel beams are much less attractive as perching sites for starlings and pigeons than are I-beams. If desirable perching sites are present in older structures, close off these sites (such as rafter and girded areas in hangars, warehouses, and under bridges) with netting. Hang curtains made of heavy-duty plastic sheeting, cut into 12-in. strips in warehouse or hangar doorways, to discourage birds from entering these openings. Install anti-perching devices, such as spikes, on ledges, roof peaks, rafters, signs, posts, and other roosting and perching areas to stop certain birds from using them. Change the angle of building ledges to 45° or more to deter birds. Incorporate bird exclusion or deterrence into the design of structures to provide the most effective, long-term solution.

Reduce gull and waterfowl use of retention ponds and drainage ditches with overhead wire grid systems. Wires can be extruded metal, heavy gauge monofilament, or braided "superlines" used for fishing. Wires spaced 10 ft apart or in a 10- x 10-ft grid will discourage most gulls and waterfowl from landing. Similar wire systems have successfully kept gulls off of roofs and out of landfills, and crows out of electrical substations. When it is desirable to eliminate bird use, install netting over small ponds and similar areas. Be aware that birds may become tangled in the netting, and maintenance problems arise with high winds and freezing weather. Complete coverage of ponds with plastic, 3-in. diameter "bird balls" or floating mats will exclude birds and yet allow evaporation of water. Designing ponds with steep slopes will discourage wading birds such as herons. Use culverts in drainage ditches whenever possible.

Because of the extremely high water table and frequent heavy rains in the area, it was necessary to install open canals to ensure proper drainage at this airport. The banks are cement lined and very steep to discourage wading birds. (Photo E. Cleary)

Population Management

Live Capture

Chemical capture. Alpha chloralose (A-C) is registered with the FDA as an immobilizing agent for use in capturing waterfowl, coots, and pigeons. A-C can only be used by people certified to use it or by people working under the authority of personnel with the USDA/WS. A-C, incorporated into bread baits, is ideal for selectively capturing ducks, geese, and coots that can be hand-fed at urban ponds and parks. Corn baits are recommended for pigeons or groups of waterfowl or coots that cannot be individually baited. Birds eating a clinical dose of A-C can be captured in 30 to 90 minutes. Complete recovery normally occurs within 8 hours but can take up to 24 hours.

Live trapping. Trapping wild animals requires a high degree of knowledge and skill, and is generally most successful when undertaken by skilled professionals. The major advantage of live trapping is selectivity; any nontarget birds can be released unharmed. The major disadvantage is that live trapping is often labor intensive. Tend traps frequently and remove captured animals; in the case of cage traps with decoy birds, provide food and water. Hygnstrom et al. (1994) provide detailed descriptions of various trap designs.

Use trapping to remove raptors (hawks and owls) in the AOA. Trapping should be done by professionals having the skills and proper tools to remove the birds without injuring them. Because raptors are desirable parts of bird communities, most permits for trapping raptors require banding the birds and relocating them into suitable habitat at least 50 miles from the airport.

Live trapping with walk-in traps on roofs or other isolated sites can be done to remove pigeons at airports. If relocated, pigeons can fly long distances to return to the site of capture. Therefore, euthanize captured pigeons following American Association of Wildlife Veterinarians (AAWV) guidelines.

Net launchers use a blank rifle cartridge to propel a net. Fired from the shoulder much like a shotgun or rifle, net launchers can capture individual or small groups of problem birds that can be approached within about 50 ft.

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Live trapping of raptors requires a high degree of skill. Remember that all raptors are protected by federal law and may only be taken with a federal depredation permit. (Photo courtesy USDA)

Lethal Control

Some lethal control is usually necessary as part of a GA airport's integrated program to control problem wildlife. Use lethal control only as a last resort after all other reasonable nonlethal options (habitat modification, exclusion techniques, and repellent actions) have been exhausted, and there is an ongoing threat to public safety. Managing a wildlife hazard situation at an airport might require killing a particular animal or require that a local population of a problem species be reduced until a long-term, nonlethal solution is completed (for example, relocation of a nearby gull nesting colony). In addition, lethal control of a few individuals is sometimes necessary to reinforce nonlethal frightening techniques.

Develop the following information to justify lethal control and to lessen adverse public reaction to a program involving killing:

- Describe the situation and how the presence or behavior of the animal(s) is a threat to safe aircraft operations;
- List the hazing or harassment strategies that were used and their results;

Occasionally shooting some birds at an airport will help reinforce nonlethal repellent techniques. (Photo courtesy USDA)

- Describe the method used (including who, when, and what);
- Document that the killing procedures were correct (that is, followed AAWV guidelines) and specific for the target wildlife species;
- Identify the location on the airfield where the action was taken; and
- Document the effectiveness of the killing program in helping to solve the problem (for example, decrease in bird strikes).

Recommend steps to be taken, if any are likely, to reduce the need for killing in the future.

Remember: Obtain all necessary state and federal depredation permits. Active migratory bird nests (containing eggs or chicks) are protected by federal law and may not be taken without a federal depredation permit. For some species of migratory birds, nests that do not contain eggs or chicks may be removed without a federal depredation permit. Eagle nests may not be taken at any time without a federal permit. Each situation will have to be addressed on a case-by-case basis, depending on the species of bird, level of threat posed, location relative to runways, bird movement patterns, and other factors.

Destroying nests and eggs. Do not allow Canada geese, mute swans, and gulls to nest on airport property. Provided the correct permits are in place, destroy (break eggs and remove nest material) any goose, mute swan, or gull nests with eggs found at an airport. Egg addling (oiling, shaking, or puncturing), whereby the birds continue to incubate nonviable eggs, is not recommended for airports, as it encourages the nesting birds (and any nonbreeding birds associated with them) to stay at the airport. At the time of nest destruction, harass the adult birds from the airport. Check the nesting area weekly for renesting until the end of the nesting season (generally the end of June). As an alternative to harassment, it may be better to shoot nesting geese and mute swans. Mute swans and Canada geese are protected by federal and often state laws.

Destroy nests of pigeons, starlings, and house sparrows whenever they are encountered in airport buildings and structures. Where practical install physical barriers to prevent renesting (see the "Exclusion Techniques" subsection in the "Strategies and Techniques for Controlling Birds" section in Chapter 3).

Shooting. Shooting birds in an airport environment generally falls into two main categories: quietly, or loudly as a reinforcement of audio and visual repelling techniques. First, pigeons using

Adopt a zero tolerance policy for waterfowl and gull nesting on airport property. Destroy goose nests and eggs. Here a U.S. Fish and Wildlife employee is chasing a nesting pair of Canada geese from their nest, preparatory to removing the nest and eggs. (Photo courtesy L. Terry)

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Remember: Shooters must make positive identification of all target birds before shooting. This will reduce the risk of killing nontarget birds. (Photo courtesy USDA)

hangars, bridge girders, and other sites can be shot at night with an air rifle. This nighttime shooting is done quietly and discretely, with the objective being to disturb the birds as little as possible so that the maximum number can be removed.

In the second category of shooting, common birds, such as gulls and geese, in the AOA that are not responding to various repellent methods can be shot with a 12-gauge shotgun. This shooting is done during daylight, in the open, so that other birds can witness the action.

Remember the four cardinal rules when considering shooting problem birds.

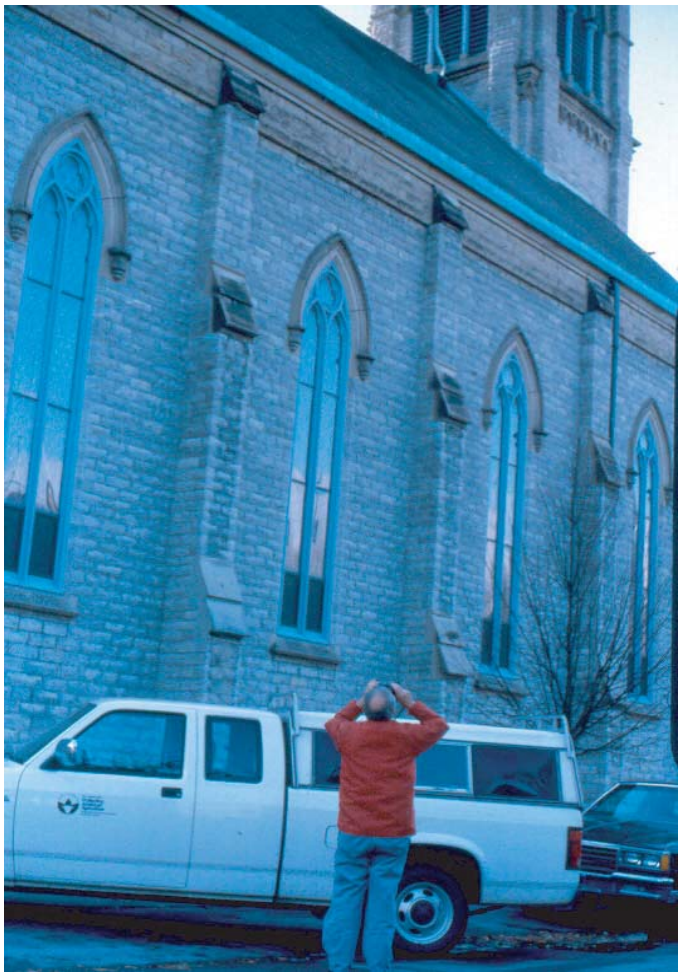
1. **Use only personnel who have an excellent knowledge of wildlife identification and are trained in the use of firearms.**
2. **Use the proper gun and ammunition for the situation.**
3. **Have necessary federal and state wildlife kill permits in place, and keep accurate records of killed birds by species and date.**
4. **Notify airport security, air traffic control, and, if appropriate, the local law enforcement authority.**

Shooting birds can have several effects on a flock:

- It reinforces other audio or visual repelling techniques;
- The loud noise, coupled with the death of one or more of the flock members, can frighten the rest of the flock away and
- The target birds are permanently removed.

Before starting a shooting program, local ordinances against the discharge of firearms within certain distances of buildings, or within the city limits, may need to be waived.

Oral toxicants. Currently in the United States, only one oral toxicant, DRC-1339, or Starlicide™ (active ingredient 3-chloro-p-toluidine hydrochloride), is registered with the U.S. EPA for use in bird population management. Starlicide (0.1% active ingredient) is formulated in a pellet bait for use at feedlots to control starlings and blackbirds. DRC-1339 (98% active ingredient) can be formulated with a variety of baits and used to control starlings, pigeons, gulls, ravens, and blackbirds under certain conditions, some of which might be applicable at GA airports. The control of pigeons around airport buildings and starlings roosting at or near an airport are the situations most likely applicable. Only USDA/WS personnel or persons working under their direct supervision can use DRC-1339.



The use of toxic baits to kill target birds without affecting nontarget species requires considerable skill and patience. (Photo E. Cleary)

The use of toxic baits to kill target birds without affecting nontarget species requires considerable skill and patience. Daily movement patterns of the target birds among feeding, loafing, and roosting sites must be determined so that attractive bait sites that are controlled from public access (such as a roof top) can be selected. The proper bait (a highly desired food) must be selected, and the birds then must be prebaited, often for a week or more, to ensure good bait acceptance and that nontarget animals are not visiting the bait site. Proper prebaiting is the most critical step of a successful program. During the baiting period, all uneaten bait must be removed daily. With DRC-1339, birds typically die one to three days after bait ingestion; therefore, areas surrounding bait sites will need to be searched for several days after baiting to remove dead birds.

Contact toxicants. Hollow metal perches containing a wick treated with the toxicant fenthion were previously used to control pigeons, house sparrows, and starlings in and around buildings. However, the U.S. EPA has phased out the use of fenthion-treated perches because of concerns for secondary poisoning of raptors and mammalian scavengers feeding on dying birds. No replacement chemical has been registered at this time (2009).

If toxic perches become available, their use outside of buildings is not recommended because there is no way of preventing nontarget birds from landing on them. Even when used inside buildings, careful placement of perches and monitoring must be done to ensure nontarget birds such as swallows are not exposed to the toxicant. All dead birds must be picked up and properly disposed of by appropriate personnel.

Strategies and Techniques for Controlling Large Mammals

Repelling Techniques

Auditory Repellents

One of the major wildlife problems identified by our survey questionnaires, on-site surveys, and analysis of data from the FAA's National Wildlife Aircraft Strike Database, is that large mammals (for example, deer and cattle) and medium-sized mammals (such as coyotes and feral dogs)

Never reject the simple just because it is simple. Simple methods often work better than complicated methods. This man's job is to patrol a particular area of an international airport and chase away hazardous wildlife by making noise. (Photo E. Cleary)

can pose a serious threat to aircraft safety at GA airports. Deer are the most hazardous species for both GA and air carrier aircraft. Probably the most commonly used auditory scaring device for deer is the propane cannon. However, deer rapidly habituate to propane cannons. Propane cannon use on airports to repel deer and other mammals from airport runways is not recommended except for short-term (a few days) emergencies until a more permanent solution (fencing or deer removal) can be achieved. Other electronic noise-generating devices have also proven ineffective in repelling deer or other mammals for more than a few days. Pyrotechnics also provide only short-term repellency for mammals.

Visual Repellents

Visual repellents such as flags and effigies have proven ineffective for repelling mammals. Their use is not recommended for keeping deer or other mammals away from airports. Red lasers are also ineffective in dispersing deer.

Chemical Repellents

There are several taste and odor repellents marketed to repel deer, rabbits, and other mammals from browsing on vegetation (Hygnstrom et al. 1994). Some are applied directly to the vegetation; others are used as area (odor) repellents (for example, predator urine). Some of these products might be suitable for short-term protection of valuable landscaping plants and fruit trees. However, their use on airports to repel or discourage deer or other mammals is not recommended because they are unlikely to have any influence on wildlife movements in the airport operating area.

Trained Dogs

The use of trained dogs, especially border collies, to chase deer from golf courses, airports, and other sites is a recent development. The advantage is that deer see the dog as a natural predator. The disadvantages are that the dog must be under the control of a trained person, and the dog must be cared for and exercised every day.

Habitat Modification

Food

Take care when selecting and spacing plants for airport landscaping. Avoid plants that produce fruits and seeds wanted by deer and other mammals. On airside areas, large expanses of low-growing dense vegetation can provide ideal habitat for rodent and insect populations that attract raptors, gulls, and mammalian predators such as coyotes. Managing airside vegetation to minimize rodents, insects, and seeds might be complex, requiring insecticide, herbicide, and rodenticide applications; changes in vegetation cover; and adjustments in mowing schedules. Such management plans will need to be developed with professional wildlife biologists and horticulturists knowledgeable about the local wildlife populations, vegetation, and growing conditions.

Food waste from airport restaurants and local and/or transient pilots, if not properly disposed of, can attract problem mammals such as coyotes, raccoons, dogs, cats, rats, and mice. Ensure that all food waste is placed in closed containers, inaccessible to wildlife, until it is removed from the airport.

Food provided by airport employees for feral dogs and cats can be a major attractant not only to the feral animals but to problem wildlife, such as coyotes, raccoons, and rats. In addition to posing a threat to aviation safety, the feral animals can pose a threat to the health of airport employees. Any feeding of feral dogs and cats by airport personnel should be stopped.

Improperly disposed of trash is attractive to many species of hazardous wildlife. Always ensure that all trash is handled correctly. (Photo E. Cleary)

Water

Standing water can be highly attractive to all wildlife—mammals and birds—particularly in areas where fresh water is scarce. Where possible, modify storm water detention ponds to allow a maximum 48-hour detention period for the design storm. Avoid or remove retention ponds and detention ponds featuring dead storage to eliminate standing water. Design detention basins to remain dry between rainfalls. Where constant flow of water is expected through the basin, or where any portion of the basin bottom might remain wet, design the detention facility to include a concrete or paved pad and/or ditch/swale in the bottom to prevent vegetation that might provide bird nesting habitat, which in turn could attract mammalian predators. Use rock-lined, steep-sided, narrow, linearly shaped basins to facilitate the control of hazardous wildlife. The rocks help hide the water during periods of low inundation.

Standing water can be very attractive to birds. This is a construction site at a midwestern airport. (Photo courtesy FAA)

When it is not possible to drain a large detention pond, use physical barriers, such as bird balls, wire grids, pillows, or netting to deter birds and other hazardous wildlife. Evaluate the use of physical barriers and ensure that they will not adversely affect water rescue.

Encourage off-airport storm water treatment facility operators to incorporate suitable wildlife hazard mitigation techniques into their operating practices when the facility is located within the separation criteria specified in FAA AC 150/5200-33.

Shelter

All wildlife require shelter for resting, escape, and reproduction. Dense stands of trees and undergrowth on airport property can provide excellent shelter for deer, coyotes, rodents, and other wildlife. In general, clear, or at least sufficiently thin, these habitats to eliminate the desired shelter and to allow easy visual and physical access by wildlife control personnel. Piles of construction debris and discarded equipment, unmowed fence rows, and other unmanaged areas are not only aesthetically unpleasing but typically provide excellent shelter for rats and mice as well as den sites for woodchucks, feral dogs, and coyotes. Eliminate such areas at airports.

Exclusion Techniques

Large- and medium-sized mammals can pose a serious threat to aircraft safety. At GA airports, institute a "zero tolerance" policy for deer, livestock, and other large mammals in the AOA because of their severe threat to aviation safety.

The best, although most costly, procedure for excluding these animals from the air operations area is proper fencing. The FAA recommends a 10- to 12-ft chain-link fence with 3-strand barbed wire outriggers. Occasionally an airport may be able to use an 8-ft chain-link fence with 3-strand barbed outriggers, depending on the deer activity in the area. Use a 4-ft skirt of chain-link fence material, attached to the bottom of the fence and buried at a 45° angle on the outside of the fence, to prevent animals from digging under the fence and to reduce the chance of washouts. This fencing also increases airport security. There are many electric fence designs for excluding deer, as discussed in Hygnstrom et al. (1994) that are not as costly as permanent fencing, but have drawbacks in safety and maintenance.

This photo shows an airport's perimeter fence with a 4-ft skirt attached to prevent animals from digging under it and to reduce washouts. (Photo courtesy PDX)

Initially, fencing such as that shown here is expensive. However, when the cost is amortized over several years, the long-term cost drops dramatically. Also, because this type of fencing greatly improves airport security, it may be possible to share the cost of this type of fencing with the FAA. (Photo courtesy USDA)

Properly install and maintain all fencing. Keep the fence line right-of-way free of excess vegetation. Patrol the fence line daily; fix any washouts, breaks, or other holes in the fence as soon as they are discovered. Take immediate action to remove any deer or other large mammals seen on or near the AOA.

Use cattle guards to stop hoofed livestock (cattle and horses) from entering fenced areas through permanent openings kept for vehicular access. These devices, if at least 15 ft long and perpendicular to the fence, will also stop deer from entering through gated areas at airports.

Population Management

Live Capture

Chemical capture. Large mammals, such as deer, can be captured with tranquilizer guns. However, the disposition of the captured animal can be problematic. Live capture and relocation of deer is not recommended or allowed in most states because deer populations are at or near carrying capacity. When the use of firearms is not safe or practical, the use of tranquilizer guns might be appropriate. Capturing animals with tranquilizer guns requires personnel with a high degree of skill and experience in their use. When used in an airport environment, safeguards must be in place to ensure partially tranquilized deer do not enter runway areas.

Live trapping. Specialized drop-door traps, drop nets, or rocket net setups can be used to live capture deer, but live capturing deer is not recommended for airport situations for reasons outlined above. Use basket or box-type live traps to capture medium-sized mammals such as raccoons, skunks, woodchucks, beavers, and feral dogs. Leg-hold traps and snares can be used to capture coyotes, feral dogs, and raccoons.

Successful mammal trapping, especially with leg-hold traps and snares, requires a high degree of skill and experience. Once set, check traps frequently (at least once every 24 hours and more often in hot or cold weather). Trappers must be knowledgeable in procedures for handling and euthanizing mammals. State and local regulations may restrict the use of some types of traps.

All live traps should be tended at least daily. Dispose of trapped animals in accordance with state and local regulations. (Photo E. Cleary)

Lethal Control

Shooting. Adopt a "zero tolerance" policy for deer at airports. If fencing is inadequate to keep deer away from an airport or if deer have gotten inside the airport's fence, shooting is the best procedure for removing the deer. When practical, donate the meat from deer that are removed from airports to a local charity. Because of inherent safety considerations and to ensure safe and efficient removal, shooting at airports should be done by professional sharpshooters, using non-ricocheting bullets in rifles equipped with night vision scopes and noise suppressers. Elevated shooting stands can be erected on the ground or on a truck bed to direct shots toward the ground. Deer are protected in all states. Shooting of deer at airports must be coordinated with the state wildlife agency. GA airports may consider having local police units do the shooting.

At GA airports with deer problems, encourage hunting during the regular deer season in areas adjacent to airports with deer problems to reduce the population in the general area. Archery hunting sometimes can be used in areas closed to firearms.

Where safe and legal, deer hunting on and near airport grounds is a good way to reduce deer numbers in the area. (Photo E. Cleary)

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Lethal traps. Depending on state and local laws, Conibear™ (body gripping) traps can be used to remove woodchucks, beaver, and other medium-sized mammals that create problems at airports. Neck snares can be used to capture coyotes, beaver, and certain other mammals. The use of these lethal traps requires a high degree of skill and experience to selectively capture the target animal. Once set, traps must be checked frequently (at least once every 24 hours and more frequently in hot or cold weather) to euthanize any animals that might be captured but not killed. Trappers must be knowledgeable in procedures for handling and euthanizing captured mammals.

Strategies and Techniques for Controlling Small Mammals

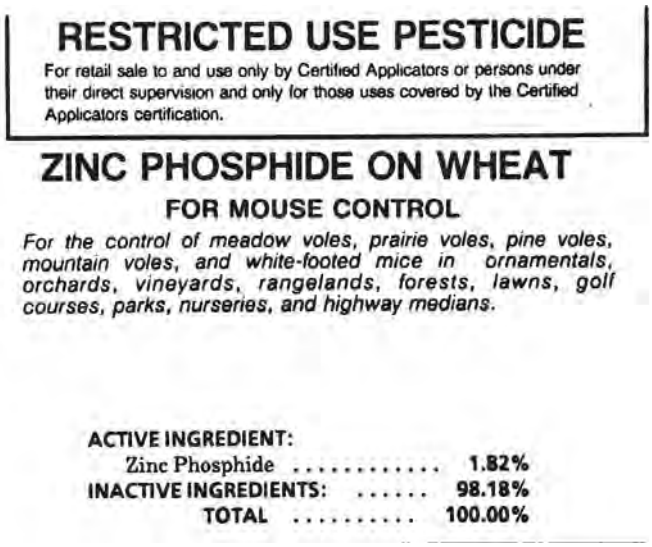
Toxicants

Populations of small rodents (such as voles, house and deer mice, and Norway rats) may erupt in grassy and brushy areas or around construction debris at airports, attracting raptors and creating a hazard to aviation. In general, control rodent populations by habitat management (mowing, sanitation, and cleanup of brushy areas and/or piles of debris). However, there may be situations where the use of a rodenticide is appropriate to reduce rodent populations in airside vegetation.

Note: The control of commensal rodents—rats and house mice—in airport terminal buildings and other facilities will not be discussed here. These jobs are usually handled by private pest control operators.

There are two types of rodenticides that may be available for use in airside vegetation: anticoagulants and acute toxicants. Anticoagulants cause the rodent to die from internal bleeding. Some anticoagulants require multiple feedings to induce sufficient bleeding for death, whereas others require only a single feeding. Anticoagulant baits can be placed in various types of bait containers positioned in areas of high rodent activity.

The only acute toxicant registered for aboveground treatment of field rodents is zinc phosphide, available in pellet and grain bait formulations and as a concentrate for specialized bait formulations. Depending on registration label instructions, rodenticide baits can be broadcast in the vegetation or hand placed in burrows and runways. Care must be taken to minimize nontarget



Before using any pesticide, always read and follow all label directions. (Photo E. Cleary)

bird and mammal exposure with broadcast and hand-placed baits. Anticoagulant baits can also be placed in various types of bait containers positioned in areas of high rodent activity.

Fumigants

At airports, burrowing rodents such as woodchucks (groundhogs) and prairie dogs can be killed by fumigation of burrows with either gas cartridges or aluminum phosphide tablets. Gas cartridges, ignited from a burning fuse after placement in the burrow, generate carbon monoxide. Aluminum phosphide pellets react with moisture in the burrow to produce phosphine gas. Care must be taken to plug all burrow entrances with sod after placement of the cartridge or pellets in the burrow. Gas cartridges are a general use, over-the-counter pesticide. Aluminum phosphide pellets can only be applied by certified pesticide applicators and might not be available in all states. As with all pesticides, it is critical to make sure the wildlife species you are treating is covered under the registration for your state.

Notices to Airmen of Potential Wildlife Hazards

Airport managers must maintain a safe aircraft operating environment. This may include restricting aircraft operations when immediate wildlife hazards exist at or near the airport. Aircraft movements at GA airports may not be subject to the same restrictive time schedule pressures as air carrier aircraft movements at Part 139 certificated airports. Recreational GA aircraft pilots do not have a rigid schedule to keep and may be able to delay their takeoff or landing to accommodate wildlife control problems at the airport. Because airport managers must maintain a safe aircraft operating environment, they can restrict aircraft operations when hazardous conditions such as wildlife on or near the runway require it. Admittedly, the pilot has the final decision whether or not to land or takeoff.

Private pilots may be able to delay their takeoff or landing with little or no consequences. Air couriers (bank, medical, and film), air taxies, or charter operations may be able to change or delay their operation schedules to allow airport personnel time to address imminent or recurrent hazardous wildlife problems.

Where legal, gas cartridges can be used to control burrowing rodents such as woodchucks and prairie dogs. (Photo E. Cleary)

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This Cessna aircraft, with only 80 hours of flight time, struck a large bird over a lake several miles from a midwestern airport. (Photo M. Mullen)

Also, inherent in the idea of flight schedule modification is the idea of closing various runways, or the entire airport, if necessary, to address imminent or recurrent wildlife hazards. For example, pilots may be able to delay departure during a 20-minute period at sunrise or sunset during winter when large flocks of blackbirds cross an airport going to and from an off-airport roosting site. Also, air traffic controllers on occasion may temporarily need to close a runway with unusually high bird activity or a large mammal (for example, deer) incursion until wildlife control personnel can disperse the animals.

Conclusions

Habitat modifications to minimize food, water, and shelter, and physical or psychological barriers to exclude wildlife are the foundations of wildlife hazard management programs for airports. In addition, an integrated array of repelling techniques is necessary to disrupt normal behavior and to stress hazardous wildlife that attempt to use the airport environment. These repelling techniques must be used judiciously and be backed by real threats to minimize habituation. To this end, lethal

Airfield approach lights provide ideal perches for hunting raptors. (Photo E. Cleary)

control of selected individuals of common species is sometimes necessary to reinforce repellent actions. Furthermore, the management of a wildlife hazard situation at an airport may require removal of a particular animal or group of animals or require that a local population of a problem species be reduced by lethal means until a long-term, nonlethal solution is implemented. Finally, the most critical factor for the success of a wildlife hazard management program is to have motivated and trained professionals who are knowledgeable about the wildlife species attempting to use the airport environment and the techniques used to manage the problems these species create.

The ultimate responsibility for control of hazardous wildlife rests with the airport operator. The pilot-in-command is the final decision maker of whether or not to takeoff or land.

Table 3.1 shows the current prices of some of the more commonly used bird control devices from one of the major suppliers in the United States, as of January 1, 2010. Tables 3.2 and 3.3 present a summary of the effectiveness and relative cost ($ through $$$$) of various control techniques for different wildlife species. The more $ signs, in general the more expensive the method. Trying to set an accurate price on many of the control methods mentioned is very difficult. Eliminating a food source may be as easy as properly storing and disposing of garbage, or it may be as expensive as eliminating all farming at the airport. Eliminating water at the airport may only require opening some clogged drains or eliminating some small berms caused by snow removal, or it may require a completely new drainage plan for the entire airport. Appendix D presents a list of the minimum recommended equipment and current prices (January 1, 2010) that would be found at a small- to medium-sized airport.

Table 3.1. Prices of some of the more commonly used bird control devices from one of the major suppliers in the United States, as of January 1, 2010.

Laser	
Avian dissuader hand-held pistol style	$1,095 each
Desman laser rifle style	$7,700 each
Pyrotechnics	
Screachmer siren	$45/100 rounds
Bird banger	$45/100 rounds
Screachmer banger rocket	$95/100 rounds
Pyrotechnic Launchers	
Single shot launcher	$34 each
Double shot launcher	$42 each
Seven shot launcher	$120 each
Propane Cannon	$290–$385 each
Chemical Repellent	
Rejex-it® Migrate® for turf	$90/gallon
Visual Repellents	
Scarey Man®: multi-use unit	$1,100 each
Pre-set timer unit for Scarey Man	$1,200 each
Evil eye balloons	$9.50 each
Reflective tape	
0.5" x 250'	$2.50/roll
1.25" x 250'	$7.50/roll
Electronic Repellents	
Bird Gard® Super Pro	$660 each
Bird Gard Pro	$220 each
Mobile Bird Gard	$690 each

Table 3.2. Relative effectiveness and cost of control methods for hazardous birds. Effectiveness: B = best; G = good; F = fair; P = poor; N = not recommended. The more $ signs, the more expensive the method.

Control Method for Birds	Crows/Jays/Magpies	Blackbirds	Starlings/Minas	Cormorants/Anhingas	Ducks	Geese	Swans	Gulls	Herons	Egrets	Cranes	Pigeons/Doves	Vultures	Hawks	Falcons	Eagles	Osprey/Kites	Owls	Gallinaceous Birds	Shorebirds	Thrushes	Sparrows
Repelling Techniques																						
Chemical repellents for birds					F/$$	F/$$	F/$$	F/$$				F/$$										
Audio repellents for birds																						
Electronic sounds	F/$$$	G/$$$	G/$$$	P/$$$	P/$$$	P/$$$	P/$$$	G/$$	P/$$$	P/$$$	P/$$$	P/$$$	P/$$$	P/$$$	P/$$$	P/$$$	P/$$$	P/$$$	P/$$$	F/$$$	P/$$$	P/$$$
Pyrotechnics	G/$$	G/$$	G/$$	G/$$	G/$$	G/$$	G/$$	G/$$	G/$$	G/$$	G/$$	G/$$	G/$$	G/$$	G/$$	G/$$	G/$$	G/$$	G/$$	G/$$	G/$$	G/$$
Ultrasonic	N/$$	N/$$	N/$$	N/$$	N/$$	N/$$	N/$$	N/$$	N/$$	N/$$	N/$$	N/$$	N/$$	N/$$	N/$$	N/$$	N/$$	N/$$	N/$$	N/$$	N/$$	N/$$
Visual repellents for birds	P/$$	P/$$	P/$$	P/$$	P/$$	P/$$	P/$$	P/$$	P/$$	P/$$	P/$$	P/$$	P/$$	P/$$	P/$$	P/$$	P/$$	P/$$	P/$$	P/$$	P/$$	
Trained falcons and dogs to repel birds				G/$$$$	G/$$$$	G/$$$$	G/$$$$	G/$$$$	G/$$$$	G/$$$$	G/$$$$								G/$$$$			
Radio-controlled model aircraft to repel birds	F/$$$	F/$$$	F/$$$	F/$$$	F/$$$	F/$$$	F/$$$	F/$$$	F/$$$	F/$$$	F/$$$	F/$$$							F/$$$	F/$$$	F/$$$	F/$$$
Nonlethal projectiles to repel birds					G/$$	G/$$	G/$$												G/$$			

Habitat Modification																						
Food	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$
Water	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$
Shelter	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$	B/$$
Exclusion of Birds		G/$$	G/$$		G/$$	G/$$	G/$$	F/$$	F/$$	F/$$	F/$$	G/$$						G/$$	F/$$		G/$$	G/$$
Population Management																						
Capturing birds																						
Chemical capture of birds	F/$$				F/$$	F/$$		F/$$				F/$$										
Live-trapping birds		G/$	G/$$		G/$$	G/$$	G/$$	G/$$				G/$$										G/$
Destroying eggs and nests				G/$	G/$	G/$	G/$	G/$				G/$										
Lethal control of birds																						
Shooting birds	G/$$$	F/$$$	F/$$$	G/$$$	G/$$$	G/$$$	G/$$$	F/$$$	G/$$$	G/$$$	F/$$$	G/$$$	F/$$$	F/$$$	P/$$$	N	G/$$$	F/$$$	G/$$$	F/$$$	PG/$$$	P/$$$
Oral toxicants for birds								F/$$				G/$$										
Contact toxicants for birds	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Notification of Pilots of Wildlife Hazards	G/$	G/$	G/$	G/$	G/$	G/$	G/$	G/$	G/$	G/$	G/$	G/$	G/$	G/$	G/$	G/$	G/$	G/$	G/$	G/$	G/$	G/$

Table 3.3. Relative effectiveness and cost of control methods for hazardous mammals. Effectiveness: B = best; G = good; F = fair; P = poor; N = not recommended. The more $ signs, the more expensive the method.

Control Method for Mammals	Canines	Deer	Cattle	Raccoons
Repelling Techniques				
Chemical repellents for mammals	N	N	N	N
Audio repellents for mammals	P/$$	P/$$	P/$$	P/$$
Visual repellents for mammals	P/$	P/$	P/$	P/$
Habitat Modification				
Food	B/$$	B/$$	B/$$	B/$$
Water	B/$$	B/$$	B/$$	B/$$
Shelter	B/$$	B/$$	B/$$	B/$$
Exclusion Techniques				
Exclusion of mammals	G/$$$	B/$$$	B/$$$	F/$$$
Population Management Techniques				
Capturing mammals				
Chemical capture of mammals	F/$$$	F/$$$		F/$$$
Live-trapping mammals	G/$$	P/$$$$		B/$
Lethal control of mammals				
Shooting mammals	G/$$	G/$$	N	G/$$
Toxicants for small mammals				
Fumigants for small mammals				
Lethal traps for mammals	G/$$	N	N	G/$$
Notices to Airmen of Potential Wildlife Hazards	G/$	G/$	G/$	G/$

PART 2

Activities for General Aviation Airport Managers Concerned About Hazardous Wildlife Problems

Part 2 is intended for GA airport managers who must develop programs to control hazardous wildlife at their airports. It covers the following topics:

- Measuring the threat (Chapter 4);
- Developing a wildlife control program at general aviation airports (Chapter 5);
- Evaluating wildlife hazard management programs at general aviation airports (Chapter 6);
- Wildlife hazard management training for general aviation airport personnel (Chapter 7); and
- Government agencies and regulations impacting wildlife hazard control at general aviation airports (Chapter 8).

CHAPTER 4

Measuring the Threat

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

Introduction

Experts within the U.S. civil and military aviation communities recognize that the threat to aviation safety (as well as the resulting economic repercussions) from collisions between aircraft and wildlife (wildlife strikes) is increasing (see for example, Dolbeer 2000, Allan and Orosz 2001, MacKinnon et al. 2001, Dolbeer and Eschenfelder 2003, Cleary and Dolbeer 2005, and Cleary et al. 2007). There are several reasons for this increase, the most obvious of which is the increasing number of in-service aircraft, both commercial and private. Also, many populations of wildlife species commonly involved in strikes have increased markedly in the last few decades, creating more possibilities for concern.

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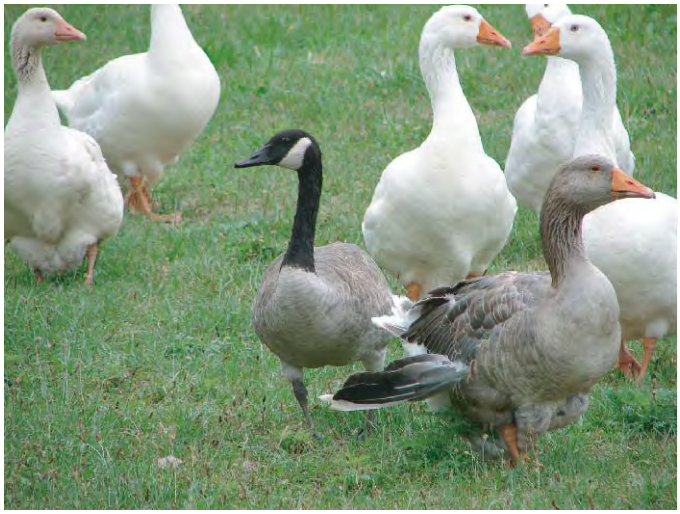

Resident Canada geese populations are increasing at over 12% annually. They will readily socialize with domestic geese in parks and other places where people feed them. (Photo E. Cleary)

Most research to address this problem has been directed at the commercial sector. Little if any effort has been made to analyze, evaluate, and measure wildlife strike problems encountered at GA airports and by non-air-carrier (i.e., GA) aircraft. Most studies of wildlife strikes at the national and international levels have either considered civil aviation in total—a combination of general and commercial aviation (see for example, Cleary et al. 2000, 2002; Cleary et al. 2004, 2005, 2006; and Dolbeer and Wright 2008)—or just military aviation by itself (see for example, Richardson and West 2000) or some combination of the two—civil and military (see for example, Thorpe 2003, 2005).

Most funding, research, and regulatory efforts directed toward addressing the civil aviation wildlife strike problem come from the federal level, specifically the FAA. Most of these efforts have been directed toward certificated airports to conduct operations involving certain commercial air carrier aircraft. Little federal effort along these lines has been directed specifically toward GA airports.

The FAA began collecting wildlife aircraft strike data in the early 1970s. Other than cursory analysis, the wildlife strike data was never subjected to rigorous analysis until 1995 (see Dolbeer et al. 1995). Unfortunately, by that time most of the pre-1990 data had been lost. The first analysis of data from the FAA's National Wildlife Aircraft Strike Database, and all subsequent analyses, did not distinguish between strikes involving air carrier aircraft and those involving GA aircraft. Also, no effort was made to distinguish between GA airports and certificated airports.

For this guidebook, the FAA's National Wildlife Aircraft Strike Database was searched with two different parameters: for strikes occurring at identified U.S. GA airports and for strikes involving GA aircraft regardless of where the strike occurred (see Cleary and Dickey 2008a and 2008b). GA aircraft were defined as fixed-wing aircraft having one or two engines and weighing less than 59,525 lbs (27,000 kg). Many strike reports were found involving aircraft types commonly used by air carriers. All of these aircraft types have been involved in wildlife strikes at GA airports. Because of concerns with the susceptibility of specific aircraft types to damage from wildlife strikes, those aircraft types were included in the analysis. The search returned 11,743 usable records. The strike data was then analyzed to determine the scope of the problem and to identify the wildlife species posing the greatest hazard to GA aircraft.

Between January 1, 1990, and December 31, 2007, white-tailed deer were involved in 398 reported wildlife strikes with GA aircraft; 358 of these strikes caused damage to the aircraft, totaling $22.1 million. (Photo courtesy D. Dewhurst, U.S. FWS National Digital Library)

Ranking Wildlife Species Hazardous to General Aviation Aircraft

GA airport managers have limited resources (time, money, and personnel) to manage problems at the airport. Many species of wildlife can pose a threat, either directly or indirectly, to aviation safety. However, not all wildlife species are equally hazardous. To prioritize expenditures of their limited resources, GA airport managers need to know which wildlife species pose the greatest hazard to GA aircraft.

GA aircraft report much higher damage rates from wildlife strikes than the national average. Cleary et al. (2007) found that between January 1, 1990, and December 31, 2006, 13% of all U.S. civil aircraft involved in bird strikes were damaged and 55% of all U.S. civil aircraft involved in mammal strikes were damaged. For strikes involving GA aircraft at GA airports between January 1, 1990, and October 31, 2008, 33% of GA aircraft reporting bird strikes were damaged and 90% of GA aircraft reporting mammal strikes were damaged.

Between January 1, 1990, and October 31, 2008, 309 identified wildlife species or species groups were involved in 11,038 strikes with fixed-wing aircraft having one or two engines and weighing less than 59,525 lbs (27,000 kg). There were reports of 31 identified mammal species involved in 951 strikes. There were reports of 4 identified reptile species involved in 17 strikes. There were reports of 270 identified bird species involved in 10,775 strikes.

Species involved in less than 10 strikes were dropped (580 reports or 4.94% of the total) from further analysis to allow easier identification of those species that pose the greatest threat to GA aircraft. There were 11 species of mammals and 73 species of birds that were involved in 10 or more strikes.

The 84 species were combined into 25 groups. Each group was ranked on seven factors to determine the wildlife groups that pose the greatest hazard to GA aircraft. The seven factors are:

- The percentage of damaging strikes,
- The number of strikes causing minor or uncertain damage,
- The number of strikes causing substantial damage or destroying the aircraft,

Between January 1, 1990, and December 31, 2007, gulls were involved in 464 reported strikes with GA aircraft; 152 of those strikes caused aircraft damage totaling $3.1 million. (Photo E. Cleary)

- The number of strikes having a negative effect on the flight,
- The amount of aircraft down time for each incident,
- The direct damage cost for each incident, and
- The total secondary cost for each incident.

The results are presented in Table 4.1. Please see Cleary and Dickey (2008a) for a detailed discussion of the ranking process.

The ranking scores for the various ranking factors for all species or species groups were totaled to develop an overall composite ranking.

Ranking all wildlife species or species groups, the six most hazardous species or species groups for fixed-wing aircraft having one or two engines and weighing less than 59,525 lbs (27,000 kg) are (1) deer, (2) gulls/terns, (3) geese, (4) ducks, (5) raptors, and (6) vultures (Table 4.1). The hazard ranking scores are relative to the hazard posed by deer.

The relative hazard scores were adjusted to a scale of 1 to 100, with 100 being the most hazardous. Deer, being the most hazardous, were ranked at 100 on the relative hazard ranking scale. Gulls/terns scored 95; this means they are 5% less hazardous to GA aircraft than deer. Geese scored 69; they are 31% less hazardous than deer.

Ducks scored 56; they are 44% less hazardous than deer. In the lowest ranking, bats, being the least hazardous to GA aircraft, were scored at 14, or 86% less hazardous to GA aircraft than deer (Table 4.1).

Wildlife Strikes at General Aviation Airports

Many GA airports are located in suburban or rural environments. Most of the species involved in the wildlife strikes are ones that are well adapted to the environment found at or near airports. The large open areas at or around airports are well suited to their needs—providing opportunities for feeding, loafing, reproduction, or escape.

Table 4.1. Relative hazard ranking for wildlife species involved in 10 or more strikes with GA aircraft, January 1, 1990, to October 31, 2008, in the United States. The wildlife species are ranked on the relative "severity of outcome" if involved in a strike. Deer, the species having the greatest potential to cause aircraft damage, are ranked highest (100), and all other species are ranked relative to deer. Raptors are about half as hazardous as deer, and bats are 86% less hazardous than deer.

Species or Species Group	Sum of All Rankings	Relative Hazard Rankings
Deer	18	100
Gulls/Terns	19	95
Geese	26	69
Ducks	32	56
Raptors	37	49
Vultures	41	44
Doves	48	38
Canines	50	36
Herons/Egrets/Cranes	52	35
Blackbirds/Starlings	55	33
Pelicans/Cormorants	67	27
Owls	71	25
Crows	78	23
Gallinaceous	82	22
Shorebirds	83	22
Thrushes	83	22
Laysan Albatross	94	19
Sparrow-like	100	18
Foxes/Raccoons	102	18
Meadowlarks	104	17
Swallows	110	16
Perching birds	114	16
Rodents/Lagomorphs	117	15
Bats	127	14

Between January 1, 1990, and December 31, 2007, Canada geese were involved in 216 reported strikes with GA aircraft; 149 of those strikes caused aircraft damage totaling $5.5 million. (Photo courtesy T. Bowman, U.S. FWS National Digital Library)

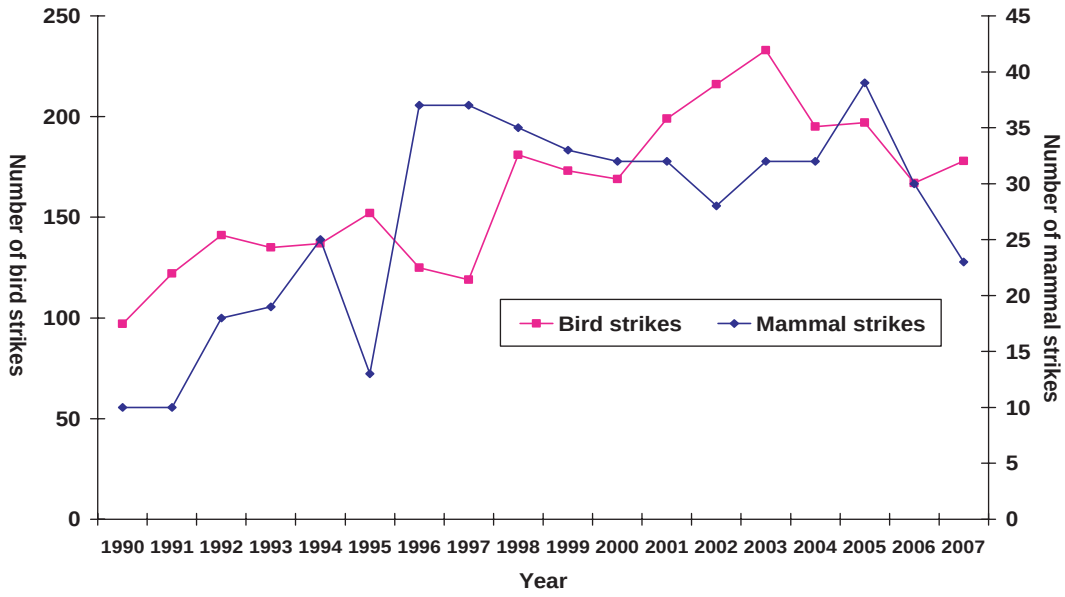

Figure 4.1. Wildlife aircraft strikes at general aviation airports, USA, 1990 to 2007.

There has not been the same significant increase in the number of strikes reported from GA airports as there has been overall for U.S. civil aviation. At GA airports, there was a general increase in the number of reported bird strikes between 1990 and 2004. However, after peaking in 2003, the number of reported bird strikes declined sharply, from a high of 233 in 2003 to 167 in 2006. There was a slight increase in 2007 and early 2008. The number of reported mammal strikes showed a similar pattern. There was a general increase in the number of reported mammal strikes between 1990 and 1997. Since its peak in 1996, there has been a general decline in the number of reported mammal strikes. There was a slight increase in 2005, followed by a sharp decrease in 2006, 2007, and early 2008 (Figure 4.1). The reasons for these fluctuations are unclear. There did not appear to be any correlation between the number of hours flown by GA aircraft and the number of reported strikes.

Between January 1, 1990, and October 31, 2008, the FAA received 3,531 wildlife strike reports from 863 GA airports, involving 189 aircraft types. Admittedly, the sample size is relatively small compared with the overall size of the FAA's database. However, given the number of years covered (almost 19) and the number of GA airports reporting (863), the sample is large enough to allow development of a rudimentary but accurate picture of the hazardous wildlife problems commonly faced at GA airports by GA aircraft.

Almost 86% (N = 3,035) of the reported strikes involved birds; a little over 14% (N = 495) involved mammals. Only two bat strikes and one reptile strike were reported. Because of the low number of bat strikes, no further effort was made to distinguish between terrestrial and flying mammals. These percentages are in marked contrast to what is typically reported. For example, for the period 1990 to 2006, Cleary et al. (2007) found 97.5% of reported U.S. civil aircraft wildlife strikes involved birds, 2.2% involved terrestrial mammals, 0.2% involved bats, and 0.1% involved reptiles.

Please see Cleary and Dickey (2008b) for a detailed analysis of wildlife strikes at GA airports.

The Cost of Wildlife Strikes to General Aviation

For this portion of the analysis, strikes occurring at or near identified U.S. GA airports between January 1, 1990, and October 31, 2009, were considered. During that time the FAA received 88,881 reports of wildlife aircraft strikes involving U.S. civil aircraft; 4% (3,531) of these reports

This Falcon 20 ingested at least four mourning doves into the #1 engine and five into the #2 engine during takeoff from a midwestern airport. About 20 dove carcasses were picked up on the runway at the strike site. The aircraft was damaged beyond repair. Mourning doves weigh about 4 ounces (120 grams). (Photo courtesy USDA)

involved strikes occurring at identified U.S. GA airports and involved fixed-wing aircraft having one or two engines and weighing less than 59,525 lbs (27,000 kg).

Human Deaths and Injuries Resulting from Wildlife Strikes

During the period analyzed, there were 22 bird strikes reported that resulted in 25 human injuries. Waterfowl, vultures, hawks, and pigeons caused the most injuries. There were 19 mammal strikes that resulted in 28 human injuries. Deer, cattle, and domestic dogs caused the most injuries.

No human deaths resulted from wildlife aircraft strikes occurring at GA airports during the time period considered. However, human deaths have occurred because of wildlife strikes to GA aircraft while the aircraft was en route. Most recently:

- The instructor pilot of a Cessna 172 and his student both died when the leading edge of the left wing of their aircraft hit what is believed to have been a black vulture at 800 ft AGL on July 8, 2003, in central Texas. The aircraft was not able to maintain lift and crashed.
- A University of North Dakota instructor pilot and student pilot died October 23, 2007, when their Piper PA-44 Seminole crashed after it struck one or more Canada geese near Browerville, Minnesota.
- Five people died March 4, 2008, northwest of Oklahoma City when their Cessna 500 struck several American white pelicans.

Economic Losses

The economic losses to general aviation due to wildlife strikes are summarized in Table 4.2. For the 18-year, 10-month period, reported losses from all wildlife strikes totaled 303,094 hours of aircraft downtime and $48.6 million in monetary losses. Losses due to bird strikes totaled 102,697 hours of aircraft downtime and $24.2 million in monetary losses. Reported losses from mammal strikes totaled 200,397 hours of aircraft downtime and $24.4 million in monetary losses. Large mammals, particularly deer, represent a greater economic threat to GA aircraft than do birds.

Analysis of wildlife strike reports from U.S. airports and airlines suggests less than 20% of all strikes are reported to the FAA (Cleary et al. 2005 and Wright and Dolbeer 2005).

On approach to an eastern U.S. airport, this CRJ with 35 people on board sustained a goose strike to the radome, at 250 knots. There was major damage to the radome and electronic components. (Photo courtesy FAA)

Table 4.2. Number of reported wildlife strikes indicating damage or a negative EOF, and reported losses in hours of downtime and millions of U.S. dollars, for strikes occurring at identified U.S. general aviation airports involving fixed-wing aircraft having one or two engines and weighing less than 59,525 lbs (27,000 kg), January 1, 1990, to October 31, 2008.

	Total Reports	Total Reports Indicating Adverse Effect	Reports Indicating Negative Effect on Flight	Reports Indicating Other Negative Effect	Reports Indicating Aircraft Damage	Reported Time (Hours) Aircraft out of Service (No. of Reports)	Cost in Millions of Dollars ($) (No. of Reports) Direct Cost	Other Cost	Total Cost
Totals for 18.83 Years	3,531	1,874	1,012	207	1,393	303,094	$44.120	$4.507	$48.627
						(610)	(611)	(257)	(868)
Averages for 18.83 Years	188	100	54	11	74	16,122	$2.347	$0.240	$2.587
						(32)	(33)	(14)	(46)
			Mean loss per incident			497	$0.072	$0.018	$0.090
			Estimated minimum annual loss[1]			49,529	$7.198	$1.748	$8.946
			Estimated maximum annual loss[2]			247,645	$35.989	$8.741	$44.730

[1] Minimum values are based on the assumption that all 1,874 reported strikes indicating an adverse effect (negative EOF and/or damage) to aircraft (mean of 100/year) incurred similar amounts of damage and/or downtime and that these reports are all of the adverse-effect strikes that occurred.

[2] Maximum values are based on the assumption that the 1,874 reported strikes indicating an adverse effect represent only 20% of the total strikes that occurred (Cleary et al. 2005, Wright and Dolbeer 2005).

Assuming (1) all 1,874 reported wildlife strikes that had an adverse effect on the aircraft and/or flight caused similar amounts of downtime and/or monetary losses, and (2) these reports are all the damaging strikes that occurred, then at a minimum, wildlife strikes occurring at GA airports annually cost the GA community 49,529 hours each year of aircraft downtime and $8.95 million in monetary losses.

Further, assuming a 20% reporting rate, the annual cost of wildlife strikes to the GA community is estimated to be in excess of 247,645 hours of aircraft downtime and $44.73 million in monetary losses (see Table 4.2).

General Aviation Airports and Their Legal Responsibilities

General aviation airports range in size from small, privately owned, single turf runways to large metropolitan airports with several runways and thousands of operations a day. Nearly all GA airports face similar problems: a lack of money and the inability to access much of the federal money that larger Part 139 airports can obtain.

Because of these budget constraints, many GA airports do little or nothing about wildlife hazards at and near their airports, despite the fact that aircraft wildlife strikes pose significant safety risks to the flying public. This disregard for wildlife hazards may result in legal action against the airport operator and the airport sponsor or owner. Many GA airport operators and administrators believe that wildlife occurring at or near the airport is natural and that nothing can be done about it. Their feeling is that if an accident occurs as the result of a wildlife strike, it is an act of nature.

Wildlife aircraft strikes can cause injury, death, and/or the loss of an aircraft. Airports may be held liable for not doing enough to control wildlife at or near the airport. Several wildlife aircraft strikes at U.S. airports have resulted in legal action against the airport owners.

February 26, 1973. Cowbirds attracted to this trash transfer station, which is still in operation, were ingested by a Learjet 24 during departure. The aircraft's engines failed and the plane crashed, killing eight people and seriously injuring one person on the ground. After a lengthy litigation, the court finally determined that the airport manager could be held liable for failing to take precautions to end the known bird hazards. (Photo E. Cleary)

These legal accusations against airport owners or operators range from negligence to breach of duty (due diligence). In a case involving the City of New Haven, CT, it was ruled that the airport does have a duty to ensure that the pilots know of all birds or wildlife that are in the area, and in a case involving the City of Watertown, SD, it was ruled that the airport failed to exercise reasonable care to protect pilots and the flying public against the wildlife dangers at the airport.

Several other cases cite that a breach of contract may be present if an airport fails to maintain safe conditions for airport users, especially when there is knowledge of existing bird hazards and bird attractions (food, shelter, etc.) at the airport. The courts have held that in such cases the airport failed to exercise due diligence.

CHAPTER 5

Developing a Wildlife Control Program at General Aviation Airports

Collisions between wildlife and aircraft are not the only threat to aviation safety posed by wildlife. Here European starlings constructed a nest in the aircraft's wing. (Photo courtesy U.S. FWS)

Introduction

It is recognized that GA airports are not subject to 14 CFR 139. However, no matter the size of a GA airport—small or large—it is important to follow the recommended best management practice when dealing with wildlife problems; Part 139 is the nationally and internationally recognized standard. Many states' aviation departments and other countries have adopted and adapted it for their uses. In 14 CFR 139.337, Wildlife Hazards, the FAA sets out what it believes should be in wildlife hazard assessments (WHAs) and in WHMPs. This is the accepted national and international standard for WHAs and WHMPs. Since some states' departments of aviation have adopted in total or in part the FAA requirements, it may be helpful to contact your state department of aviation for further guidance.

This information is presented here as a guide and starting point for GA airport managers when attempting to address hazardous wildlife problems at their airports and may vary greatly in use-

This national wildlife refuge next to a major eastern airport poses a serious hazard to aviation safety. Airport and refuge managers must work closely to reduce the hazard. (Photo E. Cleary)

fulness due to the size of individual airports. As used here, "wildlife hazard survey" and "wildlife hazard assessment" should be considered synonymous and may be used interchangeably.

Not every GA airport will be able to meet the FAA's WHA and WHMP standards when trying to correct airport wildlife problems, nor should every airport have to meet these standards. The extent to which GA airports should try to meet the standards will depend on several factors, including but not necessarily limited to:

- The size of, and aeronautical activity at, the airport;
- The severity of the problem; and
- The resources available—money, personnel, and time—to commit to correcting the problem.

Sources of Funding

Funding for certain parts of an airport's wildlife hazard control program is available through the Office of the Associate Administrator for Airports – Office of Airport Planning and Programming (APP). APP oversees the AIP. The AIP funds can be used by airports to carry out projects aimed at improving airport operations and safety. The AIP funds are distributed either by direct grants to applicant airports or through block grants to various states.

Certain parts of an airport's program to control hazardous wildlife can be paid for with AIP funds. As a general rule, AIP funds can be used to pay for a WHA and to buy equipment necessary to implement a WHMP. AIP funds cannot be used to buy supplies or pay wages. For example, an airport could use AIP funds to buy a propane cannon, but could not pay for the propane using AIP funds. Similarly, the airport could buy a shotgun with AIP funds, but the airport could not buy ammunition for the shotgun with the AIP funds.

In block grant states, airport operators wishing to apply for AIP funds should apply directly to the state department of aviation. In direct grant states, airport operators should apply to the appropriate FAA Airports Division, Regional Office. A list of FAA Regional Offices can be found in Appendix A.

Airports accepting AIP funds are required to comply with all associated Grant Assurances. Grant Assurance 19, *Operation and Maintenance;* Assurance 20, *Hazard Removal and Mitiga-*

Maintaining drainage ditches improves water flow and reduces food and cover sources for birds. (Photo E. Cleary)

tion; and Assurance 21, *Compatible Land Use* have a direct impact on an airport's wildlife hazard control program. The FAA has added several Advisory Circulars to the Grant Assurances. AC 150/5200-33, *Hazardous Wildlife Attractants on or near Airports,* was added to the AIP list of Grant Assurances in July 1999. Therefore, obligated GA airports are bound by the AC's requirements.

Wildlife Hazard Surveys

The first step in developing an airport WHMP is to conduct a WHA. The WHA, conducted by a qualified airport wildlife biologist, provides the scientific basis for the development, implementation, and refinement of a WHMP. Although parts of the WHA may be incorporated directly into the WHMP, they are two separate documents.

Requirement for Wildlife Hazard Assessment

Outside of emergency situations, air carrier aircraft do not use GA airports, and such airports may not be required to conduct WHAs. However, GA airport managers should seriously consider conducting a WHA if GA aircraft operating from the airport suffered a multiple wildlife strike, sustained substantial damage from a strike, or ingested wildlife into an engine.

Title 14 Part 139.337, Wildlife Hazard Management, applies to certificated airports, not GA airports. But, GA airport managers may find this information helpful. Table 5.1 presents a section-by-section discussion of 14 CFR 139.337 (b), which covers triggering events for a WHA. The left-hand column contains the regulations and the right-hand column presents a brief explanation of the intent of each section.

Necessary Elements of a Wildlife Hazard Assessment

Title 14 CFR Part 139.337 (c) (1–5) provides specific guidance as to what facts must be addressed in a WHA. Table 5.2 is a point-by-point commentary on each section of the regulations concerning the factors to be addressed in a WHA.

A light aircraft lands next to an airport retention pond (left) that attracts water birds such as the anhinga (right). Airports that have permanent standing water that attracts hazardous wildlife should conduct a wildlife hazard assessment and take actions to reduce hazards to aviation safety. (Photos E. Cleary)

Table 5.1. Triggering events for a WHA [14 CFR 139.337 (b)].

14 CFR 139.337	Comments
14 CFR 139.337 (b). In a manner authorized by the Administrator, each certificate holder shall ensure that a wildlife hazard assessment is conducted when any of the following events occurs on or near the airport.	A WHA, conducted by a qualified airport wildlife biologist (AC 150/5200-36, Appendix C), must be conducted if—
14 CFR 139.337 (b) (1). An air carrier aircraft experiences a multiple wildlife strike;	Aircraft strikes more than one animal (geese, starlings, bats, deer, coyotes, etc.).
14 CFR 139.337 (b) (2). An air carrier aircraft experiences substantial damage from striking wildlife. As used in this paragraph, substantial damage means damage or structural failure incurred by an aircraft that adversely affects the structural strength, performance, or flight characteristics of the aircraft and that would normally require major repair or replacement of the affected component;	The definition of substantial damage is taken directly from the International Civil Aviation Organization (ICAO) *Manual on the International Civil Aeronautics Organization Bird Strike Information System.*
14 CFR 139.337 (b) (3). An air carrier aircraft experiences an engine ingestion of wildlife; or	Wildlife is ingested into a turboprop, turbofan, or turbojet engine. Engine damage does not have to result from the ingestion.
14 CFR 139.337 (b) (4). Wildlife of a size, or in numbers, capable of causing an event described in paragraph (b)(1), (2), or (3) of this section is observed to have access to any airport flight pattern or aircraft movement area.	Airports with a standing NOTAM announcement on their automatic terminal information service (ATIS), comments in the airport/facility directory (A/FD), or comments on the 5010 warning pilots of wildlife hazards on or near the airport meet this condition.

Table 5.2. Contents of a WHA [14 CFR 139.337 (c)].

14 CFR 139.337	Comments
14 CFR 139.337 (c). The wildlife hazard assessment … shall be conducted by a wildlife damage management biologist … having training or experience in wildlife hazard management at airports … or working under the direct supervision of someone who meets the requirements …	The WHA is to be conducted by someone having the following qualifications: Education • Meets U.S. Office of Personnel Management standards for GS-486 Wildlife Biologist. Work experience • Has prepared a WHA acceptable to the FAA; • Has prepared a WHMP acceptable to the FAA; or • Is working under the direct supervision of someone who meets the above requirements.
14 CFR 139.337 (c) (cont.).… the wildlife hazard assessment shall contain	
14 CFR 139.337 (c) (1). Analysis of the event or circumstances that prompted the study.	Who, what, when, where, why of the situation prompting the WHA.
14 CFR 139.337 (c) (2). Identification of the wildlife species observed and their numbers, locations, local movements, and daily and seasonal occurrences.	What wildlife species have access to the airport? What are their legal statuses, movement patterns, and seasonal patterns? Refer to Table 4.1 for a ranked listing of hazardous species. Pay particular attention to those species considered the most hazardous occurring at or near the airport.
14 CFR 139.337 (c) (3). Identification and location of features on and near the airport that attract wildlife.	Wildlife are attracted to an airport because something exists at or near the airport that they desire, such as large open areas where they can loaf in relative safety; abundant food or water; and/or escape, loafing, or nesting cover. These attractants need to be identified and evaluated.
14 CFR 139.337 (c) (4). Description of the wildlife hazards to air carrier operations.	This is a judgment call best made by a professional wildlife management biologist trained in dealing with airport issues. Hitting three to four swallows is much less hazardous than hitting one 12-pound Canada goose (see Table 4.1).
14 CFR 139.337 (c) (5). Recommended actions for reducing identified wildlife hazards to air carrier operations.	The biologist preparing the WHA must provide prioritized recommendations for mitigating the attractants for hazardous wildlife identified in (c) (3).

Duration of Wildlife Hazard Assessment and Basic Survey Techniques

Conducting a WHA requires the "identification of the wildlife species observed and their numbers, locations, local movements, and daily and seasonal occurrences" (14 CFR 139.337 (c) (2)). Complex situations at large airports may require a 12-month assessment so that the seasonal patterns of birds and other wildlife that use the airport and surrounding area can be properly documented. In less-complex situations, a few days may suffice to identify the majority of problems and suggest possible solutions.

The FAA recommends that standardized survey procedures be used to provide an objective assessment that can be repeated at later dates for comparative purposes. One objective procedure for assessing bird populations, based on North American Breeding Bird Survey methodology, is the establishment of standardized survey points at about a half mile apart throughout the

To ensure accuracy and to get a complete picture of seasonally abundant species, wildlife hazard assessments should last at least 12 months. (Photo courtesy S. Hillebrand, U.S. FWS National Digital Library)

AOA. (Ten to 20 survey points are generally recommended, depending on the size of the airport.) Assigning each bird or bird flock observed during a point count to a grid location can be useful in further refining spatial distributions of birds at the airport. Additional survey points may be established in nearby off-airport areas (such as a taxicab lot, golf course, or city park) suspected of attracting hazardous birds that move across the AOA. Standardized counts of birds should be made at each of these survey points at least twice monthly. In addition, specialized surveys may be needed as part of the overall assessment to document large to midsized mammals such as deer or jackrabbits (from a vehicle using a spotlight or night vision equipment), and small mammals such as voles and mice (snap traps) at the airport. These specialized mammal surveys should be conducted at least twice during a 12-month WHA.

Wildlife Hazard Management Plans

The following applies to certificated airports, not to GA airports. However, GA airport managers may find this information helpful. There are many advantages to developing a WHMP. In particular, it allows the airport manager to develop and set priorities, set bench-

marks, plan budgetary needs, and help justify requests for additional funding. Also, having a WHMP in place would help defend against legal action should a damaging strike occur. A well-developed and well-implemented plan shows that positive actions are being taken to correct hazardous situations.

Requirement for Wildlife Hazard Management Plans

The WHA is used to determine if a WHMP is needed. In addition to the information in the WHA, the airport manager should consider:

- The aeronautical activity at the airport,
- The actions recommended in the WHA to reduce the wildlife hazard,
- The views of the airport manager and airport users, and
- Any other known factors relating to the wildlife hazard.

At a minimum, it is recommended that the airport manager develop and implement a plan to deal with any hazardous wildlife attractants or situations identified in the WHA.

As part of the process of preparing the WHMP, contact the local U.S. FWS Ecological Services Field Office and request information about the presence of federally listed or proposed endangered or threatened species or designated or proposed critical habitat at or near the airport. If federally listed or proposed endangered or threatened species or designated or proposed critical habitat are present, the airport operator must prepare a biological assessment (50 CFR 402.13) assessing the impacts of the WHMP on these species or habitats.

Airport managers may request that the wildlife biologist who prepared the WHA assist with the preparation of the WHMP and review the finished plan. However, only the airport operator can commit airport resources (time, money, and personnel), and the ultimate responsibility for the development and implementation of the plan rests with the airport operator.

The presence of a threatened or endangered species at an airport, such as this nesting California least tern, would constitute extraordinary circumstances and require preparation of either an environmental assessment or an environmental impact statement before the WHMP could receive FAA approval. (Photo courtesy USDA)

Necessary Elements of a Wildlife Hazard Management Plan

The goal of an airport's WHMP is to minimize the risk to aviation safety, airport structures or equipment, or human health posed by populations of hazardous wildlife at and around the airport.

The WHMP must accomplish the following:

- Identify personnel responsible for implementing each phase of the plan,
- Identify and provide information on attractants for hazardous wildlife at or near the airport,
- Identify appropriate wildlife management techniques to minimize the wildlife hazard,
- Prioritize appropriate management measures,
- Recommend necessary equipment and supplies,
- Identify training requirements for the airport personnel who will implement the WHMP, and
- Identify when and how the plan will be reviewed and updated.

At large GA airports it may be helpful for the airport manager to appoint a wildlife hazards working group that periodically reviews the airport's WHMP and the plan's implementation to make recommendations for further refinements or modifications.

14 CFR 139.337 (f) (1–7) provides specific guidance as to what facts must be addressed in a WHMP. Table 5.3 details how the requirements of Part 139.337 (f) (1–7) and 139.337 (g) are to be addressed in an FAA-approved WHMP.

Note: This material is presented as a guide or starting point for GA airport managers. Depending on state regulations, GA airports may not have to meet all of the requirements.

Equipment

Certain basic equipment, such as pyrotechnics, distress calls, and sometimes firearms, is required to adequately control hazardous wildlife at or near an airport. The equipment needed will depend on the species involved, the size of the airport, and the number of personnel used. Appendix D presents a suggested list of equipment that a small- to medium-sized airport should have on hand to deal with hazardous wildlife problems.

Wildlife deterrent devices can be broadly divided into visual, acoustic, and lethal categories. These can be further subdivided into portable and static systems. The levels of sophistication, and therefore cost, are variable and include the simple scarecrow (static visual), complex radio-controlled sound generators (static acoustic), pyrotechnics and vehicle-mounted distress call apparatuses (mobile acoustic), handheld lasers (mobile visual), traps (static lethal), and guns (mobile lethal). The choice of system or systems to be used will depend on cost, legal and logistical constraints, and the species being controlled.

Some of the wildlife control devices available to airports have not undergone a rigorous scientific evaluation of their effectiveness. It is not possible, therefore, to recommend particular devices for wildlife control at every airport.

Table 5.3. Contents of a WHMP [14 CFR 139.337 (f) (1–7) and 139.337 (g)].

14 CFR 139.337	Comments
14 CFR 139.337 (f). The wildlife hazard management plan shall include at least the following:	
14 CFR 139.337 (f) (1). A list of the individuals having authority and responsibility for implementing each aspect of the plan.	Assign or delegate specific responsibilities for specific sections of the WHMP to various airport departments and related agencies, such as: • Airport director • Operations • Maintenance • Security • Planning • Finance • Wildlife coordinator • Wildlife hazards working group • Local law enforcement authorities (that might provide wildlife law enforcement and other support) including: – U.S. Fish and Wildlife Service – State wildlife agency – City police – County sheriff
14 CFR 139.337 (f) (2). A list prioritizing the following actions identified in the wildlife hazard assessment and target dates for their initiation and completion:	Provide a prioritized list of problem wildlife populations and wildlife attractants (food, cover, and water) identified in the WHA, proposed mitigation actions, and target starting and completion dates. A list of completed wildlife population management projects and habitat modification projects designed to reduce the wildlife strike potential can be included to provide a history of work already accomplished. It is helpful to group attractants by areas and ownership. Airport property • AOA • Within 2 miles of AOA • Airport structures Non-airport property • Within 2 miles of AOA • Within 5 miles of AOA

(continued on next page)

Table 5.3. (Continued).

14 CFR 139.337	Comments
14 CFR 139.337 (f) (2) (i). Wildlife population management;	Address species-specific population management plans (such as deer, gulls, geese, and coyotes): • Habitat modification • Resource protection • Repelling/exclusion • Removal Chapter 3 provides a discussion of the various wildlife control methods.
14 CFR 139.337 (f) (2) (ii). Habitat modification; and	Food/prey management: • Rodents • Earthworms • Insects • Grain/seeds • Garbage (handling, storage) • Handouts (feeding wildlife) Vegetation management: • AOA vegetation • Drainage ditch vegetation • Landscaping • Agriculture Water management: • Permanent water • Wetlands • Canals/ditches/streams • Holding ponds • Sewage (glycol) treatment ponds • Other water areas • Ephemeral water – Runways, taxiways, aprons – Other wet areas Airport buildings: • Airfield structures • Abandoned structures • Terminal • Airport construction
14 CFR 139.337 (f) (2) (ii) (cont.). [and] land use changes.	Eliminate activities at or near the airport such as agriculture, surface mining, urban development, and creation of off-airport storm water management systems.

Table 5.3. (Continued).

14 CFR 139.337	Comments
14 CFR 139.337 (f) (3). Requirements for and, where applicable, copies of local, state, and federal wildlife control permits.	Certain species of wildlife may be protected at all levels of government—local, state, and federal—or may not be protected at all, depending on the location and species. Address the specific species involved and their legal statuses in this section. Describe the wildlife management permitting requirements and procedures for all levels of government having jurisdiction, for example. • Federal: 50 CFR, Parts 1 to 199 • State: fish and game code (or equivalent) City, county ordinances • If pesticides are to be used, the following are also needed: – Pesticide use regulations – Federal: Federal Insecticide, Fungicide, and Rodenticide Act – State regulations (varies by state) – Pesticide use licensing requirements Summaries are generally adequate. It is not necessary to quote chapter and verse of federal, state, and local laws and regulations.
14 CFR 139.337 (f) (4). Identification of resources that the certificate holder will provide to implement the plan.	Provide information identifying what resources the airport will supply in terms of • Personnel • Time • Equipment (for example, radios, vehicles, guns, traps, propane cannons) • Supplies (for example, propane, shot gun ammunition, and pyrotechnics) • Pesticides (restricted and nonrestricted use) • Application equipment • Sources for equipment and supplies

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Table 5.3. (Continued).

14 CFR 139.337	Comments
14 CFR 139.337 (f) (5). Procedures to be followed during air carrier operations that at a minimum include	
14 CFR 139.337 (f) (5) (i). Designation of personnel responsible for implementing the procedures;	Who, when, what circumstances: • Wildlife control personnel • Wildlife coordinator • Operations dept. • Maintenance dept. • Security dept. • Air traffic control
14 CFR 139.337 (f) (5) (ii). Provisions to conduct physical inspections of the aircraft movement areas and other areas critical to successfully manage known wildlife hazards before air carrier operations begin;	Who, when, how, what circumstances: • Sweeps of runway and taxiway • Monitoring the AOA and other areas attractive to wildlife
14 CFR 139.337 (f) (5) (iii). Wildlife hazard control measures; and	Who, what circumstances, when, and how are wildlife control personnel contacted? What methods are to be used to • Repel • Capture • Kill
14 CFR 139.337 (f) (5) (iv). Ways to communicate effectively between personnel conducting wildlife control or observing wildlife hazards and the air traffic control tower.	Training in communication procedures Equipment needed, such as radios, cellular phones, and lights
14 CFR 139.337 (f) (6). Procedures to review and evaluate the wildlife hazard management plan annually or following an event described in paragraphs (b)(1), (2), and (3) of this section, including:	At a minimum, hold annual meetings, or after an event described in 139.337(a) (1–3) meet with representatives from all airport departments involved in wildlife hazard management efforts and the qualified airport wildlife biologist (AC 150/5200-36, Appendix C) who did the original WHA.
14 CFR 139.337 (f) (6) (i). The plan's effectiveness in dealing with known wildlife hazards on and in the airport's vicinity, and	Input from all airport departments, air traffic control, and the wildlife biologist as to effectiveness of the plan. Good records are required for evaluating the effectiveness of a program (see Chapter 6).
14 CFR 139.337 (f) (6) (ii). Aspects of the wildlife hazards described in the wildlife hazard assessment that should be reevaluated.	For example • Number of times wildlife seen on AOA. • Requests for wildlife dispersal from air traffic control, pilots, or others. • Increased number of strikes.

Table 5.3. (Continued).

14 CFR 139.337	Comments
14 CFR 139.337 (f) (7). A training program conducted by a qualified wildlife damage management biologist to provide airport personnel with the knowledge and skills needed to successfully carry out the wildlife hazard management plan required by paragraph (d) of this section.	Training and/or certification for • Wildlife control personnel • Other airport personnel • Pesticide user (see Chapter 7)
14 CFR 139.337 (g). FAA Advisory Circulars contain methods and procedures for wildlife hazard management at airports that are acceptable to the administrator.	AC 150/5200-33, *Hazardous Wildlife Attractants on or near Airports*

Portable Equipment

Portable equipment used by airport personnel at the airport offers the best control, provided the personnel involved are properly trained and motivated. Wildlife perceive pyrotechnics or vehicle-mounted distress call generators as direct threats. Perceived threats are variable in time and location, thus increasing their effectiveness. This variability is not possible with static systems.

Consistent with relevant wildlife take laws and regulations and controls on the use of firearms, wildlife control personnel might need firearms to remove wildlife that cannot be dispersed by nonlethal means. When using firearms, wildlife control personnel must be properly trained, have the proper firearms and ammunition, and have the necessary federal and state permits.

There is some debate about the need for lethal control in airport wildlife management. However, most experts agree that nonlethal pyrotechnics and other devices must occasionally be reinforced with lethal control to maintain their effectiveness. The occasional use of lethal control reduces wildlife habituation to nonlethal control devices and allows selective removal of any wildlife failing to respond to nonlethal dispersal techniques.

Safe and effective use of pyrotechnics requires training and experience. [Photos J. Metcalf, Greater Orlando Aviation Authority (GOAA)]

Static devices lose their effectiveness very quickly. Once the wildlife learns that the devices are harmless, they will completely ignore them. (Photos E. Cleary)

Static Devices

Static wildlife scaring devices, such as gas cannons or other sound generators, lose their effectiveness quickly. Some of the more sophisticated devices that produce various sounds in random or preprogrammed order can delay habituation. Static devices are best for short-term use over a limited area and should be used with portable equipment already described.

Trained Predators (Raptors and Dogs)

Trained raptors and dogs can be effective in dispersing some species of wildlife in certain situations. Raptors and dogs are only one tool among many. They are not a panacea. The successful use of raptors and dogs requires a large investment in training for the animals and their handlers. This training is essential to ensure that the animals themselves do not become a strike risk and to maximize their deterrent value. Do not underestimate the time and cost involved in incorporating raptors or dogs into a wildlife control program. The use of trained predators alone is not an acceptable substitute for the use of other wildlife management techniques.

Logging Wildlife Management Activities

Many aircraft owners and their insurance companies are taking legal action against airport managers and regulators to recover the costs of wildlife strike damage. It is important that whoever is responsible for airport wildlife control record all wildlife control actions taken. If an incident occurs, these records can help prove that a satisfactory wildlife control program was in place and that the program was functioning properly. Data gathered as part of a wildlife control program is also important in assessing the effectiveness of control actions taken. There are several different methods for recording data—everything from simple paper records to sophisticated devices based on pocket PC technology. The latter save time and effort, especially when entering the data onto a computer for further analysis. Regardless of the recording methods used, keep a detailed and comprehensive record of all wildlife control activities. Summarize these records at least every 12 consecutive months. This will help prove the airport is following its own policies and procedures.

The use of trained predators should be considered as one more tool in the toolbox, not as a panacea. Due to the cost of falconry, only large, well-funded airports may be able to afford it. (Photo J. Metcalf, GOAA)

Wildlife Strike Reporting

All wildlife management programs must be monitored to see if they are working effectively and whether they need to be adjusted, extended, or improved. The only effective way to do this is by collating wildlife strike data for the airport concerned. Other measures, such as counting the wildlife at the airport, provide useful added information but are not a direct measure of the strike risk at the airport.

Report all strikes, whether or not they cause damage to the aircraft and regardless of the wildlife species involved. Unless the species struck at the airport are known, management efforts cannot be directed correctly. Do not penalize airport or aircraft operators for reporting wildlife strikes. Even though strikes from small species such as swallows or sparrow-sized birds are unlikely to cause damage, encourage airport personnel or aircraft owners to report them.

Note: Never use the total number of strikes at an airport as a measure of strike risk or the performance of the wildlife control specialists.

The number of reported strikes should increase when a wildlife hazard control program is started and airport personnel become aware of the situation and the need to report strikes. The increase in reported strikes may be an artifact of education and effort, not the result of an increase in the number of strikes. The main risk arises from strikes with larger species and smaller species that form large flocks (for example, European starlings). Use a risk assessment that combines strike frequency with likely severity to assess the risk. Remember, a risk assessment cannot work effectively unless all strikes are reported.

CHAPTER 6

Evaluating Wildlife Hazard Management Programs at General Aviation Airports

On January 17, 2009, a Baptist Health MedFlight departed Memphis en route back to Little Rock without a patient. MedFlight struck a flock of birds around the Forrest City area and made an emergency landing. The MedFlight crews do not wear helmets, and crew members were lucky the pilot's vision remained intact to land the aircraft. (Photo courtesy USDA)

Introduction

The following material is presented with the largest, busiest GA airports in mind. These airports often face many of the same hazardous wildlife problems as certificated airports. Such airports would do well to imitate the wildlife hazard program recordkeeping and evaluation procedures recommended for certificated airports. Medium to small GA airports may not need such a complex recordkeeping system, and airport operators at these smaller airports can take this material and adapt it to their needs.

Wildlife populations at and in the vicinity of airports are constantly changing in response to changes in land use, state and federal management policies, and environmental factors. In addition, wildlife may adapt or habituate to control strategies that were once effective, or they may develop new behavioral or feeding patterns at or near the airport. New wildlife control technologies may become available, or established products or techniques may be withdrawn or banned. Finally, there could be changes in wildlife control and management personnel at an airport. Once

a WHMP is in place, develop a process to evaluate the program at least annually. This chapter outlines a means of conducting such evaluations.

Monitoring and Recordkeeping

Without accurate records and proper program evaluations, it is difficult to justify and defend certain management actions, such as wildlife removal, or to defend the airport during litigation in the aftermath of a damaging wildlife strike. Without consistently maintained records of wildlife activity, wildlife strikes, and wildlife management actions, the proper evaluation of a program is impossible. Without evaluation, no assessment of the effectiveness of a program can be made.

Hazard Assessments, Plans, and Studies

As will be discussed in Chapter 7, to facilitate access and reduce losses, keep all reference books, such as wildlife field guides, videos, posters, and other training and educational materials, in a specific location. For ready reference have copies of WHAs, wildlife hazard management programs, and other relevant wildlife studies conducted at the airport available. Ideally, locate the wildlife library at the site where information on wildlife control activities and wildlife strikes is entered into logs, files, and databases.

Daily Log of Wildlife Control Activities

Maintain a daily log of wildlife activity and management actions; important factors to record include:

- Date, time, and location at airport where wildlife is observed,
- Species of wildlife and approximate numbers, and
- Control actions taken and response of wildlife.

Record this information on a standard form (see Table 6.1 for an example of a daily log form) that can be used by wildlife control personnel at the site where the activity takes place. If a form is not available, record the information in a logbook kept at the operations base. Airport managers

Bird surveys should be conducted at least monthly. The surveys should be random in time and pattern to minimize sampling errors. (Photo E. Cleary)

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are encouraged to copy any of the tables or forms in this guidebook and adapt the forms for their particular airports and needs.

The use of a standardized form or recording format, such as that presented in Table 6.1, is strongly recommended. The information recorded will be most useful if it is summarized into monthly and annual statistics (see Table 6.3). Use of a standardized format allows this summarization to be easily done. The use of computerized database systems customized to provide summaries of wildlife control activities is recommended.

Log of Wildlife Strikes

Maintaining a consistent record of wildlife strikes is essential for defining the wildlife hazard level for an airport and for evaluating the airport's wildlife hazard management program. In addition to maintaining these strike records for internal use at the airport, electronically submit (preferred method, http://wildlife-mitigation.tc.faa.gov/wildlife/strikenew.aspx) or mail (using FAA Form 5200-7, Bird/Other Wildlife Strike Report—see Appendix F) strike reports to the FAA. The FAA will incorporate the information into the FAA National Wildlife Aircraft Strike Database (http://wildlife-mitigation.tc.faa.gov).

A wildlife strike has occurred when:

1. A pilot reports striking one 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 one or more birds or other wildlife;
4. The animal's presence at the airport had a significant negative effect on a flight (such as aborted takeoff or landing, high-speed emergency stop, or aircraft leaving pavement area to avoid collision with animal); or
5. Bird or other wildlife remains are found within 200 ft of the centerline of a runway, unless another reason for the animal's death is identified.

In the United States, there is no regulatory requirement to report a wildlife aircraft strike. However, airport personnel, pilots, and ATC tower personnel are strongly encouraged to report all wildlife strikes. Without an accurate record of wildlife strikes, it is impossible to evaluate the

This is the second damaging bird strike this Rockwell Commander has suffered in less than 10 years. The bird was struck at 1,500 AGL and at about 130 kts. (Photo courtesy B. Mackinnon, Transport Canada)

Whenever possible, photograph all bird strike damage. This Diamond 20 struck a tundra swan at 2,000 ft AGL, 120 kts, and sustained over $32,000 in damage. (Photo courtesy of FAA)

potential hazard at an airport or evaluate the effectiveness of a control program. Record each strike event electronically at http://wildlife-mitigation.tc.faa.gov or on FAA Form 5200-7, Bird/Other Wildlife Strike Report (see Appendix F). Mail photocopies of the paper form to the FAA at:

Federal Aviation Administration
Office of Airport Safety and Standards, AAS-310
800 Independence Avenue, SW
Washington, DC 20591

When filling out Form 5200-7, include as much of the information requested as is available. Typically, not all information requested on the form will be available or known, but the report is valuable even if some information is missing.

For Category 5 strikes, include a notation that a carcass was found but no strike was reported. For all strike reports, make every effort to have the wildlife correctly identified by species. Freeze specimens that cannot be readily identified in a labeled bag until a local wildlife expert can be consulted. If only feather remains are available, mail them and a completed copy of FAA form 5200-7 Bird/Other Wildlife Strike Report to the Smithsonian's Feather Identification Laboratory for identification.

AC 150/5200-32, *Reporting Wildlife Aircraft Strikes,* provides instructions on submitting bird strike remains for identification. There is no charge for this identification service. Please include a copy of the strike report or other relevant information along with the bird remains to assist the feather experts in identification.

Material sent via Express Mail Service:
Feather Identification Laboratory
Smithsonian Institution
NHB, E610, MRC 116
10th & Constitution Ave, NW
Washington, DC 20560-0116
(Identify as "safety investigation material")
Phone# 202-633-0787 or 202-633-0791

Material sent via U.S. Postal Service:
Feather Identification Laboratory
Smithsonian Institution, Division of Birds
PO Box 37012
NHB, E610, MRC 116
Washington, DC 20013-7012
(Not recommended for priority cases)

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Records of Significant Management Actions Taken

In addition to maintaining a daily log of wildlife control activities and wildlife strikes, it is important to keep records of other preventative management actions that may not be part of the daily routine of wildlife control. Examples of such actions could be installing or repairing fencing, thinning trees, clearing construction debris, applying pesticides or repellents, conducting grass height management, installing netting in hangars or wires over ponds, and regrading pavement or grass areas to eliminate standing water. Activities such as writing letters to catering services about proper storage of food waste are also important management actions. Documenting these activities in some type of summary file or table can aid in determining the total cost and effectiveness of the wildlife control program.

Summary Reports by Month and Year

Periodically summarize information from the daily wildlife control activities log and from records of wildlife strikes to provide baseline data for analyzing and evaluating the wildlife control program. A logical approach is to conduct monthly summaries that are then incorporated into an annual report. These summaries do not need to be complex but must reflect the level of activity for the common control techniques deployed. For example, monthly summaries of pyrotechnics fired, runway sweeps to clear birds, distress call deployments, birds and mammals removed (listed by species), and wildlife strikes (listed by species) would be useful (see Table 6.2). Prepare a short paragraph outlining other significant activities during the month, such as repairing a fence, meeting with airport tenants about wildlife issues such as feeding birds in taxi stand area, or regrading an area to remove standing water. Prepare an annual report (see Table 6.3) by combining data from the monthly reports.

It is emphasized that Tables 6.2 and 6.3 are only presented as examples to provide guidance in developing a format to summarize data. A particular airport might use methods not listed in Tables 6.2 and 6.3, such as falconry, radio-controlled model airplanes, dogs, or propane cannons. The important point is that there must be an impartial, numerical documentation of wildlife control methods deployed and wildlife strikes occurring at the airport. The use of a computer database can be extremely helpful in producing these summary reports.

The hole in this fence allows feral dogs and other medium-sized mammals easy access to the airport. It is important to record both the date the hole was first found and the date it was repaired. (Photo E. Cleary)

Training

Maintain and annually summarize a record of all training that wildlife control personnel have received. Include attendance at conferences, courses, and workshops (for example, firearms safety); self-study courses; and specialized on-the-job training.

Evaluation of Wildlife Hazard Management Programs

Wildlife hazard management programs should be reviewed at least annually or following an event that would normally trigger a WHA. The review should include the program's effectiveness in dealing with known wildlife hazards at and in the vicinity of the airport, and aspects of the wildlife hazards described in the WHA that should be reevaluated. The qualified airport wildlife biologist who helped prepare the program and a subgroup from the airport's wildlife hazard working group should conduct this review.

Appendix E describes a simple system (modified from Seubert 1994) for assessing a WHMP at an airport. Five assessment categories are used to indicate the adequacy of a wildlife hazard control program and how well the program is being implemented:

Category 1. Management functions related to wildlife hazards at or in the vicinity of the airport.

Category 2. Bird control at or in the vicinity of the airport.

Category 3. Mammal control at or in the vicinity of the airport.

Category 4. Management of habitat and food sources on airport property related to wildlife hazards.

Category 5. Land uses and food sources off of the airport potentially related to wildlife hazards at the airport.

Within categories 1 to 4 (activities at the airport), a series of elements are listed that are evaluated as either "Satisfactory," "Unsatisfactory," "Needs Improvement," or "Not Applicable." For

This helicopter was traveling at 80 MPH when it struck a bald eagle at 2,000 ft AGL. The eagle penetrated the windshield, striking a passenger in the chest. (Photo C. Cooper, Hummingbird Helicopters)

category 5 (off-airport attractants), the elements are scored on a scale of 0 (not present) to 3 (site creates significant wildlife hazard for airport; action should be taken). Those elements deemed "Unsatisfactory" or "Needs Improvement" (in categories 1 to 4) or that are scored 2 or 3 (in category 5) are then commented on in a summary form. The elements listed within each category are not intended to cover every possibility at every airport, and the elements can be modified or expanded to meet situations unique to an airport.

Airport Wildlife Hazards Working Group

Function

Wildlife hazard management at an airport often requires communication, cooperation, and coordination among various groups at the airport and with various local, state, and federal agencies and private entities. For many large GA airports, the establishment of an airport wildlife hazards working group (AWHWG) will greatly facilitate this communication, cooperation, and coordination. Medium to small GA airports with few staff may not need such a complex organization to deal with wildlife problems.

Membership

Include in the AWHWG a representative from each of the key groups and agencies that have a significant involvement or interest in wildlife issues at the airport. AWHWGs could include representatives from the airport advisory board and the local office of the National Audubon Society, any fixed base operators at the airport, the airport manager, and representatives from the city or county council. If a WHA was done, it may also be helpful to have the wildlife biologist who conducted the WHA in the AWHWG. Also, include representatives from any facility near the airport that significantly attracts wildlife (such as a landfill or wildlife refuge).

In general, do not exceed 10 people in the core AWHWG. This will keep meetings from becoming unwieldy. In addition to regular members, invite to the meetings, as appropriate, people with

An airport wildlife hazard working group (AWHWG) should be made up of representatives from the airport, pilots, fixed base operators, wildlife biologists, and local government. (Photo courtesy FAA)

Here representatives from the AWHWG are reviewing proposed changes to the airport's layout plan to ensure compatibility with goals for management of hazardous wildlife. (Photo courtesy FAA)

specialized knowledge, interest, or concerns. Typically, someone from airport management chairs the AWHWG. Minutes of each meeting should be kept and distributed to all members.

Summary and Conclusions

Periodic evaluations of an airport's WHMP and the activities undertaken to implement the program are critical because of the dynamic nature of wildlife hazards and control technologies. The foundation for these evaluations is the maintenance of consistent records of wildlife control

One of the goals of the AWHWG is to work with state and federal wildlife management agencies to ensure that all practical steps are taken to prevent hazardous wildlife from being attracted to the airport. (Photo J. Metcalf, GOAA)

activities and wildlife strikes. The use of standardized formats for keeping these records, such as those presented in Tables 6.1 to 6.3, permits easy compilation of events and activities into monthly and annual statistical and narrative summaries. Once these summaries are available, objective examinations and comparisons can be made of trends in strikes, wildlife activities, control methods deployed, and other factors.

An objective, standardized format for assessing a WHMP and its implementation is presented in Appendix E. This format allows an outside biologist or evaluation group to systematically review the actions being taken and make recommendations in areas where improvements are needed. The availability of summary statistics such as those provided through recordkeeping is essential for this assessment.

Finally, the establishment of an AWHWG provides an excellent means of improving communication, coordination, and cooperation among the diverse groups involved in wildlife hazard management at an airport. The AWHWG also can provide an important forum for reviewing, evaluating, and improving an airport's WHMP.

The following tables can be downloaded and printed from the TRB website by accessing the overall report. To find this report, go to www.trb.org and search for "ACRP Report 32."

Table 6.1. Example of a daily log of wildlife control activities.

Airport:					Month:		Year:
Date	Time	Location (Grid)	Wildlife		Control Method	Results/Comments	Initials
			Species	No.			

Table 6.2. Example of a form to provide monthly summary of wildlife control activities.

Airport:			Month:	Year:
Control Activity[1]	This Month	Same Month Last Year	Comments (List wildlife dispersed or removed by species and method.)	
No. of pyrotechnics fired				
No. of times distress calls deployed				
No. of runway sweeps to clear birds				
No. of wildlife removed				
Miles driven by wildlife patrol				
No. of reported strikes				
No. of reported strikes with damage				
No. of carcasses found (no strike reported)				
Summary of other wildlife control activities:				

[1] Modify list as appropriate.

Table 6.3. Example of a form to provide annual summary of wildlife control activities derived from monthly reports (Table 6.2). Modify each airport's form to reflect the common control activities undertaken during the year. The data may also be presented graphically.

Airport:								Year:	
	Number of:								
Month	Pyro-technics Fired	Times Distress Calls Deployed	Runway Sweeps to Clear Birds	Wildlife Dispersed	Wildlife Removed[1]	Miles Driven by Wildlife Patrol	Reported Strikes[2]	Reported Strikes with Damage	Carcasses Found (No Strike Reported)[2]
Jan									
Feb									
Mar									
Apr									
May									
June									
July									
Aug									
Sep									
Oct									
Nov									
Dec									
Total									

[1] Provide separate list by species and method.
[2] Provide separate list by species.

CHAPTER 7

Wildlife Hazard Management Training for General Aviation Airport Personnel

This Learjet struck a deer while landing at Troy, Alabama. The aircraft went off the runway and was destroyed by fire. The pilot and copilot escaped. One month later, a second aircraft struck another deer. The airport did not have a perimeter fence installed at the time of the two accidents. (Photo courtesy of USDA.)

Introduction

The management of wildlife is a complex endeavor that often attracts public interest. Once an assessment of hazards has been completed and a wildlife hazard control program has been developed, the program must be implemented by well-trained and knowledgeable individuals if it is to be successful in reducing wildlife strikes and to be accepted by the public.

Training from recognized experts should include classroom instruction, fieldwork, and attendance at conferences, such as the Bird Strike Committee–USA/Canada. (Photo C. Steves, FAA)

Depending on the size of an airport and the level of wildlife hazard, the wildlife hazard control program may be implemented by a single airport employee undertaking wildlife control activities on an occasional "as needed" basis or by a full-time wildlife biologist with a staff of operations personnel providing continuous bird patrols. Many of the smaller GA airports fall into the first category, while some of the larger GA airports may fall into the latter.

At many GA airports the personnel involved in these control activities, hereafter referred to as wildlife control personnel (WCP), probably do not have any formal education in wildlife biology. However, all WCP must have sufficient training to be knowledgeable in the basic principles of wildlife management and in the identification, behavior, general life history, and legal statuses of the hazardous species in the area. WCP also must be trained in the safe and proper use of various control strategies and techniques outlined in the wildlife hazard control program. Finally, an awareness of endangered and threatened wildlife species that might visit or reside at the airport is critical.

Training

GA airport managers or administrators must ensure that WCP have the necessary knowledge, skills, and abilities to successfully carry out the work of controlling hazardous wildlife. The following material presents a synopsis of the recommended areas of training that WCP must have to successfully implement control activities at GA airports. It is emphasized that once a program is in place, in addition to the training provided to WCP, there should be periodic oversight and review of the program and its implementation by a professional biologist trained in wildlife damage control.

Bird Identification

To become an expert in field identification of all bird species at a location requires many years of training and practice. There are over 600 species of birds that reside in or migrate through the United States. Many of these species, such as gulls, have quite different plumage patterns and bill colors as sub-adults (year of hatching up to 3 years in some species) than as adults. Some birds,

Many species of birds look different in winter and summer. Left: Adult laughing gulls in winter plumage. Right: Adult laughing gull in summer breeding plumage. (Photos, left: E. Cleary; right: courtesy D. Dewhurst, U.S. FWS National Digital Library)

such as laughing gulls, European starlings, and black-bellied plovers, have different summer and winter plumage patterns and bill colors. In other species, such as northern harriers and red-winged blackbirds, males and females appear quite different. Some species are present in an area all year; others are present only in migration (spring and fall), and others are present only in winter or in summer. All species have unique vocalizations, behaviors, and habitat preferences that are useful in field identification. WCP require basic training so that they can identify, in all plumages, commonly seen hazardous birds, as well as those rarer species that are considered hazardous when present or are of concern because of their status as endangered or threatened species. Figure 7.1 shows the relative hazard rankings for the 24 wildlife groups or species posing the greatest hazard to fixed-wing aircraft having one or two engines and weighing less than 59,525 lbs (27,000 kg). Refer to Chapter 4 for the discussion of how the various hazardous wildlife species were ranked.

A good pair of at least 10×40 binoculars is essential for detailed, close-up observations that are sometimes necessary for identification as well as for the detection of birds or other wildlife at a distance. Provide WCP with a quality pair of binoculars and train them in their use.

Equip all WCP with their own bird identification field guides, to be carried in the vehicle while on patrol. There are a number of excellent field guides available from bookstores, some of which are listed at the end of this chapter. There are also bird identification guides available on compact discs that provide useful life history information and vocalizations. As a learning aid, encourage WCP to make annotations regarding behavior or appearance next to identified birds in their field guides.

Mammal Identification

Unlike birds, there are typically only a few mammal species of importance at an airport. Train WCP to identify, not only by sight but also by signs, tracks, burrows, and fecal material, the common large and midsized mammals (for example, deer, raccoons, woodchucks, and coyotes) that live around the airport. Train WCP to identify signs (such as trails in grass and burrows) indicative of a population eruption of field rodents such as voles, deer mice, or rats. A survey by a biologist using snap traps might be necessary to identify the species and relative abundance of rodents occupying various airport habitats. In addition, rodent species can be identified by

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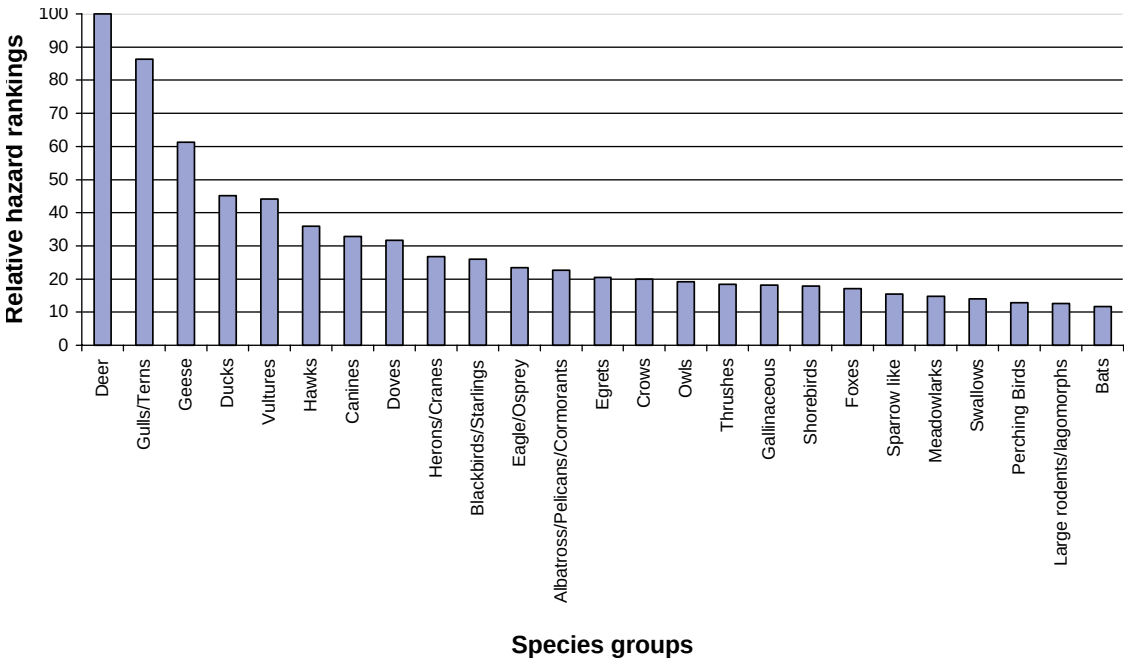

Figure 7.1. Relative hazard ranking of various wildlife species to GA aircraft. The wildlife species listed are ranked by the relative "severity of outcome" if they are involved in a strike. Deer, the species having the greatest potential to cause aircraft damage, are ranked highest (100); all other species are ranked relative to deer. Raptors and vultures are about half as hazardous as deer, and bats are about one-tenth as hazardous.

examination of skull remains in pellets (boluses) regurgitated by hawks and owls. These pellets are often found on the ground beneath perching sites used by raptors.

Citations for field guides covering mammals and their tracks throughout the United States are provided in the "Field Guides" section of the bibliography. In addition, there are many state and regional field guides for identifying mammals and their signs. A good field guide to mammals is a necessary part of any airport's wildlife hazard control library.

Basic Life Histories and Behavior of Common Species

In addition to learning to identify the hazardous birds and mammals at the airport, WCP should have some understanding of the biology and behavior of these species. This information will make the job of wildlife hazard management more interesting and be useful in anticipating problems and deploying control measures more effectively. The most useful information will come from careful observation of what the birds and mammals are doing on the airport grounds.

There are a number of questions WCP should ask and try to answer when evaluating and identifying wildlife hazards:

- At what time of year and time of day are the hazardous birds present at the airport?
- In which habitats and at what time of year do locally breeding bird species nest?
- When are young fledged from nests?
- What are the daily movement patterns between roosting, feeding, and loafing areas in relation to the airport?
- What are the feeding behaviors and food preferences of each species at the airport?
- Which habitats does each species prefer?

Grass areas at airports often contain several species of small mammals that are an attractive food for hawks, owls, herons, and egrets. Vagrant shrews, deer mice, gray-tailed voles, and Townsend's voles (left to right) were all captured during one night of trapping at a western U.S. airport in September 2003. (Photo R. Dolbeer)

- How does weather influence the presence and behavior of various species at the airport?
- How does each species react to approaching aircraft and to various repellent devices?

By being observant and noting the behavior of these hazardous species, WCP can gain useful insights that will lead to more effective habitat management or repellent strategies.

Most bird and mammal field guides provide information on geographic range, feeding habits, and habitat preferences for each species. Ehrlich et al. (1988), Alsop (2001), and Sibley (2009) provide concise summaries of life history information (nesting, feeding, and habitat preferences)

Pyrotechnics are the most commonly used wildlife repellent at airports. They can cause serious injuries or start fires if misused. Airport personnel who will be using pyrotechnics should receive professional training in their use and safety. (Photo E. Cleary)

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for most birds in North America. Chapter 1 contains several fact sheets covering control options, legal statuses, and basic life histories for some of the most hazardous birds and mammal species. Such books and fact sheets provide an excellent starting point for knowledge about a species.

Wildlife and Environmental Laws and Regulations

As will be discussed in Chapter 8, there is a complexity of federal and state laws protecting wildlife and regulating the issuance of permits to take (capture or kill) individuals causing problems. In addition, environmental laws and regulations regarding pesticide applications, drainage of wetlands, and endangered species must be considered in implementing wildlife hazard control programs. All WCP should have a basic understanding of the federal Migratory Bird Treaty Act (MBTA), whereby almost all native migratory birds are protected regardless of their abundance. WCP must understand that federal and often state permits must be issued before protected species can be taken at an airport. WCP must know that wild mammals are regulated at the state level, which may require permits for activities involving removal (killing or trapping/relocating). Nonnative birds, such as rock pigeons (feral pigeons), house sparrows, and starlings, and gallinaceous game birds, such as turkeys, grouse, and pheasants, are not protected by the MBTA but often have state protection. WCP involved in taking any wildlife species must have a clear understanding of which species have no legal protection and, for all others, the species and numbers allowed to be taken under permits issued. Permits also will list the methods of removal allowed and acceptable procedures for disposing of removed wildlife. Detailed records of wildlife taken under permit must be maintained.

Wildlife Control Techniques

Chapter 3 provides a brief description of most wildlife control techniques used at airports. WCP will need training to deploy these techniques safely and effectively.

Firearms

It is critical that only personnel trained in the use of firearms, authorized under a depredation permit, and knowledgeable in field identification of the target species and similar-looking non-

At some airports reptiles such as this green iguana can cause more problems than mammals or birds. The iguana is being kept off the runway by an iguana-resistant fence. (Photo B. Constentine)

target species be allowed to use firearms on airport grounds. Skill, experience, and the proper equipment are needed to be safe and to maximize the effectiveness of a shooting program, whether it is to remove specific problem animals or to kill one or more individuals to reinforce repellent techniques. All discharged shell casings are potential foreign object debris and must be picked up.

Pyrotechnics

Pyrotechnics can cause injury or damage if discharged incorrectly or carelessly. For example, serious injuries have occurred when pyrotechnics were accidentally discharged inside vehicles. Proper equipment (e.g., safety glasses and ear protection) and training are essential for safe use of pyrotechnics. In addition, training is needed to deploy the correct pyrotechnic for each situation and wildlife species and to minimize habituation. It is critical that pyrotechnics (and other repellent devices) not be deployed in situations where the birds or mammals might be flushed into the path of departing or arriving aircraft.

Pesticide Application

WCP applying restricted use pesticides, applying pesticides for hire, or applying pesticides to the land of another must be certified applicators or working under the direct supervision of a certified applicator, and even then they may only use pesticides covered by the certified applicator's certification. Proper application equipment and safety clothing must be used. Detailed records of pesticide applications must be maintained.

For information on the training requirements for becoming a certified pesticide applicator, contact the state university cooperative extension service.

Distress Call Tapes, Propane Cannons, and Miscellaneous Techniques

As emphasized in Chapter 3, a major problem in the use of repelling techniques or devices is habituation of the wildlife species to the threats. These techniques all require training for their proper deployment. The most critical factor for most repelling devices is that they be deployed sparingly and appropriately when the target wildlife is present and be reinforced occasionally by a real threat such as shooting. More detailed information on the use of various repelling devices is presented in Chapter 3 and Hygnstrom et al. (1994).

Propane cannons will quickly lose their effectiveness if used constantly without lethal reinforcement. (Photo J. Metcalf, GOAA)

Burrowing owls are attracted to prairie dog burrows at several southwestern airports. In some states, both prairie dogs and burrowing owls are protected, and the state is very reluctant to allow any lethal control of prairie dogs. (Photo E. Cleary)

Recordkeeping and Strike Reporting

A key component of a wildlife hazard control program is developing a system to (1) document the daily activities of WCP, (2) log information about wildlife numbers and behavior at the airport, and (3) record all wildlife aircraft strikes. This information is essential to document the effort being made by the airport in reducing wildlife hazards. The information is also extremely useful during periodic evaluations of the wildlife hazard control program and when revisions to the program are proposed. Instruct WCP on the importance of recordkeeping and train them to record this information in a standardized format. Chapter 6 provides more details about recordkeeping and wildlife strike reporting.

Sources of Training

Wildlife Control Workshops at Airports

Books, manuals, and videos can provide a starting point for building skills to manage hazardous wildlife at airports. However, hands-on training is essential to develop the necessary skills and confidence to successfully and safely carry out wildlife control activities. Workshops on airport wildlife control offered by private contractors or government agencies are an excellent means of obtaining training in wildlife identification, legal issues, and the deployment of various control techniques specific for a given airport or region of the country. These workshops can be held for all WCP at a single airport or at a centralized airport with participants coming from airports throughout the state or region.

Bird Strike Committee–USA Meetings

Bird Strike Committee–USA (BSC–USA) holds joint meetings annually with Bird Strike Committee–Canada at an American or Canadian airport. This annual meeting provides an excellent forum to discuss the latest issues and techniques in wildlife control for airports. The meeting includes demonstrations of various wildlife control equipment and techniques conducted by vendors and wildlife specialists.

Participation in the annual BSC–USA meetings is open to anyone interested in reducing wildlife hazards to aviation or in wildlife and environmental management at airports. Informa-

There are several private contractors that can provide wildlife control workshops for airport personnel. (Photo E. Cleary)

tion on annual meetings as well as information on various aspects of wildlife hazard management for airports can be found at BSC–USA's website, www.birdstrike.org.

Hunter Safety and Firearms Courses

Require airport personnel who will be using firearms to complete a hunter safety or firearms safety course. Local gun clubs, private contractors, and state wildlife agencies can provide information on these courses.

Miscellaneous Courses and Activities

Many universities and some community colleges offer courses in ornithology, principles of wildlife management, principles of wildlife damage control, or other related topics. Local Audubon Society chapters or park districts sometimes offer workshops or short courses in field identification of birds. Participation in conservation organization activities, such as Christmas

Any airport employee who will be using firearms to help control hazardous wildlife must have training in the safe and proper use and handling of firearms. (Photo E. Cleary)

bird counts and spring migration counts, is an excellent means of building bird identification skills and developing contacts with local wildlife experts.

Wildlife Hazard Management Library

Establish a designated location for references such as wildlife field guides, videos, posters, and other training and educational materials. Ideally, locate this wildlife library at the site where information on wildlife control activities and wildlife strikes is entered into logs, files, and databases.

Field Guides and Reference Books

There are many excellent field guides and reference books for learning about wildlife. There are also many field guides for individual states and specialized books for various wildlife species or species groups. A selection of books that cover North America or large regions of the United States is listed in the "Field Guides" section of the bibliography. This list is not exhaustive nor intended as an endorsement of these books to the exclusion of others, but rather as examples of what is available.

CHAPTER 8

Government Agencies and Regulations Impacting Wildlife Hazard Control at General Aviation Airports

This Cessna 150 crash-landed in a tomato field and was damaged beyond repair after a hawk shattered the windshield during approach to a western U.S. airport on July 20, 2007. (Photo courtesy USDA)

Introduction

Wildlife management is a complex mixture of science, experience, and art, regulated and implemented by various federal, state, and local governmental agencies. Overlapping federal, state, and local regulations enforced by the various governmental organizations protect wildlife and associated wildlife habitat. This chapter provides an overview of the roles and responsibilities of various agencies and organizations that influence wildlife management at or near airports.

Federal Agencies

U.S. Department of Transportation, Federal Aviation Administration

Mission and Responsibilities

The mission of the FAA is to provide a safe, secure, and efficient global aviation system that contributes to national security and the promotion of U.S. aviation. Among its other responsibilities, the FAA is responsible for enforcement of 14 CFR 139, Certification of Airports. The Office of the Associate Administrator for Airports has primary responsibility for this work.

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Several species of birds, such as ospreys, will readily nest on parking lot light standards. (Photo courtesy USDA)

There are two programs within the Office of the Associate Administrator for Airports that have a direct impact on wildlife hazard control at general aviation airports: (1) Airport Planning and Programs and (2) Airport Safety and Standards.

Airport Planning and Programs. APP oversees the Airport Improvement Program. AIP funds are used by airports to carry out projects aimed at improving airport operations and safety. AIP funds are distributed either by direct grants to applicant airports or through block grants to various states.

Certain parts of an airport's wildlife hazard control program can be paid for with AIP funds. As a general rule, AIP funds can be used to pay for a WHA and to buy equipment necessary to implement a WHMP. AIP funds cannot be used to buy supplies or pay wages.

In block grant states, airport operators wishing to apply for AIP funds should apply directly to the state department of aviation. In direct grant states, airport operators should apply to the appropriate FAA Airports Division, Regional Office. A list of FAA Regional Offices can be found in Appendix A.

Airports accepting AIP funds are required to comply with all associated Grant Assurances and Advisory Circulars.

Airport Safety and Standards. The Office of Airport Safety and Standards oversees the FAA's activities relating to wildlife hazards and their associated human health and safety concerns. Airport Safety and Standards' 150/5200 series Advisory Circulars and Certalerts provide further information.

FAA Advisory Circulars (150/5200 Series)

The FAA issues Advisory Circulars to systematically inform the aviation public of nonregulatory material of interest. The FAA recommends that public-use airport operators implement the standards and practices contained in all applicable ACs. In general, airports that have received federal grants-in-aid assistance must use the standards presented in an AC. Airports that have not accepted federal grants-in-aid (non-obligated airports) may also find these recommendations helpful. See Appendix C for copies of the current version (as of July 2009) of ACs men-

In a vain attempt to keep birds off his aircraft, the owner has installed a plastic owl on the propeller. Such static devices are not effective.

tioned in this guidebook. Advisory Circulars are revised on an irregular schedule. Copies of the most current 150/5200 series ACs are available online at: www.faa.gov/arp/.

There are three 150/5200 series FAA ACs applicable to GA airport wildlife hazard problems.

AC 150/5200-32, Reporting Wildlife Aircraft Strikes. This AC explains the importance of reporting wildlife strikes. It also examines recent improvements in the FAA's Bird/Other Wildlife Strike reporting system, as well as how to report a wildlife strike, what happens to the wildlife strike report data, and how to access the FAA National Wildlife Aircraft Strike Database. Lastly, it discusses the FAA's Feather Identification program.

AC150/5200-32 provides information on how to submit bird strike remains to the Smithsonian for identification. There is no charge for this service for American registered aircraft. Here a specialist at the Smithsonian is working with some bird strike remains to identify the species of bird involved in a strike. (Photo C. Dove)

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AC 150/5200-33, Hazardous Wildlife Attractants on or near Airports. This AC provides guidance on locating certain land uses having the potential to attract hazardous wildlife to the vicinity of public-use airports. It also provides guidance on the placement of new airport development projects (including airport construction, expansion, and renovation) pertaining to aircraft movement in the vicinity of hazardous wildlife attractants.

AC 150/52000-36, Qualifications for Wildlife Biologists Conducting Wildlife Hazard Assessments and Training Curriculums for Airport Personnel Involved in Controlling Wildlife Hazards on Airports. This AC describes the qualifications for wildlife biologists who conduct WHAs for airports certificated under 14 CFR 139. In addition, it addresses the minimum wildlife hazard management curriculum for the initial and recurrent training of airport personnel involved in implementing a FAA-approved WHMP.

FAA, Office of Airport Safety and Standards, CertAlerts Relating to Airport Wildlife Management

CertAlerts provide nondirective advisory or cautionary information dealing with aviation safety to the aviation community. There are four Office of Airport Safety and Standards CertAlerts that have direct application to GA airport wildlife hazard problems.

CertAlert No. 98-05, Grasses Attractive to Hazardous Wildlife. This CertAlert warns airport operators against the use of millet and any other large-seed producing grasses or other plants attractive to hazardous wildlife for revegetation of construction sites or other disturbed areas at the airport.

CertAlert No. 04-09, Relationship between FAA and USDA/WS. This CertAlert clarifies the roles of and relationship between the FAA and the USDA/Animal and Plant Health Inspection Service/Wildlife Services with regard to wildlife hazards at or near airports.

CertAlert No. 04-16, Deer Hazards to Aviation and Deer Fencing. In light of recent incidents where a Learjet landing at an airport in Alabama and a Learjet departing an airport in Oregon were destroyed after colliding with deer or elk, this CertAlert reminds airport operators of the importance of controlling deer and other large wild mammals on and around airfields.

The FAA recommends a minimum 10-ft chain link fence with three strands of barbed wire for deer control. This type of fencing also greatly increases airside security. (Photo A. Dickey)

CertAlert No. 06-07. Requests by State Wildlife Agencies to Facilitate and Encourage Habitat for State-Listed Threatened and Endangered Species and Species of Special Concern on Airports. This CertAlert describes procedures for responding to requests by state wildlife agencies to facilitate and encourage habitats for state-listed threatened and endangered species or species of special concern that may pose a threat to aviation safety and are found at airports. It does not apply to federally listed threatened and endangered species. FAA guidance on dealing with federally listed threatened and endangered species can be found in FAA Order 1050.1E, *Environmental Impacts – Policies and Procedures,* Appendix A, Section 8.

U.S. Department of Agriculture/Wildlife Services

Mission and Responsibilities

The U.S. Department of Agriculture/Wildlife Services provides federal leadership in managing problems caused by wildlife. USDA/WS helps manage wildlife to reduce damage to agriculture, natural resources, and property; minimizes potential threats to human health and safety; and assists in the protection of threatened and endangered species. USDA/WS has the primary responsibility of responding to problems caused by migratory birds. USDA/WS can assist federal, state, and local agencies, airport managers, and the aviation industry in reducing wildlife hazards at and in the vicinity of airports and airbases.

U.S. Army Corps of Engineers

Mission and Responsibilities

The U.S. Army Corps of Engineers (USACE) is charged with a wide range of functions related to water resources. Among these is protecting navigation and safeguarding the nation's water resources.

The USACE regulatory branch administers a permit system under Section 404 of the Clean Water Act. All proposed management actions involving any wetland habitat modification or excavation of fill material from or discharged into waters of the United States must be evaluated for Section 404 applicability and permit requirements.

This Army Corps of Engineers river channel restoration project is less than 650 ft from runway centerline at a major airport. Airport managers must work with the Corps to protect airport airspace and aviation safety. (Photo courtesy USDA)

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GA airports may need to contact the USACE when planning projects such as runway expansion or draining of wetlands to reduce waterfowl habitat. Some of these projects requiring permits may also require mitigation of impacted resources.

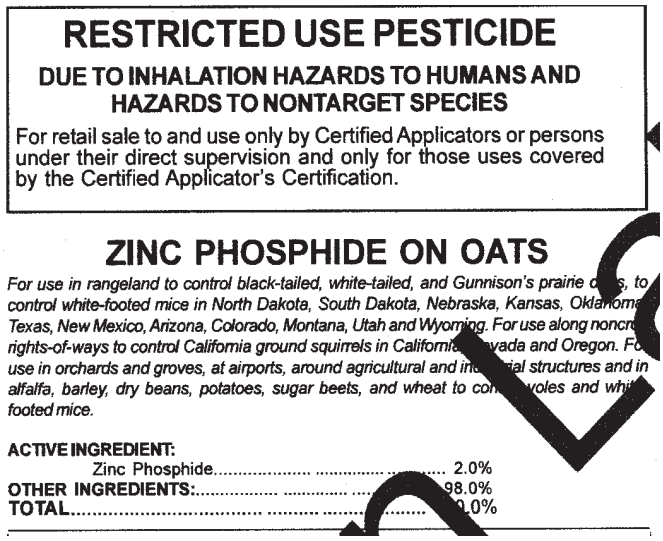
U.S. Environmental Protection Agency

Mission and Responsibilities

The mission of the U.S. EPA is to safeguard the nation's environment. EPA functions include setting and enforcing environmental standards and regulations related to air and water pollution, hazardous wastes, pesticides, and toxic substances. The EPA's mission is accomplished through partnerships with state and local governments. EPA responsibilities include pesticide registration and regulation as well as siting and construction of wastewater treatment and solid waste disposal facilities, which are permitted through state and local agencies. The FAA, USDA/WS, or private contractors may be consulted by airport authorities or state and local agencies to review impacts of proposed EPA-regulated projects on aviation safety.

There is one federal act administered by the EPA and one EPA regulation of specific interest to GA airports faced with hazardous wildlife problems:

Federal Insecticide, Fungicide, and Rodenticide Act, as Amended (7 U.S. Code 136; Public Law 104.317). This act, administered by the EPA, governs the registration, labeling, classification, and use of pesticides. Any substance used as a pesticide must be registered with the EPA and with the respective state pesticide regulatory agency. Pesticides are generally classified as either general use or restricted use. There are few restrictions on who may purchase or use general use pesticides. Restricted use pesticides may only be sold to and used by certified applicators or persons under their direct supervision, and only for those uses covered by the certified applicator's certification. Anyone wishing to use restricted use pesticides, apply any pesticides to the land of another, or apply any pesticides for hire must be a certified applicator or work under the direct supervision of a certified applicator, and even then they may only use pesticides covered by the certified applicator's certification.



RESTRICTED USE PESTICIDE

DUE TO INHALATION HAZARDS TO HUMANS AND HAZARDS TO NONTARGET SPECIES

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's Certification.

ZINC PHOSPHIDE ON OATS

For use in rangeland to control black-tailed, white-tailed, and Gunnison's prairie dogs, to control white-footed mice in North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, New Mexico, Arizona, Colorado, Montana, Utah and Wyoming. For use along noncrop rights-of-ways to control California ground squirrels in California, Nevada and Oregon. For use in orchards and groves, at airports, around agricultural and industrial structures and in alfalfa, barley, dry beans, potatoes, sugar beets, and wheat to control voles and white-footed mice.

ACTIVE INGREDIENT:
Zinc Phosphide..... 2.0%
OTHER INGREDIENTS:..... 98.0%
TOTAL..... 100.0%

There are several parts to a pesticide label. This shows the front portion of a zinc phosphide pesticide that is labeled for use at airports. Always read and follow all pesticide label directions.

This has direct application to GA airport personnel wanting to use pesticides to help manage hazardous wildlife at the airport. Before airport personnel may apply pesticides to control, for example, field mice, woodchucks, or insects, they or their direct supervisor must be a certified applicator (see state EPA section below).

Title 40 Code of Federal Regulations Part 258, Criteria for Municipal Solid Waste Landfills. Title 40 CFR Part 258.10 specifically addresses landfills and airports. Recognizing that birds can be attracted in large numbers to municipal solid waste landfills, and recognizing the potential threat posed by birds to aircraft safety, the U.S. EPA requires owners or operators of new MSWLF units to demonstrate successfully that such units do not create hazardous conditions for aircraft. This requirement also extends to lateral expansions of existing MSWLF units that are located within 10,000 feet of any airport runway used by turbojet aircraft or within 5,000 feet of any airport runway used only by piston-type aircraft.

If a new or expanded waste disposal operation is proposed within 5 statute miles of a runway end at a public use airport, the EPA also requires the operator to notify the appropriate FAA Regional Airports Division office and the airport operator of the proposal.

Approval or disapproval of a landfill site is the responsibility of the EPA, state and local governing bodies, and zoning boards. Other federal agencies may only comment as to whether they would consider the proposed landfill to be compatible or incompatible with their mission requirements. For example, the FAA may only comment on a proposed landfill's effect on aviation safety.

U.S. Department of Interior, U.S. Fish and Wildlife Service

Mission and Responsibility

The mission of the U.S. FWS is to conserve, protect, and enhance the nation's fish and wildlife and their habitats for the continuing benefit of all people. The U.S. FWS is responsible for the conservation and enhancement of migratory birds, threatened and endangered species, certain marine mammals, anadromous fishes, and wetlands. The U.S. FWS also manages the National

The operator of any landfill located within 5 miles of an airport must notify the airport operator and the FAA of any planned expansion. (Photo E. Cleary)

A young bald eagle waits for his parents to bring him more food. Between 1990 and 2008, 113 bald eagle strikes were reported to the FAA; 44 of those strikes involved GA aircraft. (Photo courtesy D. Dewhurst, U.S. FWS National Digital Library)

Wildlife Refuge System, enforces federal wildlife laws, and conducts biological reviews of the environmental impacts of development projects.

The U.S. FWS renders biological opinions on proposed federal activities that might impact federally listed or proposed endangered or threatened species, or result in the destruction or adverse modification of designated or proposed critical habitat. These opinions are solicited through a "Section 7 consultation," as required under the Endangered Species Act of 1973 (16 USC 1531–1544, 87 Statute 884, as amended).

The U.S. FWS has primary responsibility for implementation and enforcement of the Migratory Bird Treaty Act.

The Migratory Bird Treaty Act of 1918, as Amended (U.S. Code 603–711; 40 Statute 755). The United States, Canada, Mexico, Russia, and Japan are signatories to the MBTA. This act provides the statutory foundation for the federal protection and management of migratory birds in the United States (50 CFR 1–199).

These swallow nests are under the air traffic control tower's upper exterior catwalk. Active nests are protected and a federal depredation permit is needed before they may be taken. (Photo E. Garcia)

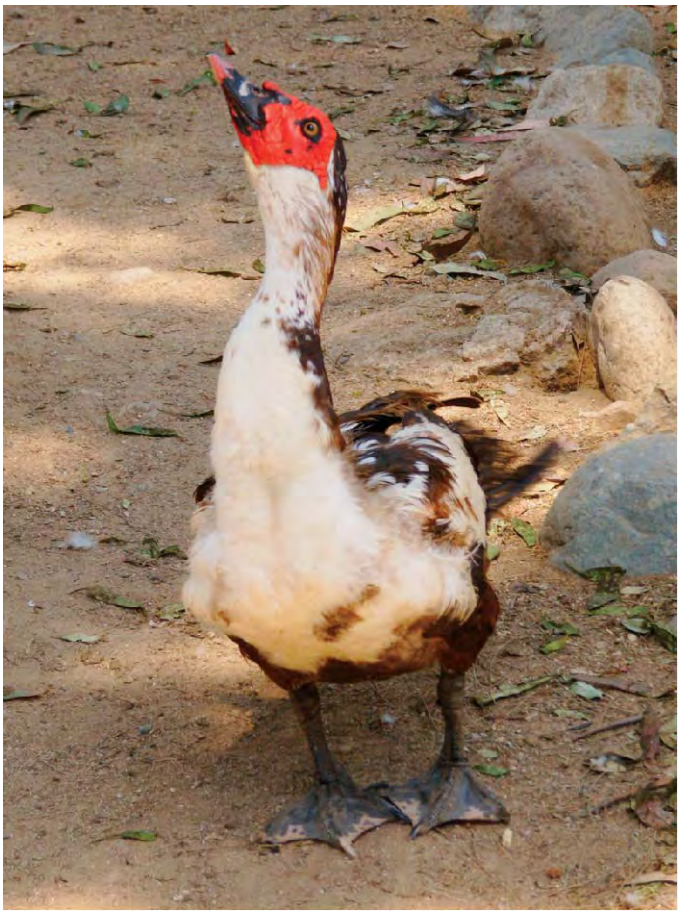
Title 50 CFR Parts 1 to 199. These regulations govern the management of federally protected wildlife within the United States and its territories based on the authority established in the MBTA. These regulations also establish procedures for issuing permits to "take" [pursue, hunt, shoot, wound, kill, trap, capture, or collect or to attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect any wild animal (50 CFR 10.12)] federally protected species. In general, a federal depredation permit issued by the U.S. FWS must be obtained before any nongame migratory birds may be taken, or before any migratory game birds may be taken outside of the normal hunting season or beyond established bag limits.

Federal law protects all migratory birds, including their nests and eggs:

"A migratory bird [is] . . . any bird whatever its origin and whether or not raised in captivity, which belongs to a species listed in sect. 10.13 [of 50 CFR] or which is a mutation or a hybrid of any such species, including any part, nest, or egg of any such bird, or any product, whether or not manufactured, which consists, or is composed in whole or part, of any such bird, or any part, nest, or egg thereof" (50 CFR 10.12). This list includes almost all native bird species in the United States, with the exception of nonmigratory game birds such as turkeys and grouse, and some introduced game birds such as pheasants and chukars. Exotic and feral species such as graylag geese, Muscovy ducks, European starlings, house (English) sparrows, and rock pigeons are not listed in 50 CFR 10.13 and are therefore not protected by federal law.

In addition to federal protection, all states protect migratory birds as well as resident game birds such as pheasants, turkeys, grouse, and partridges. States may or may not protect exotic or feral species.

With the exception of federally listed or proposed threatened or endangered species, federal law does not protect terrestrial mammals, reptiles, or other wildlife taxa (such as deer, coyotes, raccoons, groundhogs, snakes, turtles, and freshwater fish). Protection of these wildlife groups is left to the individual states.



Muscovy ducks, an escaped exotic species, are not protected by federal law. However, some states protect them. Check with the state wildlife management agency before taking such birds. (Photo E. Garcia)

Depredation Permitting Requirements and Procedures

Persons wishing to take migratory birds, nests, or eggs as part of a GA airport wildlife management program must first secure a depredation permit from the U.S. FWS. Also, some state wildlife management agencies may require that a state permit be obtained. Persons wishing to take state-protected species must first secure a permit from their respective state wildlife management agency. For assistance in obtaining any needed federal and/or state depredation permits, contact the office of the local USDA/Wildlife Services (Appendix B). As a general rule, the U.S. FWS will not issue depredation permits without concurrence from USDA/Wildlife Services.

Standing Depredation Orders

Federal law allows people to protect themselves and their property from damage caused by migratory birds. Provided no effort is made to kill or capture the birds, a depredation permit is not required to merely scare or herd depredating migratory birds other than endangered and threatened species or bald and golden eagles (50 CFR 21.41).

In addition, certain species of migratory birds may be killed or captured without a federal permit under specific circumstances, most of which relate to agricultural situations. A Standing Depredating Order that has applicability at GA airports concerns blackbirds and related species:

Federal regulations allow the taking of blackbirds that are causing damage or posing a threat to human safety. Cereal grains and sunflowers should never be grown on or near airport grounds. (Photo courtesy USDA)

"A federal permit shall not be required to control yellow-headed, red-winged, rusty and Brewer's blackbird, cowbirds, all grackles, crows, and magpies, when found committing or about to commit depredation upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance . . . " (50 CFR 21.43).

State laws may not mirror federal law in this respect. For example, in Ohio, crows may not be killed under any circumstances, outside of the state crow hunting season, without a state-issued depredation permit, and blackbirds may not be killed on Sundays.

Resident Canada geese may be taken within a 3-mile radius of National Plan of Integrated Airport Systems' airports. Airports and/or their agents must first obtain all necessary authorizations from landowners for all management activities conducted outside the airport's boundaries **and be in compliance with all state and local laws and regulations** [50 CFR 21.49 d (5)]. Resident Canada geese may be taken between April 1st and September 15th. The destruction of resident Canada goose nests and eggs may take place between March 1st and June 30th [50 CFR, part 21.49 d (3)].

People feeding semi-domesticated ducks in a park can pose a serious threat to aviation safety if the park is located too close to the airport. (Photo E. Cleary)

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Persons wishing to take any other migratory birds, or to take migratory birds in situations other than those described above, must first secure a federal migratory bird depredation permit from the U.S. FWS, and in some cases a state depredation permit. The first step in obtaining the necessary permits is to contact the nearest USDA/WS state office (Appendix B).

State Agencies

Specific state regulations and their enforcement are not addressed in this guidebook because of their wide variability. The following general comments are provided as background information.

When dealing with GA airport wildlife issues, consult state and local regulatory agencies having jurisdiction over aviation safety and regulation, wildlife and natural resources, environmental protection, health, law enforcement, and others as applicable.

State Wildlife Management Agencies

Wildlife management authority for resident nonmigratory birds, terrestrial mammals, freshwater fish, reptiles, and other taxa rest with state wildlife management agencies. These agencies establish the take and possession regulations for all state-protected species. States set their migratory game-bird hunting seasons and bag limits within the guidelines established by the U.S. FWS. States may list certain wildlife and plant species as threatened or endangered that are not considered as such at the federal level.

Persons needing to take state-protected species outside of the legal hunting season or beyond the established bag limits to promote airport safety must first secure a state depredation permit. Contact the nearest USDA/WS office (Appendix B) for assistance in obtaining any necessary state depredation permits.

State Environmental Protection Agencies

Landfill Siting Permits and Inspections

With concurrence from the U.S. EPA, state EPAs, local governing bodies, and zoning boards have the final responsibility for issuing landfill permits. It is also a state responsibility to inspect all landfills to ensure compliance with all applicable federal and state regulations.

Non-migratory game bird management is the responsibility of state wildlife management agencies. Between January 1, 1990, and March 31, 2009, 43 wild turkey strikes were reported to the FAA. Of the 43 reported turkey strikes, 27 involved GA aircraft and 11 occurred at GA airports. (Photo courtesy G. M. Stolz, U.S. FWS National Digital Library)

Landfill proponents must notify the FAA about plans to establish a new landfill or expand an existing one. However, the FAA cannot stop construction or expansion of a landfill. It can only say whether it considers the proposed construction or expansion compatible with safe airport operation. Approval of landfill construction or expansion projects is the responsibility of state and local governing bodies and zoning boards. (Photo courtesy USDA)

Pesticide Registration

Before a pesticide may be sold or used, it must be registered with the U.S. EPA and with the respective state's pesticide regulatory agency. Special local need (SLN) registered pesticides may only be used in the state—and in some cases, the specific geographical location—for which the SLN registration has been issued.

Pesticide Applicator Licensing

With U.S. EPA concurrence, each state is responsible for establishing pesticide applicator licensing requirements and applicator training procedures. The retail sale and use of restricted use pesticides is limited to certified applicators or persons working under their direct supervision and only for those uses covered by the certified applicator's certification.

Anyone who uses restricted use pesticides, applies any pesticides for hire, or applies any pesticide to the land of another must be a certified applicator or working under the direct supervision of a certified applicator, and may only use pesticides covered by the certified applicator's certification.

Airports

The majority of GA wildlife aircraft strikes occur at or near the airport. Almost 80% of GA strikes occur below 1,000 ft AGL (Cleary and Dickey 2008b). The logical place to start addressing wildlife strike hazards is at the airport. Everyone—airport operators, fixed base operators (FBOs), air traffic control personnel, and pilots—working at or using an airport must do his or her part to reduce the problem. Without the full cooperation of all parties, the problem cannot be solved.

Airport Operator

The operator of a public-use airport must demonstrate that the airport is properly and adequately equipped and that programs are in place to provide a safe airport-operating environment.

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Airport operators should encourage pilots to report unsafe conditions, including the presence of hazardous wildlife at the airport. (Photo E. Cleary)

Included in this regulation is the need to address wildlife hazard issues, conduct wildlife hazard evaluations, and develop wildlife hazard control plans.

Each public-use airport operator should take immediate action to correct wildlife hazards whenever they are detected. An important part of this process is establishing procedures for airport employees or tenants to report hazardous wildlife on or near air operation areas to the appropriate airport personnel.

Air Traffic Control

At controlled airports, air traffic control personnel must report any unsafe conditions to the appropriate airport personnel any time they are observed, including hazardous wildlife on or near the AOA.

Also, to the extent permitted by higher priority duties and other circumstances, air traffic controllers are required to issue advisory information on pilot-reported, tower-reported, or radar-observed and pilot-verified bird activity, and relay bird activity information to adjacent facilities and to flight service stations whenever it appears that the wildlife hazard will become a factor in the area (FAA Order 7110.65, 2-1-22).

Fixed Base Operators

FBOs have a responsibility to report all unsafe conditions at or near an airport, including birds or other wildlife that could pose a threat to aircraft safety. FBO personnel should report all known wildlife strikes. Strikes can be reported electronically at wildlife-mitigation.tc.faa.gov. Wildlife strikes can also be reported by completing and mailing a paper copy of FAA Form 5200-7 Bird/Other Wildlife Strike Report (see Appendix F).

Pilots

Pilots have a responsibility to report all unsafe conditions at or near an airport, including birds or other wildlife that could pose a threat to aircraft safety. Pilots and other airport personnel

Do not allow airport or FBO employees to feed feral cats or dogs. The pet food attracts rats and other small mammals, which in turn attract predatory birds. (Photo E. Cleary)

should report all known wildlife strikes. Strikes can be reported electronically at wildlife-mitigation.tc.faa.gov. Wildlife strikes can also be reported by completing and mailing FAA Form 5200-7 Bird/Other Wildlife Strike Report. This form can be downloaded and printed from the above website and duplicated as needed, and a copy of it is located in Appendix F. All strike reports are closely screened and edited to maintain validity and prevent duplicate entries in the database.

Private Contractors

Managing hazardous wildlife at and near airports is a key part of any airport's overall safety management plan. As has already been discussed, all aircraft are vulnerable to damage from wildlife strikes. Because of the complexities involved in conducting wildlife hazard surveys and

Pilots can be an excellent source of information about the kind of wildlife commonly occurring at an airport. They should report any hazardous wildlife they see. (Photo E. Cleary)

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developing WHMPs, where practical and affordable, GA airport managers are encouraged to use the services of a qualified airport wildlife biologist. There are many competent and qualified airport wildlife biologists working in the private sector. The FAA requires that wildlife biologists conducting WHAs or presenting training for airport personnel actively involved in implementing FAA-approved WHMPs at certificated airports meet certain standards of professional training and/or experience in wildlife hazard management at airports. To the extent practical, GA airport managers would do well to adhere to the same standards when attempting to deal with hazardous wildlife problems. Embry-Riddle Aeronautical University maintains a website listing some private sector wildlife biologists that meet the FAA's standards for qualified airport wildlife biologists: wildlife.pr.erau.edu/workshop/qualified_biologists.html.

AC 150/52000-36, Qualifications for Wildlife Biologists Conducting Wildlife Hazard Assessments and Training Curriculums for Airport Personnel Involved in Controlling Wildlife Hazards on Airports, explains these requirements. A Web link for this and other ACs can be found in Appendix C.

Birds and aircraft will always compete for airspace. Airport managers must work to keep their airports free of birds and other hazardous wildlife. (Photo E. Cleary)

Glossary

A

Air carrier aircraft. An aircraft that is being operated by an air carrier and is categorized as either a large air carrier aircraft if designed for at least 31 passenger seats or a small air carrier aircraft if designed for more than nine passenger seats but less than 31 passenger seats, as determined by the aircraft type certificate issued by a competent civil aviation authority (14 CFR 139.5). General aviation aircraft include all other civilian owned and operated aircraft.

Air operations area (AOA). Any area of an airport used or intended to be used for landing, takeoff, or surface maneuvering of aircraft. An air operations area includes such paved areas or unpaved areas that are used or intended to be used for the unobstructed movement of aircraft in addition to its associated runway, taxiways, or apron.

Airport. An area of land or other hard surface, excluding water, that is used or intended to be used for the landing and takeoff of aircraft, including any buildings and facilities (14 CFR 139.5).

Airport operator. The operator (private or public) or sponsor of a public-use airport.

Approach or departure airspace. The airspace, within 5 statute miles of an airport, through which aircraft move during landing or takeoff.

B

Bird balls. High-density plastic floating balls that can be used to cover ponds and prevent birds from using the sites.

Bird hazard. See Wildlife hazard.

Bird strike. See Wildlife strike.

C

Concurrent use. Aeronautical property used for compatible non-aviation purposes while at the same time serving the primary purpose for which it was acquired, and the use is clearly beneficial to the airport. The concurrent use should generate revenue to be used for airport purposes (see Order 5190.6A, *Airport Compliance Requirements,* sect. 5h).

Construct a new municipal solid waste landfill. To begin to excavate, grade land, or raise structures to prepare a municipal solid waste landfill as permitted by the appropriate regulatory or permitting agency.

Cover. Vegetation over a ground surface serving as shelter for wildlife that are roosting, resting, nesting, or feeding.

Cover types. A descriptive term characterizing vegetative composition and physical characteristics of a plant community.

D

Detention ponds. Storm water management ponds that hold storm water for short periods of time, generally less than 48 hours (compare with retention ponds).

Dredge spoil containment areas. Dredge spoil is the material removed during dredging operations intended to help keep harbors or boat channels open when they become silted in due to river or tidal actions. Dredge spoil containment areas are areas where dredge material is disposed of or stored.

Dump. The actively used and unvegetated part of an area where refuse (garbage) is placed and allowed to accumulate on the ground surface without periodic covering or compacting. This includes both authorized and unauthorized areas.

E

Establish a new municipal solid waste landfill. When the first load of putrescible (organic matter) waste is received on site for placement in a prepared municipal solid waste landfill.

F

Fly ash. The fine, sand-like residue resulting from the complete incineration of an organic fuel source. Fly ash typically results from the combustion of coal or organic waste used to operate a power-generating plant.

Furbearer. Refers to mammals that are generally hunted or trapped for their fur, such as fox, raccoon, and mink.

G

General aviation aircraft. All civilian aircraft not owned or operated for commercial passenger transport.

General aviation airport. Public use airports that are closed to air carrier operations except in unusual circumstances such as emergencies.

H

Hazardous wildlife. Species of wildlife (birds, mammals, reptiles, insects, earth worms), including feral animals and domesticated animals not under control, that are associated with aircraft strike problems, are capable of causing structural damage to airport facilities, or act as attractants to other wildlife that pose a strike hazard (AC 150/5200-33, Hazardous Wildlife Attractants on or near Airports; 14 CFR 139.3).

L

Loafing. Wildlife that are "loafing" are simply killing time, just hanging around until it is time to look for food or a place to roost.

M

Mammal strike. See Wildlife strike.

Migratory bird. "[A] migratory bird [is] . . . any bird whatever its origin and whether or not raised in captivity, which belongs to a species listed in Section 10.13 [of 50 CFR] or which is a mutation or a hybrid of any such species, including any part, nest, or egg of any such bird, or any product, whether or not manufactured, which consists, or is composed in whole or part, of any such bird, or any part, nest, or egg thereof." (50 CFR 10.12). This list includes almost all native bird species in the United States, with the exception of nonmigratory game birds such as pheasants, turkeys, and grouse. Exotic and feral species such as graylag geese, Muscovy ducks, European starlings, house (English) sparrows, and rock pigeons (feral pigeons) also are not listed in 50 CFR 10.13 and are therefore not protected by federal law.

Movement area. The runways, taxiways, and other areas of an airport that are used for taxiing or hover taxiing, air taxiing, takeoff, and landing of aircraft, exclusive of loading ramps (apron areas) and aircraft parking areas (14 CFR 139.3).

Municipal solid waste landfill (MSWLF). A publicly or privately owned discrete area of land or an excavation that receives household waste and that is not a land application unit, surface impoundment, injection well, or waste pile, as those terms are defined under 40 CFR 257.2. An MSWLF may receive other types of wastes, such as commercial solid waste, nonhazardous sludge, small quantity generator waste, and industrial solid waste, as defined under 40 CFR 258.2. An MSWLF can consist of either a standalone unit or several cells that receive household waste.

N

New municipal solid waste landfill. A municipal solid waste landfill that was established or constructed after April 5, 2001 (AC 150/5200-34).

P

Piston-powered aircraft. Fixed-wing aircraft powered by piston engines. Such aircraft normally use LL-100 fuel.

Piston-use airport. Any airport that does not sell Jet-A fuel for fixed-wing turbine-powered aircraft, and primarily serves fixed-wing, piston-powered aircraft. Incidental use of the airport by turbine-powered, fixed-wing aircraft would not affect this designation. However, such aircraft should not be based at the airport (AC 150/5200-33).

Propane cannon/exploder. A hollow cylinder that produces a loud explosion to frighten wildlife by the ignition of a metered amount of propane at timed or random intervals or by remote control.

Public airport. An airport used or intended to be used for public purposes, which is under the control of a public agency, and of which the area used or intended to be used for landing, taking off, or surface maneuvering of aircraft is publicly owned [49 USC § 47102(16)].

Putrescible waste. Solid waste that contains organic matter capable of being decomposed by micro-organisms and of such a character and proportion as to be capable of attracting or providing food for birds (40 CFR 257.3–8).

Putrescible-waste disposal operation. Landfills, garbage dumps, underwater waste discharges, or similar facilities where activities include processing, burying, storing, or otherwise disposing of putrescible material, trash, and refuse.

Pyrotechnics. Various combustible projectiles launched from a shotgun, pistol, or other device that produce noise, light, and smoke to frighten wildlife.

R

Raptors. An inclusive term referring to all birds of prey, such as hawks, falcons, eagles, and owls.

Retention ponds. Storm water management ponds that hold water for long periods of time, generally more than 48 hours (compare with Detention ponds).

Roost. Most commonly the term refers to a perch or general area (such as trees or buildings) used by (roosting) birds to rest and sleep. Roosting birds often collect in large numbers. Pigeons, starlings, and blackbirds are the most commonly seen roosting birds.

S

Sewage sludge. Any solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Sewage sludge includes, but is not limited to, domestic septage; scum or solids removed in primary, secondary, or advanced wastewater treatment processes; and material derived from sewage sludge. Sewage does not include ash generated during the firing of sewage sludge in a sewage sludge incinerator or grit and screenings generated during preliminary treatment of domestic sewage in a treatment works (40 CFR 257.2). Also, the de-watered effluent resulting from secondary or tertiary treatment of municipal sewage and/or industrial wastes, including sewage sludge as referenced in EPA's *Effluent Guidelines and Standards,* 40 CFR 401.

Sludge. Any solid, semi-solid, or liquid waste generated from a municipal, commercial, or industrial wastewater treatment plant, water supply treatment plant, or air pollution control facility or any other such waste having similar characteristics and effect (40 CFR 257.2).

Snarge. A term coined by the Smithsonian Museum of Natural History's Feather Identification Laboratory to describe bird strike remains found on an aircraft or extracted from an aircraft engine. Snarge may contain a mixture of blood, feathers, bone, and muscle tissue.

Solid waste. Any garbage, refuse, or sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but not including solid or dissolved materials in domestic sewage, or solid or dissolved material in irrigation return flows or industrial discharges that are point sources subject to permits under section 402 of the Federal Water Pollution Control Act, as amended (86 Stat. 880), or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended (68 Statute 923) (40 CFR 257.2).

T

Take (wildlife). To pursue, hunt, shoot, wound, kill, trap, capture, or collect or to attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect any wild animal (50 CFR 10.12).

Turbine-powered aircraft. Aircraft powered by turbine engines including turbojets and turboprops but excluding turbo-shaft, rotary-wing aircraft. Such aircraft normally use Jet-A fuel (AC 150/5200-33).

Turbine-use airport. Any airport that sells Jet-A fuel for fixed-wing turbine-powered aircraft.

W

Wastewater treatment facility. Any devices or systems used to store, treat, recycle, or reclaim municipal sewage or liquid industrial wastes, including Publicly Owned Treatment Works (POTW), as defined by Section 212 of the Federal Water Pollution Control Act (PL 92-500) as amended by the Clean Water Act of 1977 (PL 95-576) and the Water Quality Act of 1937 (PL 100-4). This definition includes any pretreatment involving the reduction of the amount of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in wastewater prior to or in lieu of discharging or otherwise introducing such pollutants into a POTW [40 CFR 404.3 (o), (p), (q)].

Wildlife. Any wild animal, including without limitation any wild mammal, bird, reptile, fish, amphibian, mollusk, crustacean, arthropod, coelenterate, or other invertebrate, including any part, product, egg, or offspring thereof (50 CFR 10.12, *Taking, Possession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of Wildlife and Plants*). As used in this manual, wildlife includes feral animals and domestic animals out of the control of their owners (14 CFR 139, Certification of Airports).

Wildlife attractants. Any human-made structure, land-use practice, or human-made or natural geographic feature that can attract or sustain hazardous wildlife within the landing or departure airspace, AOA, loading ramps (apron areas), or aircraft parking areas of an airport. These attractants can include but are not limited to architectural features, landscaping, waste disposal sites, wastewater treatment facilities, agricultural or aquaculture activities, surface mining, or wetlands (AC 150/5200-33).

Wildlife hazard. A potential for a damaging aircraft collision with wildlife on or near an airport (14 CFR 139.3).

Wildlife strike. A wildlife strike has occurred when:

- A pilot reports striking one or more birds or other wildlife;
- Aircraft maintenance personnel identify aircraft damage as having been caused by a wildlife strike;
- Personnel on the ground report seeing an aircraft strike one or more birds or other wildlife;
- 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; or
- The animal's presence on the airport had a significant negative effect on a flight (i.e., aborted takeoff, aborted landing, high-speed emergency stop, aircraft left pavement area to avoid collision with animal) [criteria 1–4 adopted from Transport Canada (MacKinnon et al. 2001)].

Acronyms

AAWV	American Association of Wildlife Veterinarians
AC	Advisory Circular
A-C	Alpha-Chloralose
ADC	Animal Damage Control (former name of USDA/WS)
AGL	Above Ground Level
AIP	Airport Improvement Program
AOA	Air Operations Area
APHIS	Animal and Plant Health Inspection Service
APP	Office of Airport Planning and Programming
ATC	Air Traffic Control
AWHWG	Airport Wildlife Hazards Working Group
BASH	Bird/Aircraft Strike Hazard (USAF)
BSCC	Bird Strike Committee Canada
BSC–USA	Bird Strike Committee–United States of America
C&D Landfills	Construction and Demolition Landfills
CFR	Code of Federal Regulations
EA	Environmental Assessment
EIS	Environmental Impact Statement
FAA	Federal Aviation Administration
FBO	Fixed Base Operator
FDA	Food and Drug Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FOD	Foreign Object Debris, Foreign Object Damage
GA	General Aviation
MBTA	Migratory Bird Treaty Act
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MSWLF	Municipal Solid Waste Landfill
NEPA	National Environmental Policy Act
NOTAM	Notices to Airmen
NPIAS	National Plan of Integrated Airport Systems
NTSB	National Transportation Safety Board
NWRC	National Wildlife Research Center (USDA)
OFA	Object Free Area
OFZ	Obstacle Free Zone
RC	Radio-controlled
RPZ	Runway Protection Zone

SLN	Special Local Need
TSS	Threshold Siting Service
USAF	United States Air Force
USACE	United States Army Corps of Engineers
U.S. DOD	United States Department of Defense
USDA/WS	United States Department of Agriculture, Wildlife Services
U.S. DOT	United States Department of Transportation
U.S. EPA	United States Environmental Protection Agency
U.S. FWS	United States Fish and Wildlife Service
WCP	Wildlife Control Personnel
WHA	Wildlife Hazard Assessment
WHMP	Wildlife Hazard Management Plan
WHWG	Wildlife Hazard Working Group
WS	Wildlife Services (USDA)

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U.S. Department of Defense, U.S. Air Force Bird Aircraft Strike Hazard (BASH) Team. afsafety.af.mil/afsc/bash/home.html.

U.S. Department of Interior, Fish and Wildlife Service. www.fws.gov/.

U.S. Department of Transportation, Federal Aviation Administration, Airports Division. www.faa.gov/arp/.

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APPENDIX A

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Accurate as of November 2009

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Patrick Rogers	ASO-620.K	404-305-6716
Jack McSwain	AS0-620.J	404-305-6718
Jim Price	ASO-620.P	404-305-6721
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Steven Oetzell	AWP-620.6	310-725-3611
Tony Garcia	AWP-620.1	310-725-3634
Patrick J. Lammerding	AWP-620.7	310-725-3645
Jake Florendo	AWP-620.4	310 725-3653
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Steven Hicks	HNL-676	808-541-1243
Gordon Wong	HNL-622	808-541-3565
		Fax: 808-541-3462

APPENDIX B

U.S. Department of Agriculture, Wildlife Services, Headquarters and State Offices

Accurate as of January 2010

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Joanne Garrett, Director	(301) 734-7921 FAX: (301) 734-5157

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APPENDIX C

Federal Aviation Administration Advisory Circulars and CertAlerts Useful to General Aviation Airports

Copies of the FAA Advisory Circulars, CertAlerts, and other documents can be downloaded free of charge at:

http://www.faa.gov/airports/resources/publications/
http://www.faa.gov/airports/resources/advisory_circulars/
http://www.faa.gov/airports/airport_safety/certalerts/

Advisory Circular 150/5300-13, Airport Design
Advisory Circular 150/5200-32, Reporting Wildlife Aircraft Strikes
Advisory Circular 150/5200-33, Hazardous Wildlife Attractants on or near Airports
Advisory Circular 150/5200-36, Qualifications for Wildlife Biologists Conducting Wildlife Hazard Assessments and Training Curriculums for Airport Personnel Involved in Controlling Wildlife Hazards on Airports
Advisory Circular 150/5300-13, Airport Design
CertAlert No. 98-05, Grasses Attractive to Hazardous Wildlife
CertAlert No. 04-09, The Relationship between FAA and USDA/WS
CertAlert No. 04-16, Deer Hazards to Aviation and Deer Fencing
CertAlert No. 06-07, Requests by State Wildlife Agencies to Facilitate and Encourage Habitat for State-Listed Threatened and Endangered Species and Species of Special Concern on Airports

The FAA Wildlife Strike Database is available at:

http://wildlife-mitigation.tc.faa.gov/public_html/index.html
http://wildlife.pr.erau.edu/

APPENDIX D

Equipment for Control of Hazardous Wildlife

Suggested Wildlife Control Equipment

This equipment list is a suggested minimum that would be found at a small- to medium-sized U.S. airport.

Item	Importance	Quantity	Unit Cost (approximate) ($US)	Extended Cost ($US)
10 X 40 Binoculars	A	1	$200	$200
Field guide to birds of North America	A	1	$30	$30
Desk bird book	B	1	$30	$30
Field guide to mammals of North America	A	1	$30	$30
Computer for record keeping	A	1	$1,500	$1,500
Dedicated vehicle	A	1	unknown; varies	
Hearing protection	A	4 each	$15	$60
Eye protection	A	4 each	$10	$40
Gloves	A	4 each	$15	$60
Camera	A	1	$150	$150
.22 Cal single shot pyrotechnic launcher	A	4 each	$30	$120
Bird bombs (100/box)[1]	A	10 boxes	$45	$450
Bird whistlers (100/box) [1]	A	10 boxes	$45	$450
Shotgun (12-gauge)	A	1 each	$350	$350
12-gauge shell crackers (100/box) [1]	A	4 boxes	$100	$400
12-gauge shot shells (#2 steel, 25/box)	A	20 boxes	$15	$300
Storage container	B	1 each	$200	$200
M-8 scareaway propane cannons (with bobomat base)	C	2 each	$575	$1,150
25# Propane bottles	C	4 each	$25	$100
Avian dissuader laser	D	1 each	$1,090	$1,090

[1] Pyrotechnic rounds have a short shelf life, and failure rate will increase if they are not kept in a cool, dry storage area. Keep enough rounds on hand to ensure harassment efforts are not adversely impacted by shortage.

APPENDIX E

Assessing Wildlife Hazard Management Plans at Civil Airports

This appendix describes a system (adapted from Seubert 1994) for objectively assessing the implementation of WHMPs at civil airports. Five assessment categories, each with a list of elements to be evaluated, are used to indicate how well an airport's WHMP is being implemented.

Category 1: Management functions related to wildlife hazards at or in the vicinity of the airport

Category 2: Bird control at or in the vicinity of the airport

Category 3: Mammal control at or in the vicinity of the airport

Category 4: Management of habitat and food sources on airport property related to wildlife hazards

Category 5: Land uses and food sources off of airport potentially related to wildlife hazards on airport

The elements described in categories 1 to 4 are assessed as to the degree that management programs are being implemented. The elements in category 5 are rated as to the degree of hazard posed. Elements within each category are not intended to cover every possibility—they can be modified or expanded to meet situations unique to an airport.

During an assessment, each element in categories 1 to 4 is examined and classified as one of the following:

S = Satisfactory If an assessor finds that an airport has initiated action to reduce a wildlife hazard according to program and is on schedule, the action would be considered "satisfactory."

U = Unsatisfactory If no measures have been taken, or if inappropriate measures have been taken, the assessment would be "unsatisfactory."

NI = Needs Improvement If implementation of a control measure is behind schedule or only partially accomplished, the assessment would be either "needs improvement," or "unsatisfactory," depending on the seriousness of the hazard.

NA = Not Applicable If it is apparent that certain listed techniques or items are not applicable to the airport, the assessment would be "not applicable."

If an assessment is either "NI" or "U," a comment by an assessor is required in the assessment summary (on the last page of the Wildlife Hazard Assessment Form at the end of the appendix). Examples of assessments requiring comments are as follows. (Categories 1 to 4 focus on actions that can be taken on the airport to reduce wildlife hazards.)

Category 1: Management functions related to wildlife hazards at or in the vicinity of the airport

If permits have not been obtained [Code 1.1 (in the Wildlife Hazard Assessment Form at the end of this appendix)] for shooting or trapping birds or mammals, the assessment would be "U."

If animal remains found on runways are being counted to document bird strikes, but are not being identified by species (Code 1.14), the assessment would be "NI."

Category 2: Bird control at or in the vicinity of airports

If distress calls are not being used (Code 2.2), the assessment would be "U."

If the installation of wires (Code 2.9) over an airport pond is behind schedule, the assessment could be "NI" or "U," depending on the degree of potential hazard.

If raptors are not being trapped and relocated (Code 2.23), the assessment would be "U."

Category 3: Mammal control at or in the vicinity of airports

If fencing (Code 3.2) is in need of repair or absent, the assessment would be "NI."

If rodenticides (Code 3.12) are not being used to control a rodent population attracting raptors, the assessment would be "U."

Category 4: Management of habitat and food sources **on airport property** related to wildlife hazards

If airport litter control is inadequate (Code 4.9), the assessment would be "NI."

If trees used as a roost site (Code 4.5) are not being eliminated or thinned to be made unattractive, the assessment would be "U."

Category 5: Land uses and food sources **off airport property** potentially related to wildlife hazards on airport

This provides a list of off-airport land uses and food sources that may be attractive to birds or other wildlife. The assessor should review this list and score each element on a scale of 0 to 3:

0 = land use or food source not present;

1 = present but no wildlife problems noted or anticipated;

2 = site attracts some hazardous wildlife creating possible or potential problem, site should be monitored;

3 = site creates significant wildlife hazard for airport, action should be taken.

Wildlife hazards at airports frequently are attributable to these off-site attractants, but airport managers have no authority over the use of private property. However, airport managers can initiate programs to reduce the hazards of these off-airport wildlife attractants (such as garbage dumps, certain agricultural activities) by informing local jurisdictions and landowners of the hazards, and suggesting ways of alleviating them (Code 1.12).

Wildlife Hazard Assessment Form

Airport:	Date:	Page 1 of 6

Category 1: Management functions related to wildlife hazards at or in the vicinity of the airport

CODE	ITEMS	ASSESSMENT			
		S	NI	U	NA
1.1	Acquiring wildlife control permits from federal, state, and local agencies				
1.2	Arranging for WHAs and other studies, as needed, to evaluate hazard potential of wildlife attracted by habitats, land uses, and food sources on or in vicinity of airport				
1.3	Developing wildlife hazard control program based on WHA and other studies and factors				
1.4	Defining and delegating authority and responsibility for wildlife hazard control program				
1.5	Supervising, implementing, and coordinating airport wildlife hazard control program				
1.6	Evaluating wildlife hazard control program at least once per year				
1.7	Training personnel responsible for implementing airport wildlife hazard control program, especially field personnel				
1.8	Operating wildlife patrol system with a trained field staff, conducting surveillance/inspections of critical airport areas, and effecting wildlife control when needed or requested				
1.9	Establishing a communication capability between wildlife control and ATC personnel				
1.10	Maintaining a system for warning pilots about wildlife hazards (such as NOTAMs, ATC, radar observations)				
1.11	Ensuring that airport habitats are managed to reduce or eliminate wildlife attractions				
1.12	Ensuring that airport policy prohibits feeding of wildlife and exposure of food wastes				
1.13	Interacting with local jurisdictions and landowners about zoning, land use, and the resolution of wildlife hazard problems in vicinity of airport				
1.14	Maintaining log book with daily record of wildlife control activities, wildlife activity, reported wildlife strikes, and wildlife remains found on runways identified by species				
1.15	Reporting all wildlife strikes to FAA				

Airport:	Date:	Page 2 of 6			
Category 2: Bird control at or in the vicinity of the airport					
		ASSESSMENT			
CODE	**TECHNIQUES**	**S**	**NI**	**U**	**NA**
	DISPERSE, DETER, EXCLUDE, REPEL				
2.1	Bird patrols in vehicle				
2.2	Bioacoustics (distress calls)				
2.3	Electronically generated noise				
2.4	Propane cannons				
2.5	Pyrotechnics				
2.6	Shooting to scare				
2.7	Netting hangar rafters, ponds etc.				
2.8	Perching deterrents (such as stainless steel needles)				
2.9	Overhead wires for ponds, ditches, roofs, etc.				
2.10	Chemical repellents				
2.11	Falconry				
2.12	Dogs				
2.13	Radio-controlled aircraft				
2.14	Thinning or eliminating roosting trees and shrubs				
2.15	Grass management				
2.16	Scarecrows				
2.17	Dead bird effigies				
	REMOVE				
2.18	Chemical capture (alpha chloralose)				
2.19	Nest and egg destruction				
2.20	Poisoning				
2.21	Predators to remove eggs (foxes, pigs, etc.)				
2.22	Shooting				
2.23	Trapping and relocation (for example, raptors)				

Airport:	Date:	Page 3 of 6			
Category 3: Mammal control at or in the vicinity of the airport					
		ASSESSMENT			
CODE	**TECHNIQUES**	**S**	**NI**	**U**	**NA**
	DISPERSE, DETER, EXCLUDE, REPEL				
3.1	Cattle guards				
3.2	Fencing				
3.3	Vehicle patrols				
3.4	Propane cannons				
3.5	Pyrotechnics				
3.6	Rodent-resistant sheathing on electrical cables				
	REMOVE				
3.7	Controlled hunting (e.g., deer)				
3.8	Den destruction (e.g., coyotes)				
3.9	Fumigants (e.g., woodchucks)				
3.10	Kill trapping (e.g., beavers, muskrats)				
3.11	Live trapping and relocation or euthanasia (e.g., dogs)				
3.12	Rodenticides (e.g., mice, ground squirrels)				
3.13	Shooting (e.g., deer, woodchucks, hares)				

Airport:	Date:	Page 4 of 6

Category 4: Management of habitat and food sources on airport property related to wildlife hazards

CODE	ITEMS	ASSESSMENT			
		S	NI	U	NA
	AGRICULTURE/VEGETATION MANAGEMENT				
4.1	Agricultural crops (especially cereal grains and sunflowers)				
4.2	Plowing, mowing, harvesting (rodents, insects, worms)				
4.3	Landscaping (fruits and roost sites attractive to birds)				
4.4	Brush, shrubs, wood lots (cover, browse for deer)				
4.5	Misc. nesting sites (trees) for egrets, raptors, etc.				
	WASTE MANAGEMENT/SANITATION				
4.6	Feeding birds and mammals (by people)				
4.7	Food waste storage (from cafeterias, and catering services)				
4.8	Garbage dumps				
4.9	Litter				
4.10	Sewage treatment ponds/lagoons/outfalls				
4.11	Weeds, construction debris, junk yards				
4.12	Animal carcasses (e.g. dead livestock, bird strike remains)				
	WATER SOURCES				
4.13	Aquatic vegetation				
4.14	Canals, ditches, creeks, waterways				
4.15	Low areas on pavement/ground that collect water				
4.16	Retention ponds (water, deicing fluid)				
4.17	Water fountains				
	MISCELLANEOUS ATTRACTANTS				
4.18	Earthworms along runways				
4.19	Insect hatches from vegetation or soil				
4.20	Seed-producing vegetation.				
4.21	Flat roofs (such as gull nesting and loafing sites)				
4.22	Structures (hangars, towers, signs, poles, etc.)				

Airport:	Date:	Page 5 of 6

Category 5: Land uses and food sources off airport potentially related to wildlife hazards on airport

CODE	ITEMS	SCORE[a]	COMMENTS
	AGRICULTURE		
5.1	Agricultural crops (especially cereal grains)		
5.2	Aquaculture facilities		
5.3	Livestock feedlots		
5.4	Grain storage or grain mills		
	COMMERCIAL/RECREATIONAL LAND USES		
5.5	Drive-in theaters, amusement parks, etc.		
5.6	Restaurants (esp. outdoor eating areas)		
5.7	Picnic areas, parks		
5.8	Marinas		
5.9	Golf courses		
5.10	Flat roofs (gull nesting sites)		
	WASTE MANAGEMENT		
5.11	Garbage barges		
5.12	Garbage dumps		
5.13	Garbage transfer stations		
5.14	Fish processing plants		
5.15	Sewage lagoons, outfalls		
	WATER SOURCES		
5.16	Retention ponds (water, feedlots, etc.)		
5.17	Canals, creeks, ditches		
5.18	Reservoirs, lakes, natural ponds		
	NESTING/LOAFING/FEEDING AREAS		
5.19	Wildlife refuges/nature preserves		
5.20	Misc. nesting sites (egrets, raptors, etc.)		
5.21	Roosting trees (starlings, egrets, etc.)		
5.22	Marshes, swamps, mud flats		

[a] 0 = not present;
1 = present but no wildlife problems noted or anticipated;
2 = site attracts some hazardous wildlife creating possible or potential problem, site should be monitored;
3 = site creates significant wildlife hazard for airport, action should be taken.

Airport:	**Date:**	**Page 6 of 6**
Summary: Comments are required for all elements in Categories 1–4 assessed as "Unsatisfactory" or as "Needs Improvement," or with a score of 2 or 3 in Category 5.		
Manager or wildlife supervisor:		Phone:
		Fax:
		E-mail:
Assessor:		Phone:
		Fax:
		E-mail:

Assessor's comments for elements rated "unsatisfactory" or "needs improvement" in Categories 1-4 or for elements scored 2 or 3 in Category 5.

Element code	Assessment symbol	Comments

Assessor's general comments (use back if needed):

APPENDIX F

Federal Aviation Administration Form 5200-7, Bird/Other Wildlife Strike Report

Form Approved OMB NO. 2120-0018

U.S. Department of Transportation
Federal Aviation Administration

BIRD/OTHER WILDLIFE STRIKE REPORT

1. Name of Operator

2. Aircraft Make/Model

3. Engine Make/Model

4. Aircraft Registration

5. Date of Incident ____/____/____ Month Day Year

6. Local Time of Incident ☐ Dawn ☐ Dusk ___ HR ___ MIN ☐ Day ☐ Night ☐ AM ☐ PM

7. Airport Name

8. Runway Used

9. Location If En Route *(Nearest Town/Reference & State)*

10. Height *(AGL)*

11. Speed *(IAS)*

12. Phase of Flight

- ☐ A. Parked
- ☐ B. Taxi
- ☐ C. Take-off Run
- ☐ D. Climb
- ☐ E. En Route
- ☐ F. Descent
- ☐ G. Approach
- ☐ H. Landing Roll

13. Part(s) of Aircraft Struck or Damaged

	Struck	Damaged		Struck	Damaged
A. Radome	☐	☐	H. Propeller	☐	☐
B. Windshield	☐	☐	I. Wing/Rotor	☐	☐
C. Nose	☐	☐	J. Fuselage	☐	☐
D. Engine No. 1	☐	☐	K. Landing Gear	☐	☐
E. Engine No. 2	☐	☐	L. Tail	☐	☐
F. Engine No. 3	☐	☐	M. Lights	☐	☐
G. Engine No. 4	☐	☐	N. Other:	☐	☐

(Specify, if "N. Other" is checked)

14. Effect on Flight

- ☐ None
- ☐ Aborted Take-Off
- ☐ Precautionary Landing
- ☐ Engines Shut Down
- ☐ Other: *(Specify)*

15. Sky Condition

- ☐ No Cloud
- ☐ Some Cloud
- ☐ Overcast

16. Precipitation

- ☐ Fog
- ☐ Rain
- ☐ Snow
- ☐ None

17. Bird/Other Wildlife Species

18. Number or birds seen and/or struck

Number of Birds	Seen	Struck
1	☐	☐
2-10	☐	☐
11-100	☐	☐
more than 100	☐	☐

19. Size of Bird(s)

- ☐ Small
- ☐ Medium
- ☐ Large

20. Pilot Warned of Birds ☐ Yes ☐ No

21. Remarks *(Describe damage, injuries and other pertinent information)*

DAMAGE / COST INFORMATION

22. Aircraft time out of service: _____ hours

23. Estimated cost of repairs or replacement *(U.S. $)*: $

24. Estimated other cost *(U.S. $) (e.g. loss of revenue, fuel, hotels)*: $

Reported by *(Optional)*

Title

Date

Paperwork Reduction Act Statement: The information collected on this form is necessary to allow the Federal Aviation Administration to assess the magnitude and severity of the wildlife-aircraft strike problem in the U.S. The information is used in determining the best management practices for reducing the hazard to aviation safety caused by wildlife-aircraft strikes. We estimate that it will take approximately **5 minutes** to complete the form. If you wish to make any comments concerning the accuracy of this burden estimate and any suggestions for reducing this burden, send those comments to the Federal Aviation Administration, Management Staff, ARP-10, 800 Independence Avenue, SW, Washington, DC 20591. The information collected is voluntary. Please note that an agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. The OMB control number associated with this collection is 2120-0045.

FAA Form 5200-7 (3-97) Supersedes Previous Edition ☆ U.S. GPO: 1997-418-084/64203 NSN:0052-00-851-9005

Mail to:

Federal Aviation Administration
Office of Airport Safety and Standards, AAS-310
800 Independence Avenue, SW
Washington, DC 20591

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation