Transport Canada Transports Canada

Wildlife *Control*

Procedures Manual

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Wildlife Control Procedures Manual

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Introduction

As air travel becomes more popular, so grows the need for effective wildlife management at airports. Over the years, aircraft noise has diminished while the numbers of aircraft have increased dramatically. Not only are birds and mammals less able to avoid aircraft movements—there are fewer places left for these animals to find refuge.

The first recorded bird-strike fatality occurred in 1912, when an aircraft collided with a gull over the coast of California and crashed into the ocean, killing the pilot. Since then, the number of reported wildlife strikes has risen steadily. In 2000, there were 772 reported strikes to Canadian aircraft. Although none involved human fatalities, the strikes that adversely affected flight or inflicted damage incurred huge costs.

The direct costs—primarily to airlines—associated with replacing and repairing damaged aircraft parts pale in comparison to the indirect costs incurred through aborted takeoffs, rescheduled flights, passenger and crew accommodations, and missed connection arrangements. Perhaps most damaging are the affects to airline reputation and reliability incurred when customers are inconvenienced by wildlife-related incidents.

Through the implementation of effective wildlife-management plans—including active and passive wildlife-management techniques—the costs, risks and damages associated with wildlife strikes can be significantly reduced.

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This document is an update of Transport Canada's *Wildlife Control Procedures Manual* (TP11500). Last revised in 1994, the previous manual included guidance on wildlife-management procedures at Canadian airports, as well as information concerning available products and techniques and wildlife-control legislation.

Since publication, considerable field research at many airports in Canada and the United States has led to improved management procedures. Furthermore, many new wildlife-management products have been introduced, while some control methods outlined in the 1994 edition require modification to remain effective. This revised manual includes a ranking of hazardous species found at Canadian airports, as well as methods for control of those species not included in the previous edition.

The Wildlife Control Procedures Manual compiles information from a variety of Canadian and American publications to present up-to-date information on the wildlife-hazard management issue.

The 1994 edition served as the National Airports Group (NAP) policy manual on wildlife management, and included policy and strategic planning information that is no longer relevant. Transport Canada has recently published a guide to wildlife control titled *Sharing the Skies* (TP 13549), which includes strategic information previously included in the manual. This new edition of *The Wildlife Control Procedures Manual* serves as a tactical guide for wildlife-management personnel at the airport and in the field, providing specific guidance on the management of individual species.

Sections A and B are an overview of wildlife management from both national and international perspectives. The overview is followed by sections on long-term solutions available through passive wildlife-management techniques, including habitat modification and mitigating hazardous land-use activities adjacent to airports. Active management techniques are discussed in the following three sections, assessing various removal, exclusion and dispersal methods. Sections H and I discuss control methods for problem birds and mammals in the airport environment; suggested management techniques are limited to those that have proven effective through research and application. Section J concludes the manual with information on implementing and assessing wildlife control programs.

The appendices contain, among other items, proposed amendments to the *Canadian Aviation Regulations* (CARs) that specifically address—for the first time—wildlife management and planning at Canadian airports. The proposed regulation will ensure a more formal approach to wildlife management by establishing the criteria for the management of wildlife hazards at all designated airports.

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Every airport is unique: their size, number of aircraft movements and type of air-traffic control programs vary significantly. Wildlife management programs are as varied as the airports they serve, and should result from thorough site-specific inventories and assessments. Wildlife control is an art as well as a science, and the information contained in this manual will provide a starting point from which airport wildlife controllers can begin to manage existing wildlife and habitat problems.

Section A

Overview of Wildlife Management

Introduction

Transport Canada regards all airport wildlife as a potential safety hazard. Departmental policy therefore encourages the siting, construction, maintenance, and operation of airports and their facilities in a manner that minimizes this hazard.

The role of Transport Canada headquarters is to develop and promulgate regulations, standards and related applicable policies. This includes providing functional direction to regional offices on regulatory safety oversight programs and related guidance material. Regions are responsible to deliver the program in accordance with functional direction. The department does not play a direct role in the implementation of wildlife control programs at individual airports, but does provide awareness material and expertise upon request or through the normal cycle of distributing education and awareness material. Responsibility for program design and implementation now rests with management teams at each airport.

A successful wildlife-control management plan reduces hazards to aircraft and minimizes maintenance problems by rendering airport property less attractive to animals. The safety benefits are real for all concerned: airports, airlines, the public—and wildlife.

Airport wildlife can be controlled by:

- managing habitat so that airports do not attract wildlife,
- excluding wildlife from airports through the use of fences or other means,
- dispersing wildlife from the premises, and
- removing wildlife, either dead or alive.

The best long-term control is achieved through habitat management; however, it is impossible to completely control wildlife in this way. Birds are particularly difficult to manage because they are mobile and they readily adapt to changing environments. In most situations, active removal or dispersal of wildlife is necessary, in conjunction with habitat management techniques.

Established Practices and Principles for Airports

Habitat management modifies and limits wildlife attractants on airport lands. By altering the airport environment, habitat management simplifies the task of

excluding wildlife, and helps reduce the amount of time required to remove problem species. The need to initiate active dispersal or hazing against birds or mammals often arises when habitat management plans have not been fully or successfully implemented.

Identification of site-specific problem species

The development of a habitat management plan begins with an ecological site study that identifies specific problem areas. This study creates an inventory of wildlife in the vicinity of airports and includes identification, population sizes, locations, and movements of all species. The study describes the aerodrome features and areas that attract wildlife; problem areas are directly related to problem bird and mammal species on site.

An effective reporting program is a key contributor to a successful ecological survey. The designated Wildlife Control Officer patrols the airport grounds and maintains a daily log of wildlife activity. Log entries include sighting times, locations, numbers and species observed, actions taken, and results obtained. From this data, activities and projects associated with the management plan can be ranked and executed accordingly.

Contractors and insurance

Some airports choose to hire private bird- and mammal-control firms rather than maintain wildlife control officers on staff. The existence of a well-crafted wildlife management plan is critical in contracting scenarios, as the contents of the plan inform and define the actions and responsibilities of the contractors. Agreements address many issues, including equipment supply, hours of operation, and ancillary duties.

Insurance companies often impose certain conditions on contractors, not the least of which may be the requirement to maintain adequate public-liability policies—coverage that protects the airport operator in the event of damage or injury resulting from the work of the contractor.

Private bird- and mammal-control firms should ensure their scope of work is properly detailed within the contract, as insurance may not cover work that is not specifically mentioned in the agreement.

Habitat modification

The most effective way to reduce wildlife hazards in the vicinity of airports is to ensure birds and mammals are not drawn to the grounds. All aspects of airport design should address and minimize the food, shelter, water and open

Open drainage ditches that attract birds

space that attract wildlife. Modifying natural and man-made environments—following assessments of problem species and their attractants—can render these areas unappealing and inaccessible to wildlife. This is an effective long-term solution that can minimize problem species in specific areas.

Examples of airport habitat modifications include:

- modifying buildings and signs to reduce nesting and perching areas,
- designing drainage ditches to minimize standing water, and
- removing vegetation from banks of water bodies.

Airport managers are also advised to consider site-specific grass-management programs (which can deter many problem species) and should, when leasing airport lands for agricultural purposes, prohibit the harvesting of certain crops and limit practices—such as ploughing—to certain times of the day.

Adjacent land-use activities

Airports that were once miles from city limits must now face wildlife-control issues raised by the close-proximity of incompatible land-use activities such as landfill sites, garbage dumps, agricultural activities, and coastal commercial fish-processing plants. Airport operators should communicate with regional and municipal governments as active participants in land-use planning decisions.

Where incompatible land uses exist or are being considered, airport operators should work to minimize the adverse effects. Creating education and awareness programs and establishing co-operative working relationships with governments, interest groups, and stakeholders, usually lead to compromises that accommodate all parties.

Dispersal techniques

Scare tactics and auditory deterrents are perhaps the most common and widely used method of wildlife control. These first-line techniques, used to repel wildlife immediately from the airport, include shell crackers, pyrotechnics, and

gas cannons. Unfortunately, the low cost, ease of application, and immediate realization of results from these methods has led to their over-use. Generally, their effectiveness is short-lived; they are inexpensive in the short run but require repeated applications for the control of persistent wildlife types. And while costs escalate with the number of applications, so does the likelihood of habituation—and the requirement for new measures and budget allocations when it becomes clear that problem species have not been deterred or eliminated.

The use of scare tactics and dispersal methods should not be considered a primary control method for persistent or resident wildlife species. These techniques can, however, provide the first line of defence for true transients and migrant species that cause periodic problems. In all other cases, dispersal techniques should be employed as components of integrated wildlife-control programs.

Exclusion methods

Exclusion methods comprise man-made barriers such as fences and netting that keep wildlife away from areas at airports where food, water and shelter can normally be found. These barriers are commonly used to restrict mammal movement and manage bodies of water. When successful, these measures provide permanent solutions to wildlife problems in protected areas.

Removal methods

Generally, removal methods—trapping, shooting, and poisoning—provide short-term solutions to the presence of problem species. Removal methods will eliminate the species temporarily, but if the attractant is not removed the population will simply replenish itself. Trained personnel and, in most cases, permits are required to carry out these measures. Please check with local authorities for guidance and information on legislation in your jurisdiction.

Wildlife-strike Statistics

Introduction

This section presents an overview of available wildlife-strike data as it pertains to aircraft and the animals with which they collide. Comprehensive data and analysis can be found in *Sharing the Skies* (TP 13549E), available from Transport Canada.

Number of strikes

Available data shows that since 1912, 223 people have been killed worldwide in at least 37 bird-strike-related civil-aircraft accidents. In military aviation, 165 fatalities have occurred in 353 serious accidents since 1950. Anecdotal evidence suggests that these numbers represent only a fraction of the total bird-strike-related occurrences. Countless strikes go unreported each year for a variety of reasons, including:

- bird-strike reporting is not mandatory in most parts of the world;
- some countries, airlines and airports are reluctant to publish bird-strike statistics due to liability concerns and negative public perception of flight safety;
- loss of information occurs in many developing countries due to lack of funding, expertise, and media coverage; and
- damage caused by bird-strikes is sometimes attributed to other causes.

Many member states of the International Civil Aviation Organization (ICAO) report occurrences of bird-strikes annually; ICAO summarizes and publishes this data for each year. Canada has a well-established bird and mammal reporting procedure of its own, outlined in Section J. Transport Canada also publishes an annual summary report that analyzes all January-to-December database information. This report can be viewed on-line at: http://info/aviation/aerodrme/birdstke/main.htm.

Aircraft crashes and loss of life

The first bird-strike fatality was recorded in North America in 1912, when Cal Rodgers—the first man to fly across the United States—lost his life after a gull became jammed in the controls of his aircraft, causing the plane to crash.

Most crashes—civil and military—follow collisions with large birds such as vultures and migratory waterfowl; however, flocks of small birds such as starlings and cowbirds are often involved. In military aviation, severe engine damage due to bird ingestion often results in the loss of low-flying single-engine aircraft. Fortunately, pilots are usually able to eject and parachute to safety.

However, on September 22, 1995, a Boeing E-3B Sentry (AWACS) struck a flock of geese on takeoff from Anchorage, Alaska. As the aircraft lifted off, a senior controller saw geese rise and turn directly into the aircraft's flight path. Birds were ingested into the number-one and number-two engines. The aircraft went down, exploded, and burned in a wooded area less than two kilometers from the end of the runway. All 24 crew members were killed. An official U.S. Air Force accident investigation concluded that the accident "was directly caused by the ingestion of Canada Geese into engines number one and number two."

Birds are suspected to have caused a number of otherwise unexplained civil and military aviation crashes. One involved a Vickers Viscount that went down in the Irish Sea in 1968. While no proof of a strike was established—much of the aircraft was not recovered for examination—Bewick's Swans were known to be migrating in the same area that day.

Crashes that may have involved bird-strikes are often never reported, either by aviation authorities or by the media. In April 2000, 21 people died when an Antanov AN-8 collided with birds on takeoff in Pepa, Congo. Few details regarding this accident were ever made available. Due to a lack of funding and expertise in the country, no investigation was ever completed, nor was the crash covered intensively by the media.

Table 1.1 (see pages B.4 and B.5) outlines all recorded international bird-strike incidents involving fatalities or the loss of an aircraft.

Near crashes

Occasionally, bird-strike damage is so extensive it is difficult to comprehend how a crash did not occur. For example, a KLM Boeing 747 struck a flock of Canada Geese just prior to touchdown at Calgary International Airport on October 26th, 1992. Multiple bird-strikes during this critical phase of flight—in close proximity to the ground—have the potential to lead to disaster. The aircraft landed without further incident and no one on board was injured; however, the aircraft sustained major uncontained damage to the number-one engine. The leading-edge slats were also severely damaged.

Another near-accident occurred in a collision between a flock of migrating Snow Geese and a CP Air twin-engine B-737 on descent into Winnipeg International Airport with 82 passengers on board. The aircraft took several hits: one inflicted a heavy dent to the top of an engine air-intake cowling and another strike dented the bottom of the cowling on the opposite side. Had the aircraft been in a roll attitude at the moment of impact, geese could have entered both engines. Disaster was also averted when the pilot reduced airspeed after being issued a general warning that migrating waterfowl were in the vicinity of the approach path.

In June 1993, a Canadian Airlines Boeing 737 aircraft with six crew and 110 passengers experienced a severe bird-strike during a scheduled flight to Vancouver. No bird activity was noted during the initial roll, but immediately after rotation the view from the windscreen was suddenly obscured by a flock of gulls—more than 60 dead gulls were later found on the runway. Multiple strikes occurred at approximately 30-feet AGL. The number-one engine lost power, exhibiting compressor stalls and high vibration. The number-two engine continued to develop full power, but vibration led the crew to suspect that it too was damaged. Once established in a climb, the captain declared an emergency and leveled off at 2,200-feet AGL before turning back. The power lever on the left engine was reduced to idle—the engine was torching and surging. Approximately 10 minutes after the bird-strike, the aircraft landed and taxied to the terminal. The aircraft's leading-edge slats were badly damaged; both engines had to be replaced. The cost: more than $4 million.

Table 1.1 World-wide Bird Strike Accidents Involving Destruction Of Aircraft Or Fatality, 1912–1997

Helicopter

Date	Aircraft	Location
3/2/81	Bell 206	Vancouver, Canada

Transport Aircraft

Date	Aircraft	Location
10/4/60	Lockheed L188Electra (Allison 501)	Boston, USA
7/15/62	Douglas DC3 (P&W R1830)	Lahore, Pakistan
11/23/62	Vickers Viscount (Dart)	Maryland, USA
7/28/68	Falcon 20 (CF700)	Lake Erie, USA
7/28/69	Douglas DC3 (P&W R1830)	Khar, Ambadu, India
3/26/73	Lear 24 (CJ610)	Atlanta, USA
12/12/73	Falcon 20 (CF700)	Norwich, United Kingdom
6/14/75	NA265 Sabreliner (JT12A)	Watertown, USA
11/12/75	DC10 (CF6)	Kennedy N.Y., USA
11/20/75	HS125 (Viper)	Dunsfold, United Kingdom
2/6/76	Lear 24 (CJ610)	Bari, Italy
11/12/76	Falcon 20 (CF700)	Naples, Fla., USA
4/4/78	B-737 (JT8D)	Gossellies, Belgium
7/25/78	Convair 580 (Allison 501)	Kalamazoo, USA
4/7/81	Lear 23 (CJ610)	Lunken, Cincinnati, USA
12/6/82	Lear 35 (TFE731)	Le Bourget, Paris, France
8/17/83	Lear 25 (CJ610)	Wilmington, USA
9/15/88	Boeing 737 (JT8D)	Bahar Dar, Ethiopia

Airplanes of 5700 kg and below

Date	Aircraft	Location
4/3/12	Wright Flyer	Long Beach, Calif., USA
2/10/29	Arado	Madras, India
– / – /55	Cessna	Aberdare Mtns, Kenya
1/10/59		Serengeti, Tanganyka
– /03/63	Beech 35	Bakersfield, Calif., USA
2/1/64	Turbulent	Nr Belfast, United Kingdom
7/2/71	Cessna 180	British Columbia, Can.
4/16/72	Mitsubishi MU2	Atlantic City, USA
8/30/76	Saab MFJ15	Nr Awassa, Ethiopia
4/23/77	Aero Commander 690	Meigs Field, Chicago, USA
10/19/79	Swearington Merlin	Palo Alto, Calif., USA
8/6/81	Cessna 402	Near Musiars, Kenya
– / – /81	Callair A9	Australia
11/24/87	Osprey Homebuild	Cape Liptrap, Australia
12/26/91	Piper PA31 Navajo (5Y–SRV)	Maasi-Mara, Kenya
1/25/92	Cessna 401 (5Y–BGW)	Maasi-mara, Kenya
5/4/95	NF-5	Norway
8/10/95	F-15	Isreal
9/25/95	E-3B	United States
1/19/96	Mir. 2000	France
1/26/96	S. Etendard	France
9/25/97	Tutor	Canada
10/22/97	T-34C	United States

Table 1.1 World-wide Bird Strike Accidents Involving Destruction Of Aircraft Or Fatality, 1912–1997 continued...

Helicopter

Part Struck	Birds/Weight	Occupants/Injury
Windshield	Raven / 1.2 kg	4/4 killed

Transport Aircraft

Part Struck	Birds/Weight	Occupants/Injury
Engines	Starlings / 80 gm	72/ 62 killed9 injured
Windshield	Vulture / up to 10 kg	3/1 killed
Tailplane	Whistling Swan / 6 kg	17/17 killed
Engines	Gulls / 280 gm to 1.7 kg	3/
Engines	Cranes / up to 6 kg	4/
Engines	Cowbirds / 44 gm	7/7 killed/ 1-third- party injured
Engines	Gulls / 275 g to 420 g	9/1 minor injury
Engines	Franklin's Gull / 260 gm	6/3 injured
Engine	Gulls / 485 g to 1.7 kg	139/
Engines	Lapwing / 215 gm	9/6 third party killed
Engines	Gulls / 280 gm to 1.7 kg	3/
Engines	Ring-billed Gulls / 485 gm	11/11 injured
Engine	Wood Pigeon / 465 gm	3/
Engine	Sparrowhawk / 105 gm	43/3 injured
Windshield	Loon / 3.7 kg	2/1 killed1 injured
	Black-headed Gulls / 275 gm	–/1 injured
Engines	Starlings / 80 gm	2/
Engines	Speckled Pigeon / 320 gm	104/35 killed21 injured

Airplanes of 5700 kg and below

Part Struck	Birds/Weight	Occupants/Injury
	Gull	1/1 killed
		1/1 killed
Wing tip	Vulture	1/1 killed
	Griffin Vulture / 5.4 kg	1/1 killed
Tailplane	Common Loon / 3.7 kg	1/1 killed
	Gull	1/1 killed
	Bald Eagle / 5 kg	3/2 killed
Windshield	Geese	3/3 killed
	Vulture	22 killed
Engine	Gull	4/4 killed
Engine	Gulls	4/2 killed1 injured
Windshield	Ruppell's Griffon Vulture / 7.5 kg	1/1 killed
Strut/ top-surface wing	Black Kite	1/1 minor injury
Windshield		1/
Windshield	White-headed Vulture / about 5.4 kg	9/9 killed
Wing tip		7/7 killed
Engine	Gulls	2/
Engine	Storks	2/2killed
Engines	Canada Geese	24/24 killed
Engine	Gulls	2/
Windshield	Gulls	1/
Engine	Unknown	2/
	Unknown	2/2 killed

Direct damage resulting from bird-strikes

While strikes can occur against the underside of the fuselage, the flaps, landing lights, and landing gear, the forward facing parts of the aircraft—including engines, wings, windshields and noses—are the most commonly struck.

Windshield strikes can cause cracks, shattering, and penetration. In the worst cases, pilots are exposed to flying glass and bird debris, as well as the powerful airflow resulting from a compromised windshield.

Military aircraft damaged by Turkey Vulture

The propellers on piston-engine aircraft are strong and, although often struck, are rarely damaged by birds. The rotating blades also tend to protect engines, if only by reducing bird size and, therefore, the effect of impact. In fact, severe damage to piston engines as a result of bird-strikes is rarely reported.

Exposed turbine engines, however, are highly vulnerable to bird impact. Compressor, rotor and stator blades can bend or break—in the worst cases, they are completely destroyed.

In January 2001, a Delta Airlines MD-11 ingested a Herring Gull into the number-one engine on takeoff from Portland International Airport in Oregon, U.S. This caused an uncontained failure and the takeoff was aborted. The strike inflicted approximately $1 million in damage, including a torn engine cowl and burned tires and landing gear.

Delayed-effect damage resulting from bird-strikes

Some bird-strike damage is subtle enough to evade initial or cursory inspections. Referred to as *delayed-effect damage*, it usually occurs to turbine-powered engines. One such incident involved a DC-8 that struck a bird during takeoff from Rome. The engine remained in use after a visual check revealed no apparent damage. However 50 service hours later the engine failed while cruising over Lethbridge, Alberta. An inspection showed that a blade had failed and the

compressor was damaged. Although there was no proof, engine failure likely resulted from the bird ingestion.

Caution should be continually exercised, as demonstrated in the case of a DC-8 bound for Tokyo from Vancouver. The aircraft struck a large flock of sparrow-sized shorebirds as it lifted off the runway. The captain reported the strike to the tower, and ground staff found several hundred dead birds on the runway. This information was relayed to the captain, who then spoke to his company's chief engineer. Although the cockpit instruments did not indicate trouble, the captain decided to return for inspection. Two hours later—after dumping 20 tons of fuel—the aircraft returned to the airport. A post-flight inspection revealed damage to eight fan blades in one engine, seven in another engine, and minor damage to the other two. The two seriously damaged engines had to be replaced. Upon examining the damaged blades, engineers speculated that fracture and disastrous engine damage was inevitable—likely within two or three hours of cruise-power operation, or about half way across the Pacific Ocean.

Multiple-cause accidents resulting from bird-strikes

An accident that is caused by the combined or successive effects of several factors is called a *multiple-cause accident*, illustrated in the following scenario.

On takeoff, a B-747 collided with a flock of gulls. The crew heard noises that suggested a bird-strike. At the same time, they felt vibration—verified by instruments—in the number-four engine, which was subsequently shut down. The vibration ceased. The aircraft returned to the airport, where the runway was wet and slippery. At touchdown, the crew applied brakes and attempted engine reverse on number-one, -two, and -three engines. The latter engine malfunctioned and could not be reversed. With two engines reversed on one side, the aircraft began to yaw, skidded off the end of the runway, and stopped when the nose landing gear collapsed after striking a slab of concrete. All occupants were evacuated via the emergency chutes; a few passengers received minor injuries.

Damage to the aircraft was substantial. Visual examination showed no bird-strike evidence on engines one, two or four, but the number-three engine had been struck by at least one gull, damaging the engine fan blades. Testing of the aircraft systems showed that a component of the thrust-reversing mechanism on the number-three engine was locked, and that the vibration monitor on the number-four engine malfunctioned because of a broken wire.

Several factors contributed to this accident, including the wet runway, the bird-strike and the faulty instrumentation. If the crew had shut down the number-three engine instead of number four—which had not been struck and operated normally—the landing could have been completed without further complications.

While not necessarily demonstrated in the above incident, it is important to note that multiple-cause accidents often include some misjudgment or error on the part of the flight crew. Serious strikes have the potential not only to damage aircraft, but also to startle and distract pilots, and—in certain circumstances—impair their judgment.

Trends in wildlife-strike incidents

Geographical distribution

Collisions between birds and aircraft occur whenever birds and aircraft occupy the same airspace; however, strike frequency varies greatly with location. For example, higher strike rates can be expected along migratory flyways and over bodies of water.

Rather than simply counting the number of incidents, strike rates should be calculated (as the number of strikes per 10,000 movements) to accurately evaluate the strike risks in a particular region. It is generally accepted that a rate exceeding three strikes per 10,000 movements indicates the need to improve or re-evaluate the existing bird-management program.

Distribution by time of day

Most bird species are active during the day; however, many diurnal species limit their daylight functions to dusk and dawn. While nocturnal birds such as owls and nighthawks are, by definition, primarily active at night and rarely hunt during the daylight hours, many diurnal species—including geese and ducks—also feed and fly at night. Night migrations of many species, such as geese and swans, are common.

While bird-strikes can therefore occur at any hour of the day and night, Transport Canada data to 2000 indicates that most strikes occur in the early morning and decrease slowly throughout the day. Very few strikes are reported between midnight and 0500h—not only are most birds inactive during this time, but also there are fewer aircraft movements. However, an examination of strike-rates indicates that the difference between rates for day and night are surprisingly small.

Distribution by time of year

Monthly strike rates reveal three peak periods:

- spring migration in March,
- fall migration in October, and
- July—likely due to the presence of naïve young birds and their dispersal from breeding areas.

Distribution by altitude

According to available data concerning the altitudes at which civil and military aviation bird-strikes have occurred, low-altitude strikes are the most common. Preliminary data analysis, however, shows that high-altitude strikes (above 500-feet AGL) involving large birds are occurring more frequently. These strikes often cause substantial aircraft damage and adverse flight effects, as aircraft are traveling at higher speeds and pilots are less aware of the presence of birds.

Only a small percentage of strikes occur at heights above 3,000-feet AGL. Transport Canada data shows that within the airport environment 90 percent of bird-strikes in which altitude is recorded occur below 500-feet AGL. The highest reported bird-strike took place at 37,000 feet on November 29, 1973; a commercial jet airliner collided with a Ruppeli's Griffon Vulture over Abijan, Ivory Coast. It is also common for strikes to occur at 0 feet AGL, immediately prior to takeoff and just after landing.

Distribution by flight phase

Most birds fly at altitudes below 500-feet AGL, where flight-phase strike statistics indicate the majority of collisions are likely to occur.

In civil aviation, about 38 percent of strikes happen during takeoff; approximately 41 percent occur while aircraft are landing. These numbers support research and development efforts aimed at reducing bird hazards in the immediate vicinity of airfields. However, off-airport strikes during climb-cruise-descent may be more hazardous not only because they are more likely to involve large soaring birds and migrating flocks of waterfowl, but also because aircraft are traveling at higher speeds. Strikes that occur en-route also pose serious hazards, since flight crews cannot benefit from the control and warning systems often afforded in close proximity to airports. Strikes that occur outside airport airspace—above 500-feet AGL on takeoff and 250-feet AGL on approach—are deemed to be beyond airport operators' direct spheres of influence. In response, researchers are currently developing radar systems capable of detecting such bird movements.

Distribution by aircraft speed

In civil aviation, most bird-strikes occur at relatively low altitudes and involve aircraft flying below cruise speed. In the United Kingdom, for example, more than 80 percent of all strikes occur at speeds between 80 and 160 knots. Statistics such as these explain why most aircraft certification standards are limited to testing the impact of a single, 4-lb. bird at design cruise speed.

Species involved

The way birds behave in the face of approaching aircraft varies with the species. Birds of prey are reported to have attacked gliders and aircraft, whereas waterfowl tend to avoid airplanes. Birds such as woodpeckers—which spend their lives among trees—are unlikely to be involved in strikes unless they are migrating. In Canada, birds as big as a Sandhill Crane and as small as a Ruby-crowned Kinglet have been struck by aircraft, but what is perhaps most perplexing is that the list of species involved in strikes continues to grow.

High-risk species are those that are most frequently involved in strikes, as well as those that cause the greatest damage. Larger birds tend to inflict more damage due to higher impact forces. Since they are more likely to be felt—and provide evidence in the form of easily identifiable remains (feathers, claws, or bills)—strikes to large birds are most often reported. Gulls, waterfowl, raptors, and vultures are some of the most hazardous species at airports.

Loafing gulls on an airfield

Gulls are a frequent problem at many North American and European airports; when species are identified. At least one third of reported strikes involve gulls. Exceptional at adapting to the human environment, these birds commonly use airports as loafing and pre-roosting sites. Gulls are good gliders, but cannot accelerate quickly to avoid approaching aircraft. Furthermore—and as often occurs with European Starlings and Dunlins—gulls often try to out-fly aircraft rather than move to the side. Many gull species are big enough to cause substantial aircraft damage, so it is not surprising they are considered the number-one hazardous bird at airports in many countries, including Canada.

Research shows that Ring-billed Gull populations in the lower Great Lakes region increased at the rate of approximately 12 percent per year during the 1970's and 1980's.

Large, slow-flying birds such as hawks—often engaged in hunting activities over airfields—pose a high risk to aircraft. Eagles have been involved in fatal bird-strike accidents, perhaps as a result of the aggressive behaviour this species can display toward aircraft.

Although vultures are not known to attack aircraft, the slow speed of these birds contributes to their involvement in many serious strikes, particularly in the Far East. Hooded Vultures and Black Kites are a nuisance at Dakar International Airport, Senegal, and at Yuncum Bathurst Airport, Gambia. The Turkey Vulture is becoming an increasing problem at North American airports due to its large size and soaring behaviour. Turkey Vulture populations are on the increase, and the birds are now found in southern Canada, where they are likely to pose problems at airports in the near future.

Despite their wariness of humans and aircraft, waterfowl—swans, geese, and ducks—cause extensive damage. Among the largest flying birds in the world, waterfowl deliver high-impact force in collisions. Strikes involving waterfowl are most common in the former USSR and Canada, where population numbers are high. Canada Geese are an increasing problem in many Canadian cities, as these birds adapt quickly and become resident in urban environments. The North American population of non-migratory Canada Geese has grown to more than two million birds. The total North American population of Canada Geese is now over five million birds, increasing the risk of bird-strikes at many airports.

Other considerations

Investigations at a few airports have verified that some species are a problem only in specific areas and only at certain times of the year.

The Snowy Owl is one example. Small numbers of this Arctic breeder move southward in some winters, hunting along runways and taxiways at airfields in southern Canada. Inexperienced and unafraid in the presence of aircraft, these large birds can pose a high risk. They have been involved in a few costly strikes at Lester B. Pearson International Airport.

The USAF has a special problem at Whiteman AFB, Missouri. The booming ground (the area in which birds perform social displays during the mating

season) of the Greater Prairie Chicken—an endangered species—is located on the base's main runway. The USAF has taken measures such as altering flight schedules to cope with the problem without killing the birds.

These examples demonstrate that the nature of bird-strike hazards varies with location; each problem should be investigated on its own merits to determine the unique characteristics.

Knowledge of the age of birds can help in determining effective control methods. While such data are scarce, what is known seems to indicate that young birds are more prone to contact with aircraft. For instance, at Kingisepp Airport, in the former USSR, six of seven gulls struck between early July and early August were identified as immature birds; Lester B. Pearson International Airport reported similar data in the 1970s.

It is sometimes difficult to know exactly where a bird-strike occurred. In one instance, a Sabena aircraft flew from Belgium to Montreal, where its crew reported a bird-strike. Later the same week, Sabena reported another strike at Montreal. The airline was concerned; engine damage was extensive and costly. Bird remains obtained from the engines of both aircraft were identified as those of lapwings, a species not native to Canada but common in Belgium. Apparently, the birds were struck on takeoff and lodged against the engines' inlet guide vanes. In Montreal, following the altered airflow during engine slowdown and reverse thrust, the carcasses were dislodged and drawn through the engines, severely damaging them. The hypothesis is not without precedent. In a similar experience, a duck carcass remained lodged against the inlet guide vanes of a Canadian aircraft during a flight of several hours.

Collisions between mammals and aircraft

While less frequent than bird-strikes—and occurring at fewer locations—collisions involving large mammals such as Elk, deer and Moose can be understandably serious. Mammal activity and sightings in the vicinity of airports are often responsible for missed approaches and aborted takeoffs.

Deer are the most commonly struck mammals at North American airports. In Canada, a total of 18 deer strikes have been reported to Transport Canada. Damage is almost always substantial. In January 2001, a Lear 60 attempting to land at Troy, Alabama, struck two deer and skidded off the runway. Quick action on the ground saved the lives of the two pilots; however, the aircraft was destroyed.

Mammals seen on airport runways

Coyote strikes also occur in North America. At an airport in California, a Coyote was struck by the nose-wheel of an L-1011. Numerous Coyote incidents have been recently reported in Canada as well, including an unlikely occurrence at Calgary in which an Air Canada aircraft hit two Coyotes at once.

Bat strikes were first reported in 1969. Mexican Freetail Bats did a great deal of damage to T-38 and T-37 aircraft at Randolph AFB, near San Antonio, Texas. These bats migrate in spring from Mexico into the South Western United States, where they inhabit large caves. Their numbers swell to an estimated 40 million by August. Each night, huge swarms of bats leave their roosts in search of airborne insects.

Bird-aircraft interactions – International trends

The following organizations maintain major databases containing North American bird-strike information:

- Transport Canada,
- the Federal Aviation Administration (United States), and
- the International Civil Aviation Organization (International).

Key information from each is summarized below.

The Bird-strike Information System (IBIS) of the International Civil Aviation Organization (ICAO) provides analysis of bird-strike reports received from different countries. Findings based on 1998 IBIS statistics reveal the following:

- 64 percent of reported strikes occurred during daylight hours, 22 percent occurred at night, and the remainder occurred at dawn or dusk;
- 72 percent of reported strikes involved turbofan aircraft (over 27,000 kg);
- 34 percent of reported strikes occurred during approach, 20 percent during takeoff-run, and 17 percent during climb out;
- 48 percent of reported strikes occurred below 100 feet; and

- in 81 percent of reported strike incidents the pilots were not warned of bird activity.

A total of 16,488 reported bird-strikes took place between 1989 and 1992. Table 1.2 illustrates the different bird groups involved in these strikes.

The following tables contain information compiled from the world bird-strike statistics of ICAO. These figures indicate that 98 percent of bird-strikes occurred during takeoff, climb, final approach, landing, and taxiing—reinforcing the critical role of effective airport-based wildlife control programs in preventing bird-strikes.

Bird Type	*# of Strikes*	*Bird Type*	*# of Strikes*
passerines	2565	oystercatchers/sandpipers	151
gulls	2375	owls	110
raptors	1063	bats	101
plovers/lapwings	594	grouse/pheasant/partridge	88
pigeons/doves	497	parakeets	34
waterfowl	248	unknown	8460
herons	202		
		TOTAL	16 488

Note: As all of these parameters are not reported for every bird strike, the totals may not add up to 16 488.

Aircraft Classification	*# of Strikes*	*Flight Phase*	*# of Strikes*
Turbo fan over 27 000	12 417		
Turbo prop under 27 000	1857	Parked	45
Piston under 5700	902	Taxi	73
Other, unknown, glider	880	Take-off Run	3213
Turbo fan under 27 000	130	Climb	2179
Turbo jet under 27 000	114	En route	218
Helicopter	89	Descent	381
Turbo jet over 27 000	58	Approach	5018
Turbo prop over 27 000	30	Landing Roll	2701
Piston over 5700	11		

Height Above GroundLevel (AGL) (ft)	*# of Strikes*	*Indicated Air Speed Knots (IAS - KT)*	*# of Strikes*
0 – 100	7801	0 – 80	719
101– 200	984	81 – 100	813
201 – 500	1348	101 – 150	7319
501 – 1000	922	151 – 200	2300
1001 – 2500	1194	201 – 250	588
Over 2501	1195	Over 250	430
Unknown	124	Unknown	120

Aircraft Damage	*# of Strikes*	*Light Condition*	*# of Strikes*
None	15 315	Dawn	451
Minor	690	Day	10 682
Substantial	483	Dusk	786
		Night	3167

Effect On Flight	*# of Strikes*
None	12 078
Aborted take-off	255
Precautionary landing	442
Engine(s) shutdown	73
Forced landing	22
Fire	3
Penetration of windshield	7
Penetration of airframe	1
Vision obscured	24

Parts Struck	*# of Strikes*	*Parts Damaged*	*# of Strikes*
Radome	1897	Radome	188
Windshield	2175	Windshield	96
Nose	2247	Nose	101
1 engine	2688	1 engine	750
2 engines	135	2 engines	25
3 engines	10	3 engines	2
4 engines	2	4 engines	1
Propeller	408	Propeller	29
Wing/rotor	2037	Wing/rotor	365
Fuselage	1840	Fuselage	82
Landing gear	845	Landing gear	50
Tail	131	Tail	40
Lights	140	Lights	100
Pitot/static head	25	Pitot/static head	8
Antenna(e)	16	Antenna(e)	10
Tail rotor	1	Tail rotor	0
Other part	1120	Other part	59

Transport Canada compiles an annual Bird-Strike to Canadian Aircraft Summary Report that analyzes Canadian airport and aircraft information received throughout the year. In 1999, Canadian aircraft received 741 reported bird-strikes. While most had no direct effect on flights, precautionary landings followed 47 incidents, engine ingestions took place in five, and 18 incidents resulted in aborted takeoffs.

In 42.6 percent of cases, carcasses could not be identified; however, when birds were recognizable:

- 35 percent were gulls,
- 12 percent were Snow Buntings,
- 12 percent were sparrows and swallows,
- 9 percent were waterfowl, and
- 4 percent were hawks.

As previous figures indicated, most occurrences took place at or near airports:

- 37 percent during the takeoff run,
- 26 percent during landing roll,
- 24 percent during approach, and
- 8 percent during climb-out.

Most strikes took place between July and October. Dash-8 aircraft received the highest number of reported strikes (103 incidents).

In the United States, the Federal Aviation Administration (FAA) publishes annual civil-aviation bird-strike reports in conjunction with the U.S. Department of Agriculture (USDA). The most recent report covers the 10-year period from 1990 to 1999, in which 28,150 bird-strikes and 681 mammal strikes were reported. Reports were compiled from all states and from foreign countries when U.S. aircraft were involved.

- 51 percent of bird-strikes occurred between July and October.
- 65 percent occurred during the day.
- 53 percent occurred when aircraft were on approach or during landing roll.
- 39 percent occurred during takeoff and climb.
- Approximately 55 percent occurred below 100-feet AGL within the airport environment.

The species most often struck include:

- gulls, 29 percent;
- doves, 12 percent;
- waterfowl, 12 percent; and
- raptors, 11 percent.

The most commonly struck mammals were White-tailed Deer (49 percent) and Coyotes (10 percent).

Summary

The analysis of wildlife-strike data has, in recent years, provided a wealth of valuable information that reveals a great deal about the nature of bird and mammal hazards. The data has become a critical aspect in wildlife-control program design, allowing airport authorities to mount targeted and effective campaigns against the unique dangers found at individual airports around the world. The data are also used by engine and airframe manufacturers in the design of aircraft components. An interesting finding in the 10-year report involved bird ingestions into turbofan engines. The number of ingestions per 1 million movements was 5 times greater for underwing-mounted engines (e.g. Boeing 737) compared to fuselage-mounted engines (e.g. MD-80).

Habitat Modification — Passive Management Techniques

Introduction

Successful wildlife management inevitably results when airports alter the features that make these locations attractive to high-risk species. Referred to as *habitat modification*, this procedure involves fundamental and sometimes drastic alterations to both the natural and man-made aspects of airport environments. Sources of food, water and shelter (places to nest, feed, loaf, or roost in safety) are removed or modified, and the number of resident animals and species are reduced; as a result, strikes occur less frequently.

While more costly than many other techniques, habitat modification offers the greatest possibility for a lasting solution. Although initial costs may be high, long-term wildlife-management costs are significantly reduced, as the need for ongoing scaring and killing activities is minimized.

The key to effective habitat modification is to remove existing attractions without introducing new enticements that may appeal to other species. Many species are rarely involved in strikes—a robin nesting beside a hangar is of little concern, yet action should be taken to prevent a flock of gulls from loafing on a runway. Every species on the airport presents a risk; however, larger flocking species are particularly hazardous and should therefore be dealt with first (see Section H). Therefore, habitat modification should be aimed primarily against those species that pose the greatest risk to aircraft safety.

The ecological survey (wildlife hazard assessment)

An ecological study that focuses on the conditions that attract hazardous wildlife to the airport should be completed before any major habitat changes are implemented. The ecological investigation of airports and their immediate vicinities should indicate:

- How many birds and other wildlife hazardous to aviation are in the area,
- Which species are involved,
- How the birds are distributed, both spatially and temporally,
- Why they are there, and
- How they move in relation to airports and aircraft flight paths.

Observations should be made during all hours of the day, and during all seasons to take into account daily and seasonal fluctuations.

Studies should include data on geography, hydrology, soil, climate, vegetation, and building designs. Birds and other fauna in the area should be considered, as well as human activities such as agricultural and waste-disposal operations. The research will provide the factual information needed to understand why hazardous species are present at airports and, as a result, will also suggest what habitat modifications might be in order.

Unfortunately, biologists have conducted few year-round studies of airports, although cursory ecological surveys have been made at many of the world's airfields. Occasionally, a quick survey is all that is needed to locate the primary source of bird problems. Sometimes the major attractions for birds are so obvious—such as open garbage dumps near the ends of runways—that no biological expertise is required.

More elaborate airport ecological studies are concerned with the physical and temporal distribution of the species, as well as the factors that affect this distribution. For example, some studies have investigated both the availability of food and the food preferences of hazardous birds frequenting airports. At Toronto's Lester B. Pearson International Airport, biologists studied the relationship between raptors and their prey. An examination of the Laughing-Gull problem at Atlantic City, New Jersey, determined that certain plants attracted Japanese Beetles, which in turn drew the gulls from a nesting area 15 miles away. The gulls came in numbers large enough that the airport sometimes had to be temporarily closed, even when—at one point—the President's aircraft was on site.

Taking action at airports

While animals can move freely between airports and adjacent areas, operational wildlife-management activities are generally limited to the zones where the majority of strikes occur—specifically, both the grounds inside perimeter fences and airspaces below 500-feet AGL on takeoff and below 200-feet AGL on approach. It is in these areas that wildlife-control personnel have the greatest ability to introduce effective measures.

Transient and resident wildlife species

Birds and mammals can be grouped generally according to their activities and the time they spend at airport sites. Such species categorizations, including *transient* and *resident*, may be used to establish programs and procedures for the control of many animals.

Transient species are those that periodically inhabit airport sites, including migratory species that pass through airfields on a seasonal basis, and other species that visit daily while traveling between feeding and roosting sites. Transient species are attracted primarily by food sources and resting areas.

Resident species are those that are native to airports for all or most of the year. Such species forage at airports while relying on these locations for permanent shelter, as well as loafing, breeding and nesting sites.

As a rule, habitat modification techniques are the most effective control method for transient and resident wildlife types. While transients respond well to scare tactics and dispersal methods (not getting the opportunity to habituate to these methods), resident and daily-transient species require extensive, long-term habitat modification programs.

Transient and resident categories include mammals as well as birds. Caribou also fall into the migratory category, moving in large herds and often entering airport areas in northern Canada. In the west, Elk have been known to move down from the mountains on a seasonal basis, often infringing on airport lands in search of better feeding areas.

Wildlife attractants at airports

As mentioned earlier, most birds and mammals are attracted to airports by sources of food and water, and by the availability of shelter, where they can safely rest, nest, and roost.

Food

Wildlife are attracted by the presence of:

- garbage (edible waste),
- fruit-producing trees and bushes,
- seed-producing vegetation,
- green weeds,
- grass,
- aquatic vegetation,
- agricultural grains,
- large numbers of rodents or small birds, and
- large numbers of insects and earthworms.

Eliminating bird-food sources at airports is a difficult task. For example, a long-grass program might be implemented to deter gulls. Long grass, however, will attract rodents, and under some circumstances may lead to an increase in raptor populations.

When it is unclear which food sources are the major attractants, it is also difficult to determine how to eliminate them. Additionally, most airports do not have the money and equipment required to purchase and apply chemical repellents, or to conduct large-scale removal of vegetation. All these obstacles point to the need for thorough ecological surveys at each site—surveys that will provide wildlife-management personnel with the critical knowledge they require to develop effective measures.

Water

Waterfowl and shorebirds are particularly attracted to surface and standing water. As a general rule, all physical features that hold standing water should be modified or eliminated. Pits or depressions that regularly collect water should be drained and backfilled; clogged waterways should be cleared. Using wire to cover bodies of water—such as lagoons—inhibits birds from landing. The banks surrounding these areas should be graded to a 4-to-1 slope to discourage birds from resting in the water—birds are less likely to frequent areas when unable to spot predators above the banks.

Open water near a runway

The regular clearing of drainage ditches minimizes bird and mammal attractants. When clogged with vegetation and eroded soil, ditches retain water. Not only are birds attracted by the presence of water for drinking and bathing, they also benefit from the insect and aquatic life that flourish in these locations. Ditches should be graded so that water runs off as rapidly as possible. Grass and other vegetation should be cut on the sloping banks. The ideal solution, when practical, is to replace ditches with buried drainpipes.

Special attention should be paid to wetland areas such as swamps, bogs, fens, and marshes, which are not always easy to drain and fill. In some cases,

Federal or Provincial regulations protect wetlands. Existing Federal and Provincial guidelines should be consulted before any wetland modification takes place.

Shelter

Shelter habitat includes safe areas where wildlife loaf, perch, roost, and nest. Depending on the species, birds will find natural or man-made shelter in the following areas:

- forests;
- dense brush;
- dead trees;
- brush piles;
- water bodies;
- drainage ditches;
- sewage lagoons;
- open short-grass fields;
- building roof ledges, crevices, and holes;
- overhead wires;
- towers; and
- vents and ducts.

Birds often seek the shelter of airport buildings and long-grass areas. These animals also find safety in open airport spaces that afford clear views of the surroundings, allowing birds to see approaching predators. Nesting also occurs at airport buildings and in long grass, as well as in shrubbery and forested areas nearby. In most cases, wildlife shelters—once identified—can be effectively managed with little cost and effort.

Attractive Habitat – Suggested methods of control

No two airports are ecologically or operationally the same, nor do they share identical wildlife problems. Consequently, it is difficult to prescribe a solution for a particular problem without first conducting a thorough investigation. The following guidelines, however, provide a general overview of control methods as they apply to certain airport terrains.

Runways, aprons, and taxiways

Problem areas should always be prioritized in accordance with the hazards they pose to aircraft safety. Not surprisingly, runways take highest priority,

including approach/departure paths and adjacent areas. When wildlife are kept clear of these areas, the hazards to incoming and departing aircraft are greatly reduced.

The hard surfaces of aprons, taxiways, and runways attract certain species:

- Gulls and shorebirds like to loaf on tarmac, as asphalt and concrete are often warmer then surrounding areas, especially in colder weather. During periods of heavy rain, these birds often feed on the worms that crawl onto runways. (At Heathrow Airport in England, several gull strikes occurred on a single day after extensive rains brought worms to the surface.)
- Crows have been reported to drop rats on runways to kill them.
- Grit from broken pavement and concrete is used by some birds to break down food in their gizzard.

Suggested control

Worm outbreaks are predictable, so airport authorities should conduct thorough clean-up operations with sweepers as soon as worms begin to invade runways. For pro-active, permanent solutions, consider these approaches:

- Apply vermicide (worm-killing chemical) to the grass strips beside runways.
- Apply worm repellent along runway edges.

Note: See Section E, Dispersal Methods, on the use of chemicals for killing earthworms along runways and taxiways.

When spraying for insects along the grassy strips beside runways, ensure a relatively broad area is treated, otherwise insects will quickly return. Because of the publicity regarding the undesirable side effects of many pesticides, use of these materials should be continually monitored to determine the effects on target and non-target species.

One reported success was at a U.S. Air Force base where starlings had caused extensive damage to a C-130 during lift-off. The 250 dead starlings found on the runway were part of a large group that was feeding on Crane Fly larvae in areas nearby. Subsequently, these areas were sprayed with a mixture of insecticide (diazinon) and moth crystals (para-dichlorobenzene); the latter chemical was added as a starling repellent. The results were favourable and the starlings avoided the area. It is likely that they were driven away by the depletion of their food source, because subsequent studies have shown that starlings are not repelled by para-dichlorobenzene.

Owl perched on a sign at airport

Another attraction that draws birds to airport tarmacs is the presence of posts, lights, and markers. Many birds, especially birds of prey, like to perch rather than stand on the ground. Any unnecessary posts or structures on the airfield should be removed. Perching can be prevented by installing sharp spikes commonly known as porcupine wire with trade names such as Nixalite. If strips of porcupine wire are attached with hook and loop fasteners, they can be easily removed for maintenance purposes. Individual posts can be made less attractive by embedding a single large nail in the top of the post. Other techniques include the application of commercial products that leave a sticky residue which makes perching uncomfortable. Applying these materials should be continually repeated, however, as exposure to sun, rain and dust reduces their effectiveness. Furthermore, these products can interfere with routine maintenance activities on lighting fixtures etc.

Apart from these specific measures, airport authorities should work diligently to ensure runways and taxiways are kept clean. Inspections should be routine, and all materials that might attract birds—such as carrion, spilled crops, and refuse—should be removed immediately.

Grassland

While grass may be aesthetically appealing, easy to maintain, and functional in absorbing water and snow melt, it is probably the dominant bird-attracting feature at airports. Both long and short grass can pose problems, as they each attract different species. In response, site-specific grass-management programs should be implemented, acknowledging airports' particular hazardous species.

Along runways, strips of short-cut turf—generally less that 10 cm high—should be firm enough to support aircraft that leave the runway, and to withstand braking. These grassy sections should also ensure visibility of signs and lights. Many airports also maintain short grass throughout infield areas.

Long-grass programs have been implemented around the world and have proven effective against some species, specifically gulls and starlings. (Long grass refers to grass that is greater than 15 cm in height).

Birds loafing on grassland

Long grass also harbours ground-nesting birds (partridges, pheasants, ducks, owls, harriers), numerous small mammals (mice, voles, hares, rabbits), and large numbers of insects.

Birds such as gulls and plovers, however, do not generally frequent long grass because it obstructs their view, interferes with their movement, and impedes their ability to achieve the wing-beat needed for takeoff. Long grass is also dense, making it difficult for birds to find such food as worms and insects. When employing long-grass programs, potential insect infestations should be closely monitored.

Suggested control

In Canada, there is no single recommended grass height that is effective at all airports. Transport Canada recommends that each airport should complete a site-specific study, then experiment to determine an appropriate, optimal grass height. The decision to maintain short or long grass depends primarily on which bird species pose the highest hazards.

Grass-height research has been done in North America and Europe. The U.S. Air Force now requires airfield grass to be maintained at a height of 17 to 35 cm. The USDA has recommended that JFK International Airport maintain grass between 15 and 25 cm. In recent years, Vancouver International Airport has undertaken an experimental program using Reed Canary Grass maintained in some areas at a height of over 75 cm. A recent study by the United States Department of Agriculture has contradicted previous research in stating that Canada Geese are not deterred by long grass—a finding that reinforces the need for studies and experimentation prior to the implementation of grass programs at airports.

Drainage is one factor to be considered before adopting new grass lengths at airports. As grass restricts the drying action of air currents, long grass could worsen existing drainage problems. Drainage problems should therefore be solved before experimenting with new grass lengths.

Vehicle access to grassy areas should be restricted so as to minimize damage and alteration to grass height.

Ensure grass areas are free of broad-leaf weeds, which attract some mammal species such as Groundhogs. These weeds also provide food sources for a variety of wildlife species—such as Snow Buntings—if allowed to go to seed. Weeds can be selectively controlled with a variety of herbicides, which should be applied in the spring.

The implementation of long-grass programs often raises the risk of insect infestations. Airport operators and wildlife-management personnel are therefore advised to establish working relationships with local agriculturists or pesticide contractors, as these experts are familiar with resident insects, and in some cases can either predict infestations before they occur, or suggest remedies during an outbreak.

Cropland

Many forms of agriculture—including fruit, vegetable, and grain farming, as well as many livestock activities—create food sources that attract wildlife. For this reason, agricultural practices in the vicinity of airports should be strictly monitored and—when possible—controlled.

Suggested control

Airport operators should carefully consider the potential risks associated with the leasing of airport lands before lease contracts are signed. Cereal grain, market vegetable, and other bird-attracting crops grown on such lands should be kept as far away from the runways as possible. Ploughing and harvesting activities, which attract flocks of birds to runway areas, should be relegated to hours of darkness or periods when the problem species are away from airports—during nesting season for gulls, for instance, and early spring and late autumn for migratory species.

Transport Canada guidelines state that areas leased for agricultural purposes should be at least 1200 feet from runways. Under the guidelines, the following crops are acceptable (listed in order of preference):

- hay,
- alfalfa,
- flax,
- soy beans,
- fall rye,

- fall wheat,
- spring wheat,
- barley, and
- other cereal grains except corn and oats.

Deciding what crops, if any, to allow at an airport requires important consideration. Farmers and airport operators should work closely throughout the planting and harvesting process. Remember, reducing the number of birds is in the farmer's interest as well as that of the public, as crop damage and aircraft damage are both minimized.

Crop selections and harvesting practices within the airport boundary should be similar to and conducted at the same time as those on lands adjacent to airports. This ensures that birds that are dispersed from the airport feel comfortable at a distance, and are therefore less likely to return. If, however, airport lands are ploughed when adjacent lands are not, then birds will favour the airport, thereby heightening the risk of strikes.

Brush

Found on undeveloped airport grounds, brush, or wasteland, commonly features tall weeds, grasses, and shrubs—all of which attract birds and other wildlife such as Coyotes.

Suggested control

Brush and bushy vegetation should be eliminated from airports; at the very least, it should be cleared to within 150 metres of runway ends and runway centre lines. Cutting, clearing and herbicide treatments can be employed for this purpose.

Woodlots

These parcels of tree-covered land provide a multitude of nesting, resting, roosting, and feeding opportunities for birds. Tree species that produce soft fruits, berries, or high numbers of seeds are especially attractive to all types of wildlife. Trees also provide cover for medium-sized and large mammals.

Large trees located at the edges of open areas provide excellent vantage points from which raptors can survey for food. In addition, trees can create an *edge effect*—an intermediate area often rich in bird life because it borders two different habitats, such as grassland and wooded areas.

Suggested control

Trees should be located as far as possible from runways, certainly not within 150 metres of runway ends or runway centre-lines.

If tree cutting is not feasible, all undergrowth should be removed. Trees can also be thinned at their tops to make them less attractive as roosting sites. Trees should be frequently inspected for colonies of nesting birds, like crows, and for roosts of such species as starlings. While airport crow colonies rarely go unnoticed, starlings are relatively inconspicuous, leaving their roosts at dawn and returning at dusk. This was demonstrated at Lahr Air Force Base, Germany, where starlings roosted by the thousands in a large stand of dense, tall shrubbery that was separated from the runway only by a narrow strip of grass. Clearing this shrubbery solved the roosting problem and reduced the hazard it created.

Landscaped areas

Many airports—civil and military—landscape the areas surrounding buildings, roads and hangars for aesthetic purposes. Decorative trees and shrubs, however, often produce seeds and berries that attract birds, while also providing shelter, roosting, and nesting sites. Dense stands of evergreen trees are particularly attractive roosting sites for starlings and crows.

Habitat modification by tree removal

Suggested control

Trees and hedgerows should be cut back a minimum of 150 metres from runway or taxiway centre lines. Some varieties of trees and shrubs are acceptable; however, appropriate horticultural stocks should be selected on the basis of expert advice obtained from government or university scientists. Table C.4 lists trees and shrubs that provide food for birds at airports.

Water-body management

Birds in search of food, drink, shelter and bathing opportunities are attracted to all airport water features: shorelines, marshes, lakes, ponds, pits, creeks, canals, ditches, gullies, wet meadows, and pools—even puddles. In addition, water bodies—even temporary ones—often support large insect populations.

C.4 Ornamental Trees and Shrubs Attractive to Birds

Serviceberry	*Amelanchier canadensis*
Alleghany serviceberry	*Amelanchier laevis*
Yellow birch	*Betula lutea*
Gray birch	*Betula populifolia*
River birch	*Betula nigra*
Paper birch	*Betula papyrifera*
Western white birch	*Betula commutata*
Flowering dogwood	*Cornus florida*
Japanese dogwood	*Cornus kousa*
Cornelian cherry	*Cornus mas*
Pacific dogwood	*Cornus nuttali*
Cockspur thorn	*Crataegus crus-galli*
Toba hawthorn	*Crataegus x mordenensis "Toba"*
Englich hawthorn	*Crataegus oxyacantha*
Paul's scarlet hawthorn	*Crataegus sp.*
Cutleaf peashrub	*Caragana arborescens*
Weeping caragana	*Caragana arborescens*
Tidy caragana	*Caragana microphylla*
Silverleaf dogwood	*Cornus alba*
Siberian dogwood	*Cornus alba*
Yellowdoe dogwood	*Cornus alba*
Red osier dogwood	*Cornus stolonifera*
Yellow twig dogwood	*Cornus stolonifera*
Peking cotoneaster	*Cotoneaster acutifolia*
Early cotoneaster	*Cotoneaster adpressa praecox*
Rockspray cotoneaster	*Cotoneaster horizontalis*
Hedge cotoneaster	*Cotoneaster lucida*
Russian Olive	*Eleagnus angustifolia*
American beech	*Fagus grandifolia*
Purple beech	*Fagus sylvatica*
Weeping birch	*Fagus sylvatica*
Betchel crabapple	*Malus ioensis*
Pissard plum	*Prunus cerasifers*
Amur choke cherry	*Prunus maackii*
May Day tree	*Prunus padus commutata*
Autumn Flowering Higan cherry	*Prunus subhirtella*
Shubert choke cherry	*Prunus virginiana*
White cedar	*Thuja occidentalis*
Witchhazel	*Hamamelis virginiana*
Oregon grape	*Mahonia aquifolium*
Virginia creeper	*Partenocissus quinquenfolia*
Western sand cherry	*Partenocissus tomentosa*
Flowering almond	*Partenocissus triloba*
Alpine currant	*Ribes alpinum*
Austrian brier rose	*Rosa foetida*
Shining rose	*Rosa nitida*
Redleaf rose	*Rosa rubrifolia*
Burnett rose	*Rosa spinosissima*
Korean spice viburnum	*Viburnum carlesii*
Wayfaring tree	*Viburnum lantana*
European highbush cranberry	*Viburnum*

Water bodies also attract aquatic mammals such as Muskrat and Beaver. Not only can both of these species inflict severe damage through lodge and dam construction, but they are also attractants, luring carnivorous animals to airports.

Birds at a water site

While there may be some controversy regarding desirable grass lengths, there is general agreement that standing water is a major bird attractant. All manuals and instruction pamphlets recommend that standing water on airfields should be drained or back-filled, and that access to open water should be eliminated whenever possible.

Suggested control

Eliminating water bodies is the best solution, although measures such as replacing drainage ditches with buried culverts can be costly. If water-body elimination is not suitable, the following guidelines should be followed:

All water bodies should be cleared of emergent and submerged aquatic vegetation by cutting, dredging, or through the use of herbicides. The banks should also be cleared of cover vegetation such as cattails and brush.

The banks of water bodies (particularly ponds, streams) should be graded to a 4-to-1 slope, which will discourage burrowing by Muskrats and damming by Beavers. Steep banks also discourage birds from using water, as they then find it more difficult to spot predators. Steep banks also create a clearly defined edge to which grass can be easily mowed, thereby reducing boundary habitats.

Low areas, where temporary pools form after rainstorms and spring melt, should be filled or fitted with improved drainage systems.

In areas where gulls and waterfowl cause major problems, physical barriers should be erected to prevent access to water. Barriers are available in the form of nylon mesh or wires that are strung across the surface to prevent birds from settling on the water. Wires should be strung across the surface of ponds at a height of roughly 18 cm and at intervals of 36 cm. To protect birds from flying

into these barely visible barriers, streamers should be attached to the wires. Fences should also be installed around the perimeter of the water so that birds cannot walk beneath the wires.

One alternative to wire and netting is Bird Balls™, which have been used successfully in the western United States since 1993. Bird Balls™ can be spread out over small water bodies to trick birds into thinking that there is no water in the area. The balls are superior to netting and wire because they adjust to fluctuating water levels and snow loads, readily shift to accommodate in-water obstacles, are unaffected by the strongest winds, are very easy to install and require little maintenance. Bird Balls are, however, relatively expensive.

If water bodies cannot be covered or drained, dredging will increase the water depth and, as a result, decrease the surface area.

Coastal airports featuring tidal waters report that bird activity tends to increase as the water rises, as birds are forced to move further up the shore. In response, airport wildlife-management activities should be increased as tides rise.

Airport buildings and structures

Sparrows, starlings, pigeons, gulls, and crows have adapted to human development, and make full use of the many opportunities that human activity provides. The built-up areas of airports offer these so-called city birds a variety of nesting and resting sites, as well as sources of food.

Large buildings, such as hangars, provide many places for birds to nest and rest. Gulls and pigeons like to sit on roofs and ledges. Sparrows, starlings, swallows, and pigeons have been found nesting in and on hangars. During aircraft overhauls, bird droppings, feathers, and nesting materials can affect exposed electronic equipment.

Airport structures such as unused sheds, deserted farmhouses and out-buildings, old windbreaks and rotten fence posts also lure wildlife with the promise of nesting, resting, roosting, and feeding opportunities. These unused structures should be removed from airport lands.

Birds pose not only collision hazards in the vicinity of buildings, they also are a serious nuisance because they soil these locations. Bird droppings create a slippery mess, and can corrode the skin of aircraft. Droppings also deface the roofs and facades of airport buildings. These droppings are often sources of bird-borne disease, which are known as zoonoses. For instance, approximately

90 percent of gulls carry salmonella. Bird zoonoses are transmitted to humans through direct contact with bird droppings and nasal discharge, or by breathing the powder of dried droppings. Dried bird feces on helicopter pads that are used for medical evacuations at facilities such as hospitals and harbours can create a significant human health issue.

Appendix 2 outlines three of the most common bird zoonoses that can infect humans. As it is difficult to know if birds are infected, the greatest security is found in a clean environment; therefore, all bird droppings are removed promptly.

Suggested control

Screening the many holes and openings in hangars is a first step in denying birds access to these buildings. In active hangars, however, doors are opened frequently; even when they are kept closed there is usually some space above or below the doors through which birds can move. Flexible netting around hanger doors has proven most successful in these situations. Netting installed across the base of rafters has proven successful in excluding birds from the rafter system.

Unfortunately, major architectural changes are expensive and rarely feasible. Minor changes, however, can also be effective in reducing the bird presence.

- Block or cover all holes, such as access vents, using screen or similar material. Blocking or covering drains can also prevent rodents becoming a problem inside a building.
- Block and seal all crevices and holes on the outer surface of the building with screen, concrete, or brickwork.
- Slope building ledges to an angle of 45 degrees or greater using boards, plastic sheeting or concrete; this eliminates attractive roosting and nesting sites.

Vertical plastic blinds installed in doors that are frequently left open will repel many birds from entering hangars or other buildings.

- Install netting, sheet metal, or other suitable barrier materials under overhanging eaves and ledges to prevent access by swallows.
- Fine parallel wires can be attached to antennae, towers, and overhead wires to discourage birds from perching and roosting. Spiked material such as porcupine wire can also be installed, although this is generally an expensive alternative.
- Use a caulking gun to apply soft, sticky material to perches; birds will avoid roosts treated in this way. The downside to this technique is that re-applications

should be made regularly and, in locations featuring a number of perches, the task of continually treating the roosting spots can be daunting.

Miscellaneous bird attractions

Besides the attractions associated with various habitats, airports offer many man-made enticements, including edible waste and edible-waste storage sites, garbage dumps, and perching sites.

Edible waste and edible-waste storage

Edible waste is created at airport restaurants, flight kitchens, and at points where in-flight meals are prepared. Proper storage is critical to ensure the material is inaccessible to birds until it is removed to off-airport disposal sites. Airport property leases should contain clauses that address waste disposal and reduce bird attractions. Feeding of birds in taxi-cab stands should be prohibited.

Open edible food waste storage

Gulls, crows, and pigeons regularly patrol terminal loading areas where food and garbage is often dropped during aircraft servicing. Frequent and unannounced inspections by airport staff can help ensure that more care is taken in the disposal of edible material.

Garbage dumps

Often an eyesore and a health hazard, garbage dumps are also a major source of food for high-hazard birds. Waste disposal sites located at airports literally breed danger; removing such facilities from airport lands should be the first act in any program to reduce bird problems. If off-airport garbage disposal is impossible, edible refuse should be mixed with earth and buried immediately after being dumped. Disposal operations also attract fewer birds when conducted at night. Several airports—including Vancouver International—have eliminated their dumps and significantly reduced bird populations.

In the current Canadian guidelines contained in TP 1247, Guidelines for Land Use in the Vicinity of Airports, garbage dumps are to be located no less than eight kilometres from airport reference points. Zoning regulations at 55

Canadian airports contain legislation that regulates the siting of garbage dumps, food waste landfill sites, and other high hazard bird attractants. Further research is underway to investigate whether this distance is appropriate. If dump-site plans are proposed for locations within that range, wildlife-management officers should participate in the planning process to ensure aviation safety is given the highest priority. At the very least, bird-control measures must be taken at all waste disposal sites in the vicinity of airports.

Perching and nesting sites

Perching sites are important for birds, offering vantage points that overlook the immediate surroundings. Perches are places from which birds sing, call and display. They also act as observation points, hunting lookouts and as places to rest, digest, preen, roost, and gather socially. As potential perches for birds, lone trees, hedgerows, fences, gates, posts, shrubs, stumps, junk, weed patches, and boulders should be removed from airport lands. Power lines are popular perches, and should be relocated underground. Although a labour-intensive solution, porcupine wire should be fitted to runway, approach, taxiway, and apron lights to discourage their use as perches.

Birds are quick to find whatever nesting opportunities are available. At airports, they nest under bridges, in culverts, old shacks and work huts, and on radar towers. For example, at Leningrad Airport in the former USSR, a Great Spotted Woodpecker pecked a hole through the foam plastic cover of a radar antenna to create a nest.

Aircraft parked on aprons or fields are also popular nesting locations. Birds usually enter aircraft through small access holes just large enough to accommodate them. Removing such nests is therefore difficult, as access panels or whole sub-assemblies may need to be opened or removed.

One report described 29 nests—made by eight different bird species—that had been found in various aircraft. While the likelihood of nesting in aircraft increases dramatically with the time they are out of service, nests can appear over a weekend—even in a single day. In the former USSR, it was reported that starlings began bringing nesting material into an opening in an AN–10 as soon as the aircraft had come to a stop after landing. Within one hour at Montreal airport, starlings placed so much nesting material in the inlet of a Vanguard engine that shutdown and component replacements were required.

Two North Star (DC–4) aircraft that were parked for a long time on the infield at Toronto airport were “liberally sprinkled” with starling nests. The birds

created an additional hazard by flying back and forth across runways and taxiways to reach the aircraft. It was recommended that these aircraft be moved farther away from operational runways, and that parked aircraft—out of service even for a short period—be checked for nests at least twice a week between April and June.

Section D

Implications of Land-use Activities in the Vicinity of Airports

Introduction

Airports naturally attract many species because of both the wide-open and short-grass areas that provide basic protection from predators and humans. As discussed in Section C, airports also provide access to food and water sources. Wildlife-management programs at many airports effectively diminish the power of these attractants by modifying and managing habitats, as well as by using techniques to disperse birds.

However, even when airport bird-control activities are effective, they can be neutralized by the presence of attractive land-use activities that are outside the airport boundary and, therefore, beyond airport operators' spheres of influence. In these cases, hazardous bird species will persist in their use of airports as convenient stopovers and resting places before and after feeding at nearby locations. Particularly severe problems arise when birds make regular flights across airport properties—when they fly between roosts and feeding areas, for instance. The greatest problem at many airports is the presence of one or more waste disposal sites within the vicinity of the airport. These facilities provide food for a large number of birds, which may then use adjacent airports as loafing and resting sites.

Where wildlife hazards are concerned, regulations that minimize attractants in surrounding areas should mirror procedures employed on airport lands. This regulatory harmony can be found through *compatible land-use planning*, a process that has resulted from the need to establish a co-operative environmental relationship between airports and the communities they serve. While relatively simple, this concept has delivered, in practice, impressive results through the development of airport/community-system plans, as well as legislation for compatible land uses, easements, and zoning. Implementation, however, requires careful study, coordinated planning, cooperation, and compromise by experts and stakeholders in all related fields.

Planning in the vicinity of airports

The goal of airport zoning regulations is to prohibit hazardous land uses outside airport properties. These land uses include:

- garbage dumps,
- food-waste landfill sites,
- sewage outlets,

- fish plants,
- fish piers,
- abattoirs,
- pig farms, and
- bird-attractant agriculture.

According to a Transport Canada guideline contained in *Land Use in the Vicinity of Airports* (TP1247), no bird-attractant land use should be allowed within an eight-kilometre radius of airport reference points. The operative word, however, is *guideline*: this minimum distance is not enforced under current Transport Canada regulations except at the 55 Canadian airports which have a waste disposal clause contained within their zoning regulations.

Where hazardous land uses are already established and prohibitions are not an option, remedial actions may be taken:

- to ensure that municipal officials responsible for planning and zoning enforcement are aware of existing guidelines;
- to inform owners and managers about the hazards their operations create; and
- to develop management programs to minimize the attractiveness of the operations.

In Saskatoon, city officials decided to locate a storm-water retention pond at the threshold of the airport's main runway. The pond drew many geese, ducks, and gulls to the area and, as a result, became a tourist attraction—bird feed was sold, and a waterfowl-nesting platform was placed in the pond. The Saskatoon Airport Authority recognized this problem and met with city officials and stakeholders who, until the meeting, were unaware of both the guidelines applying to and the hazards associated with the pond. Once informed, all parties began working together to minimize risks.

By-law development

The development of planning policies and planning statements is the first step toward ensuring compatible airport-vicinity land-use activities. On the basis of these documents, municipalities may then enact zoning by-laws, which are implemented to regulate land uses, and to set restrictions on various aspects of development. Through these by-laws—which are occasionally amended to

reflect changing needs and objectives—an ecological, social, and economic balance is maintained within municipalities.

In many cases, airports now face urban-development pressures that were non-existent when the facilities were first built. Thus, it has become increasingly important for operators to be aware of and involved in decisions that pertain to land-use activities near airports. It is also important to form partnerships and communicate with all stakeholders in the area.

Extremely hazardous land-use practices

Food-waste landfill sites

When landfill sites are proposed, Transport Canada often participates in local planning processes to identify any airport and aviation-related concerns. An aviation analysis is often conducted to assess the bird hazards that may result when the landfills are established. If studies reveal that additional bird hazards are probable, then landfill operators or proponents can be responsible for establishing programs that will control or minimize bird activity. It is preferable that these programs reflect those in place at adjoining airports, and make use of the same dispersion techniques (see Section E, *Active Management Using Dispersal Techniques*).

The use of over-wiring or netting to cover the working face of landfills—the area where waste is currently dumped—could prevent or greatly reduce gull use. It has been demonstrated at many sites that portable installation units allow the netting or wiring to be easily shifted as the dumping location changes. Landfills should also be covered daily with soil to reduce bird-food sources, or prior to any period when the landfill will not be attended such as weekends.

Landfill site near airport

Case histories

Thunder Bay, Ontario

Located about three miles from the shore of Lake Superior, Lakehead Airport (now Thunder Bay Airport) had only a minor autumn-migration bird-hazard

problem prior to 1960. In that year, however, the city of Fort William closed the municipal garbage incineration plant and opened a sanitary landfill area adjacent to the airport. Immediately, Herring Gulls began to frequent the airfield. The gulls could not be driven off despite intensive efforts during a two-and-a-half year period; as many as 2,000 gulls were often located on airport lands. A presentation to the Fort William council by the Bird Hazard Committee (the predecessor to Bird Strike Committee Canada) resulted in the decision to discontinue the landfill and return to the incineration of municipal garbage. As soon as the dump was closed, gull numbers at the airport decreased significantly, and the bird-hazard returned to an acceptable level. However, the operation of a new landfill near the airport has contributed to recent bird hazard issues, including severe damage to an Air Canada DC-9 in 1997 which resulted in the loss of one engine and a forced return to the airport.

Charlottetown, Prince Edward Island

In 2000, a compost facility was proposed in Winslow South near Charlottetown, PEI. As the facility was to be located three kilometres from the Charlottetown airport reference point, a bird-hazard study was undertaken prior to construction. The study concluded that the compost facility would have to incorporate numerous bird-mitigation measures—measures that permitted both the airport operator and Transport Canada to monitor operations and gull activity at the site. Additionally, a Bird Management Plan—addressing issues such as material storage, monitoring, and clean-up of food waste—would have to be implemented before the facility's Certificate of Approval was issued. The study also recommended that the operators should post a $20,000 bond to address future bird-control issues. It is as yet too early to comment on the effects of either the presence of the compost facility or the measures proposed by Transport Canada.

Winnipeg, Manitoba

In 1996, BFI Waste Systems built a landfill site north of Winnipeg International Airport (YWG). While the site is beyond the eight-kilometre bird-hazard protection zone, it is nonetheless located under the approach path of the airport's runway 18. As a result, Transport Canada, BFI Waste Systems, the Winnipeg Airport Authority, and other stakeholders worked at length to develop a bird-control program for the newly constructed facility. The parties agreed on measures to cover waste, harass birds, drain standing water, and replant disturbed soils. BFI now reports that while birds continue to fly over the site en-route to other feeding areas, management measures appear to have discouraged the birds from stopping at the site. The Winnipeg experience demonstrates the need for effective bird-hazard programs at all landfill sites

even remotely close to airports. All parties in the community, however, should recognize that the ideal solution remains to locate such sites as far from airports as possible.

San Francisco, California

The mix of gulls, garbage, and airports is particularly dangerous in the San Francisco Bay area. Gulls are not only attracted by garbage available on the face of the airport-area dump, they also forage immediately beneath the surface. Some estimates put the airport gull population as high as 15,000.

Several different dumping methods were tried, including digging large trenches into which the refuse was tipped and immediately covered. This was partially effective, although the gulls continued to swarm the trenches during the short intervals the garbage was exposed. The birds also began feeding from the daily stream of arriving garbage trucks.

The airport ornithologist noted that the gulls arrived at the dump shortly before dawn and left just after sundown. At night, the birds went to resting areas, some in shallow water near the coastline, others in water located on the airport itself—water that airport authorities drained immediately.

Meanwhile, household refuse was collected by day and stacked in a covered area that was inaccessible to birds. While this covered area was some distance from the airport, it was still easily accessible to the points of collection. After nightfall, the refuse was transported to the dump, deposited in open trenches and then covered with earth. When the gulls arrived the next morning, their food source was no longer available.

Not only was the gull population dramatically reduced—from approximately 15,000 to several hundred within one week—the risks to aviation safety also decreased significantly.

Coastal commercial fish plants

Coastal commercial fish plants are extremely attractive to several bird species, particularly gulls. These birds pose a high hazard to aircraft because of their large size, their behavioural characteristics (flocking and soaring), and their preference for airport environments. Gulls are also willing to undertake far-ranging daily flights for food. Commercial fish plants are therefore strongly discouraged on lands adjacent to airports. As in the case of landfills, fish plants that must be located near airports should be mandated to adopt strict control programs that minimize and control all wildlife attractants.

Moderately hazardous land-use practices

Transport Canada recommends that certain practices not be permitted within 3.2 kilometres of airport reference points. (To better define some airport areas, more than one reference point may be established.) These practices are moderately hazardous to airport activities because they attract bird species that:

- are small and not particularly far-ranging in their food-searching activities; or
- are of concern during limited time periods, such as migration and during inclement weather.

Wastewater treatment and wastewater discharge plants

Any activity that creates bodies of water in the vicinity of airports also creates indirect hazards to aircraft safety. These facilities should be located as far as possible from airport lands, and should practice appropriate wildlife-control measures.

Crop production

Topographies and near-rural locations often make airport areas popular for agriculture. Some operators also promote the use of their lands for crop production, thereby increasing airport revenues. (See *Attractive Habitats* in Section C). In any case, when land is used for crop production it is important that airport operators be involved, ensuring crop choices that minimize the attraction of hazardous species. All proposed uses and crop selections should also be reviewed by wildlife biologists. Grains and cereals are major bird attractants and should be avoided when possible. The following table lists some of the crops commonly grown around airports, and presents alternatives. When wildlife problems occur, immediate action should be taken, perhaps to modify ploughing and harvesting practices, or change crop types. In extreme cases, termination of agricultural practices may be necessary.

Moderately hazardous land-use practices

Crops	*Not Recommended*	*Suggested Alternatives*
Grains:	Barley	Rye
	Oats	Buckwheat
	Wheat (particularly Durum)	Flax
		Canola
	Corn	Timothy
	Sunflower	Alfalfa
	Clover	
Fruits:	Berries	Vegetables
	Cherries	(except potatoes)
	Grapes	
	Apples	
Livestock		
Feedlots:	Beef Cattle	Pasture-fed
	Piggeries	Livestock

Recreational activities

- Drive-in theatres
- Golf courses
- Marinas
- Picnic areas
- Outdoor restaurants
- Beaches
- Racetracks

Managed and supplemented natural habitats

- Migratory waterfowl refuges
- Designated game and mammal refuges
- Wildlife feeding stations
- Bird-nesting colonies
- Roosting sites

Other activities

The list below presents basic wildlife attractants, their common locations, and suggested remedial actions.

Attraction	*Typical Activities*	*Suggested Remedial Action*
Food waste	• Restaurants (indoor and outdoor) • Picnic areas	• Improve maintenance and disposal • Cover garbage containers
Freshly tilled/ ploughed soil	• Cropping activities • Sod farming	• Plough and till at night
High insect/ mouse activity	• Grass and hay cutting • Baling hay (before and after)	• Cut or bale at night • Remove bales as soon as possible
Livestock manure piles	• Barnyards • Stables • Racetracks • Fairgrounds • Game farms	
Lagoons	• Sewage lagoons • Stormwater retention ponds	• Exclude birds through the use of fine wires • Locate as far as possible from airports

Conclusion

Effective airport-area land management is fundamental to safe aircraft operations. Wildlife attractants should be eliminated or at the very least minimized. Amid the spiraling growth of many North American cities, airports are increasingly forced to actively participate in urban planning and development. Not only should operators remain abreast of the changes happening around them, but also they should establish effective communication and co-operation with all stakeholders in the communities the airports serve.

Section E

Active Management Using Dispersal Techniques

Bird dispersal techniques

Dispersal techniques discourage birds by scaring them with visual devices such as scarecrows, or with auditory devices such as cannons and pyrotechnics. It is critical to experiment with a combination of methods, whether together or in rotation. This experimentation should be informed—and monitored—through the periodic analyses of daily wildlife reports, which will reveal:

- the effectiveness of applied control techniques for various bird species;
- the effectiveness of different dispersal techniques at different times of the day and under different weather conditions; and
- the amount of time birds remain dispersed.

Birds are naturally wary of unfamiliar sounds and objects in their environment. Unfamiliar noises, for example, may put them at alert, or cause them to take flight. Loud and abrupt noises, such as those produced by gas cannons, are initially most effective for many species of birds. Gradually, however, birds do become comfortable—or *habituated*—to all dispersal techniques. Birds that are flushed upon first hearing an unfamiliar loud noise may merely become alert the second or third time they are exposed to the sound. If birds repeatedly hear the same noise and do not associate the sound with actual danger, they will eventually stop responding. Under these circumstances, the most effective way to prevent habituation is to reinforce the threat by occasionally killing a few birds. Wildlife-control officers are advised to monitor bird responses to scaring techniques; the resulting information will assist in modifying and improving dispersal methods.

The use of trained raptorial birds has proven effective for dispersing some species of birds under certain circumstances at some airports. The costs and complexity of this technique, however, make it unfeasible for many sites.

Even in cases where devices and techniques do work, they may not be effective on all problem species, or in all geographic areas. Perhaps most importantly, devices and techniques are only as effective as the wildlife-management teams that use them. Only skilled and persistent wildlife-management teams have the knowledge to ensure success.

Finally, if birds cannot be excluded from critical takeoff and landing paths, pilots should be warned about peak daily and seasonal bird-activity periods.

Habituation – A multifaceted approach

Habituation is the process whereby animals become accustomed to sights and sounds that might initially be frightening. Habituation occurs eventually with all scaring techniques when they are not reinforced with demonstrations of actual danger. The only exception is single-species distress cries; if used properly, they rarely result in habituation.

Environmental factors can affect the responsiveness of birds and therefore the rate of habituation. For example, feeding birds are less responsive to loud noises than resting birds—particularly if they are hungry. Small birds on open ground—far from protective cover—are more responsive than birds near cover. Gulls, on the other hand, prefer to be able to see approaching predators; they may be more responsive when their view is blocked by vegetation. Some birds respond faster to loud noises in the morning than they do later in the day. Some birds respond in daylight and not at dusk.

Habituation occurs when birds learn that sounds or objects present no real danger. Most birds tend to avoid novel stimuli, unsure whether or not the threat is real. Certain curious species will investigate promptly. A flock of starlings may avoid a model of a hawk for only a few hours before realizing its harmlessness.

As habituation occurs through repeated exposure to the same scaring technique, it is necessary to continually change the appearance or location of the device, the combination in which devices are used, or the direction from which the sound originates. Even with all these dynamic adjustments to a dispersal program, birds may still become habituated. This is particularly true of gulls, which often must be re-educated to respond through the shooting of one individual. This demonstrates the true danger of the noises to the remainder of the flock. Should shooting become necessary, target individuals at the top of airborne flocks so that they fall past lower-flying birds. This approach has proven more effective than targeting members of resting flocks, or the last birds in flying flocks.

It is worth repeating that, as noted above, a mix of dispersal techniques should continually be altered—randomly—so that target species are kept off balance.

For additional information on this subject, refer to the Aerodrome Safety Circular on an ***Evaluation of the Efficacy of Products and Techniques for Airport Bird Control*** which is available online at: http://www.tc.gc.ca/CivilAviation/aerodrome/menu.htm .

A copy of the report can be obtained by calling: 1-800-305-2059 or E-mail: http://www.tc.gc.ca/aviation.

Vehicle use in wildlife management

The field vehicle is an essential part of any wildlife management program, providing transportation for officers as well as the necessary equipment for dispersing or removing wildlife. The vehicle should meet these general specifications:

A well equipped field vehicle

Four-wheel drive

Off-road access at airports demands this feature, not just for mobility, but also for stability—four-wheel drive vehicles are less likely to chew up airfields and expose soil, which can attract birds.

FOD (Foreign Object Debris)-resistant tires

This is a critical feature, as these vehicles often travel among runways, taxiways and various off-road locations. The sharp debris found at landfill and waste-disposal sites also poses significant tire hazards. Wide tire 'footprints' improve flotation above mud and soft ground; wide tread patterns not only pick up less mud and fewer stones, they also shake off these adherents when they do become lodged between the treads.

Safety and communications equipment

Amber rotating beacons are standard on all airfield vehicles. VHF radios are essential as well, tuned to ground-movement frequencies so all related personnel can remain in contact regarding bird movements. Adjustable spotlights are excellent for night observation of birds and large mammals. Cassette or digital playback components—including exterior-mounted loudspeakers—permit the broadcast of pre-recorded distress calls.

Cartridge containers

For safety reasons, separate containers should be maintained for each calibre of used and unused ammunition cartridges.

Auditory deterrents

An effective—but temporary—scaring technique involves the use of a variety of noises including sirens, car horns, human voices, amplified recordings, and pyrotechnics (firearms, cannons).

Natural bird-dispersing sounds include the alarm and distress calls of problem species, as well as the calls of their predators. A wide range of these calls is now commercially available.

Some manufacturers advocate the use of abstract sounds that are above and below the range of human hearing. As research has shown that birds hear the same sound frequencies as humans, products generating such abstract sounds are ineffective.

Birds are less likely to habituate to natural sounds that have meaning to them, such as the calls of flockmates in distress, or calls of predators. Habituation can also be reduced by frequently moving the sound sources, ensuring sounds are used sporadically, and through the occasional killing of birds to confirm that the sound does indicate danger.

Wildlife-control personnel should keep in mind that many scaring devices have been evaluated only in terms of their effectiveness in agricultural use. At airports, wildlife management is a year-round endeavour, but the protection of crops is seasonal, and therefore habituation is not necessarily a concern.

Birds

Pyrotechnics (highly recommended)

Pyrotechnics are highly recommended for bird dispersal at airports. This technique can be extremely effective when used as part of a well-balanced and dynamic wildlife-management plan.

Pyrotechnics include various ammunitions that are fired from shotguns, starter and flare pistols, and purpose-built pyrotechnic launchers. They include shell crackers, flares, firecrackers, rockets, and mortars. The loud and abrupt noise emitted by some pyrotechnics is similar to that of shotguns, making them particularly effective against game birds that are familiar with the effects of weapons.

Some pyrotechnics also involve flashes of light, providing a visual as well as an auditory deterrent. Some devices travel 25 to 300 metres before exploding in a flash of bright light. Others travel as far as 100 metres while emitting a continuous screaming or whistling noise.

Firearms, particularly shotguns, are now widely used as delivery systems for scare cartridges. The cartridge comprises a double-charge 12-gauge shotgun shell; the first charge delivers a timed-fuse secondary shell into the midst of offending wildlife, where the second shell explodes. Some cartridges incorporate powder flashes for a visual effect, while others whistle in flight. The effective range, according to several manufacturers, is approximately 69 metres.

Similar shells can be delivered from either 22-calibre starter pistols, or specially designed handguns. These weapons not only lack the range of shotguns, their quality is in question as well. Some ammunition appears to have a limited shelf life, and there have been instances in which the second charge has exploded in the barrel of the gun. For safety reasons, short-barrel, pump action 12-gauge shotguns should be used; ammunition expiry dates should be checked regularly. Single-shot guns are recommended by the U.S. Department of Agriculture because these breech-loading guns allow easy inspection of the barrel.

Safety and application

Precautions should be taken in any program using pyrotechnics:

Dispersal guns and shell crackers

- Operators should wear eye and ear protection at all times.
- Shell crackers should be fired from open choke-type guns.
- Shell crackers may misfire, so gun barrels should be checked regularly for obstructions, particularly after a misfire.
- Cracker shells are corrosive, so guns should be cleaned daily.
- Pyrotechnics are fire hazards, and should not be used over dry vegetation.
- Pyrotechnics should not be fired from inside vehicles.

Not all shell crackers will discharge completely, and may become lodged in

the barrel. If this is the case, point the gun in a safe direction and wait at least three minutes before inspecting the breech. After removing the shell, contact the local police office to dispose of the ordinance.

Regular and proper gun cleaning is especially important. First, attach a bristle brush to a rod and push it through the barrel a few times to loosen all unburned powder. Repeat these steps with a softer brush. Next, use a clean cloth to coat the inside of the barrel with gun oil. Apply a thin layer of oil to the external surfaces of the gun to protect against moisture and rusting. Finally, check all parts of the weapon to ensure that they are in proper working condition.

The following firearm safety considerations should be observed:

- Never point the firearm at anyone, whether loaded or not. Keep the firearm pointed in a safe direction, usually straight upward.
- Never keep the firearm loaded, even with the breech open.
- Examine the firearm and liner daily. If either appears to have a fault, report it as unserviceable immediately. Before firing a pistol, ensure the barrel is dry.
- Never load firearms in or fire from inside a vehicle.
- Ensure that cartridges are handled carefully so as not to become distorted, damaged, or wet.
- Do not use excessive force when inserting cartridges into adapter sleeves. If cartridges do not slip in easily, set them aside and treat them as misfires.
- Wear gloves and long sleeves for protection against possible skin burns should cartridges misfire.
- Whenever possible, avoid firing cartridges directly up-wind.
- Use a pump-action shotgun because of its enclosed action or a breech-loaded single-shot gun because of the ease with which the barrel can be inspected.
- Never use choke-barreled guns, as they may impede the flights of the second charges.
- Always pick up spent shells and, when doing so, be aware of the potential fire hazard of delayed second blasts.
- Avoid firing over runways.
- Always pick up FOD.

In general, volleys that explode in the air are more effective than those that explode near the ground. Use the minimum number of rounds required to achieve the desired results. The effect of additional rounds will only lead to habituation. The first shots flush the birds; closely following second shots often cause them to disperse. Ensure that the carcasses of all killed birds are quickly removed, thereby

deterring scavengers. If scavengers are not a problem at the site, the presence of a dead bird in an agony position may act as an effective deterrent.

Use of the scare cartridge, particularly with birds, requires cooperation between the user and ATC personnel so that birds are not dispersed into the path of oncoming aircraft. Generally speaking, a series of carefully placed shots can direct the birds to safer areas, or off airport land entirely. A coordinated effort between two or more shooters can be highly effective.

Advantages

- Used correctly, pyrotechnics provide one of the most effective methods available for bird dispersal.
- The direction of dispersal can often be controlled by the placement of shots.
- Pyrotechnics are effective for both day and night.
- Pyrotechnics can be used as complementary devices with other deterrents.

Disadvantages

- Use of pyrotechnics is labour intensive.
- Pyrotechnics give rise to FOD on runways.
- Birds may habituate to pyrotechnics, especially if they are used improperly.
- There is a degree of fire hazard associated with these devices if used in dry conditions.

Effectiveness

The effectiveness of scare cartridges has been both overemphasized and maligned. This technique is most effective for the occasional dispersal of transient species. Although often used alone, the effectiveness of pyrotechnics can be greatly enhanced when they are used in association with taped distress calls and long-term habitat-management techniques. If used too frequently, habituation will occur. From time to time, reinforcement is necessary through the killing of individual birds.

Effective against:

- gulls, crows, starlings, and waterfowl.

Limited effectiveness against:

- raptors when deployed at short range.
- small birds, such as Snow Buntings.

Not effective against:
- most problem shorebirds at Canadian airports.
- pigeons or House Sparrows.

Permits required
Permits are required from Environment Canada for all bird scaring or hazing activities that involve migratory birds if firearms are used. The definition of firearms can be found in the Criminal Code of Canada. Permits may be required from Provincial wildlife authorities to scare other species, including blackbirds.

Gas Cannons and Exploders (limited recommendation)

Use
Bird dispersal.

Description
Gas cannons have been in development for some time, primarily for agricultural purposes. The most recent versions comprise portable gas canisters that emit a loud bang in a particular direction at preset or radio-controlled intervals. They are louder than 12-gauge shotguns and require little or no attention by ground personnel. Once placed, the cannons can be adjusted to emit blasts at varying time intervals, from 30 seconds to 30 minutes. Some deliver two shots in rapid succession. Other models mount on a rotating bracket, and can be set to fire at random intervals. As a result, each successive shot seems to come from a different direction. Remote-control firing mechanisms are also available, allowing airport personnel to adjust the timing and direction of shots from a distance.

The main disadvantage to gas cannons is habituation. Some species, such as gulls, soon learn not to flee at the sound of a loud bang. This occurs particularly rapidly when cannons fire at regular intervals, as most do. To counteract the habituation, continually vary the location of cannons, adjust timing and change the direction from which shots are fired. To ensure easy

A Cannon

re-deployment of gas cannons, mount them on small trailers that can be towed behind patrol vehicles.

Application

While little concrete information exists concerning cannon deployment—despite frequent use at airports—some experts recommend the following:

For dispersal of gulls:

- place cannons every 50 m along runways.

For dispersal of blackbirds:

- place one cannon every four to 10 hectares.

This last recommendation is based on research conducted in cornfields. Dispersal over a 10-hectare area was achieved by using two synchronous cannons: one firing at two-minute intervals, and the other every two-minutes, seven-seconds.

Although most cannons are automatic and need attention only about once every two weeks, their effectiveness is greatly enhanced when they are moved frequently—at least every two or three days, and preferably more often.

Birds will eventually habituate to cannons unless other supplementary techniques are employed—specifically, occasional killing.

Advantages

- Low labour costs; cannons need only to be checked once a day.
- Inexpensive to operate (although reasonably expensive to acquire).
- Direction, timing, and volume of the blasts are easily controlled.
- Portability.
- Effective day and night.

Disadvantages

- Rapid habituation will occur unless cannons are relocated frequently and are supplemented by other bird control measures.
- Gas cannons can be a hazard during flying hours because random firing may cause birds to disperse into the paths of aircraft.
- Older gas cannons may pose fire hazards.
- Their short range means many cannons may be required to cover the expanse of airport grounds.
- Regular maintenance is required.

Effectiveness
Calgary International Airport employs cannons on an as-needed basis, and reports they are effective for short-term control of non-resident bird species. Vancouver International Airport also uses gas cannons that are carefully positioned over problem sites where birds gather at the airfield, including puddles.

Cannons should not be relied upon as the sole—or even the major—component of bird-control programs. These devices are recommended for occasional use as part of integrated programs, in conjunction with other products and techniques. Due to their igniters, cannons should not be deployed near fuel.

Effective against waterfowl and other game birds that have learned to fear the sound of gunfire; however, young birds migrating in early fall—prior to the opening of hunting season—may habituate as quickly as non-game species.

Permits required
None.

Report Shells (no available recommendation)

Use
Dispersing soaring birds at altitude.

Description
Report shells—also referred to as aerial salutes or sound shells—are fireworks devices similar to those used at public displays. Fired remotely or manually, report shells explode at the end of their trajectory—at altitudes up to 450 feet—making a loud and abrupt noise that scares birds.

Application
Report shells have not been tested by Transport Canada, but are known to be generally effective for bird dispersal.

Advantages
- More effective for deterring birds at higher altitudes.

Disadvantages
- Difficult to aim; they also result in debris. Report shells should only be used when pointed away from aircraft movement areas.

- Unsuitable for the quick clearance of birds, as they take longer to prepare than bird-scaring cartridges.

Effectiveness
Report shells are best employed to reach birds in flight; however, consideration should be given to aircraft activity and conflicts with adjacent land owners.

Permits required
A Fireworks Supervisor Card—presented upon the successful completion of a one-day course—must be obtained from Natural Resources Canada, Explosives Regulatory Division (ERD). For course schedule and information, visit the Natural Resources Canada website at: www.nrcan.gc.ca/mms/explosif, or contact the regional office in your area:

Atlantic Region
Tel: (902) 426-3599
Fax: (902) 426-7332
Email: kmccullo@nrcan.gc.ca
Contact: Kim McCulloch

Western Region
Tel: (403) 292-4766
Fax: (403) 292-4689
Email: doclarke@nrcan.gc.ca
Inspector: Doug Clarke

Pacific Region
Tel: (604) 666-0366
Fax: (604) 666-0399
Email: jomartin@nrcan.gc.ca
Inspector: John Martin

Québec Region
Tel: (514) 652-3999
Fax: (514) 652-0999
Email: rlescaul@nrcan.gc.ca
Inspector: Roland Lescault

Ontario Region
Tel: (613) 995-8439
Fax: (613) 943-8305
Email: johendri@nrcan.gc.ca
Inspector: John Hendrick

Phoenix Wailer Systems MKII (limited recommendation)

Use
Bird dispersal.

Description
The Phoenix Wailer is an electronic bird-deterrent device featuring 94 selectable audio and ultrasonic sounds. The wide variety of sounds—greater

than other similar devices—are said to prevent habituation. These systems protect up to 3,000 feet of runway.

Pheonix Wailer in use

Application

The Phoenix Wailer produces 94 random variations of irritating electronic sounds, the emissions of which alternate between speakers and at varying speeds. The resulting stress environment—combined with the sound-movement effect—is meant to unsettle birds. For airports that are in close proximity to populated or noise-sensitive areas, a light-sensitive switch deactivates the speakers at night. This feature can be over-ridden to counter birds that become problems after dusk.

The unit may be fitted with remote speakers that can be spaced at greater intervals, thereby providing a larger coverage area and, according to the manufacturer, heightened confusion among birds.

Advantages

- Birds do not habituate quickly to the random combination of sounds.
- The output is controllable for use near built-up areas.
- Low maintenance.

Disadvantages

- Research to date shows that while the synthetic sounds emitted from these systems have no biological relevance to birds, such ultrasonic devices offer limited, short-term effectiveness. This limited benefit, however, is outweighed by the relatively high cost of the product.

Effectiveness

The Phoenix Wailer has been used at many Canadian airports including Halifax, Calgary, and Vancouver. Anecdotal evidence suggests that the Phoenix Wailer is not effective in airport environments; therefore, this product is not recommended for long-term airfield use. The Phoenix Wailer may, however, be effective for short periods of time in areas where birds repeatedly concentrate (e.g. around a spring run-off puddle).

Permits required
None.

Bird Gard AVA (limited recommendation)

Use
Bird repellant.

Description
Bird Gard AVA is an electronic bird repellant that emits pre-recorded bird distress calls.

Application
The AVA units use as many as six remote speakers which, when placed 30 m apart, broadcast over approximately 4 hectares. Speakers can be placed at ground level. Attached to a 12-volt auto battery or 110-volt AC source, the device can be set to run during the day, at night, or on a 24-hour cycle.

Advantages
- The manufacturer suggests that distress cries repel many types of flocking birds and Canada Geese.
- Labour costs are low, as the operation is automatic and the unit may be left unattended.

Disadvantages
- The distress cries do not repel pigeons, doves, or gulls.
- Habituation is likely and the units should be moved frequently.

Effectiveness
AVA units are purportedly effective in repelling various flocking and non-flocking birds such as Canada Geese, blackbirds, waxwings, and woodpeckers. The alarm sounds are also purportedly effective against certain mammals such as bats, deer, and Coyotes.

Permits required
None.

Bird Gard ABC (limited recommendation)

Use
Repels stubborn bird species.

Description
Bird Gard ABC offers the same type of control as Bird Gard AVA but at a lower cost and with fewer features. Bird Gard ABC uses actual recorded distress calls, which are electronically reproduced, to imitate an attack on one of their own kind by a predator. The manufacturer suggests that birds cannot tell the sound from the actual cries.

Application
The units contain electronic controls, a speaker, 110-volt AC adapter, vinyl weather cover, and mounting bracket. Optional motion sensor and extension speakers are available. Bird Gard ABC may also be adjusted for day, night, or 24-hour usage. Per-unit coverage is 0.4 to 0.8 hectares (1 to 2 acres).

Advantage
- The manufacturer suggests the species-specific standard unit may repel Brown Thrushes, starlings, and robins.
- Within a one-acre area, custom units may repel Redwing Blackbirds, sparrows, finches, and gulls.
- It is automatic and can therefore operate unattended.

Disadvantage
- Habituation is likely if the units are not moved frequently.

Effectiveness
The ABC model may be effective on specific, stubborn species.

Permits required
None.

Av-Alarm (limited recommendation)

Use
Bird dispersal.

Description
Av-Alarm is an electronic noise generator that uses between one and three speakers. This product is similar to the Phoenix Wailer, but has fewer sound selections.

Warning: Wear ear protection when within range of an operating unit. When set at high volume, the Av-Alarm is loud enough to damage human hearing.

Application
In agricultural applications, Av-Alarms have been found to protect 3.3 to 20 hectares of crop from bird depredation. There have been no specific tests of Av-Alarms at airports, but given their range, several units would be necessary to disperse birds from an entire airfield. As with other noise-making devices, birds are likely to habituate to Av-Alarms. In order to be effective, this product's sounds should be selected to target specific problem species. Units should also be moved frequently.

Advantages
- Low labour and maintenance costs.
- Can be used to disperse birds from a variety of habitats.

Disadvantages
- Habituation occurs quickly if product is not moved frequently, or if it is not used in conjunction with other control methods.
- Hearing protection is required for personnel working near the alarm.

Effectiveness
There have been few quantitative tests of the effectiveness of Av-Alarm. Those that have been conducted were brief and primarily in agricultural applications. Nevertheless, most tests indicated that the alarms do decrease crop damage and the numbers of birds. Other studies show that birds quickly habituate to the noise, and that distress and alarm calls are more effective. Used in combination with other techniques, Av-Alarm was effective in reducing short-term bird numbers.

One effective technique involved turning on the Av-Alarm system as flocks landed nearby; however, this strategy requires continuous monitoring, thereby driving up labour costs and defeating the purpose of an automated system.

LGL Ltd. studies conclude that the sounds broadcast by these systems are not biologically based, and are therefore unlikely to have long-term effectiveness—a quality required for airport use. This product is not recommended as a stand-alone element of airport control programs.

Permits required
None.

Distress Calls (highly recommended)

Use
Dispersal of many bird species.

Description
Many species of birds emit distress calls when they are captured, restrained, injured, or otherwise in danger. Distress calls signal danger and warn other members of the species to disperse. Specific to each species, distress calls—with a few exceptions—only affect other birds of the same species. Some species, including House Sparrows, are not known to have distress calls.

Application
Detailed instructions on the use of distress cry tapes can be obtained from the suppliers listed at the end of this section.

It is important to vary the playback of tapes so that birds do not become habituated. In airport applications and in agricultural areas, the techniques used involve playback of a call for 5 to 60 seconds at intervals ranging from 3 to 10 minutes. It is recommended that tapes be played in a 10-second-on, 10-second-off rotation for 1.5 minutes, or a 15-second-on, 25-second-off rotation for 2.5 minutes. Effective tapes—and proper use—will normally drive gulls into the air within a few seconds. Note that distress-call tapes are specific both to species and region. Ottawa Herring Gulls gave no response to Herring Gull distress tapes from Russia until the fourth time they were played—a dozen repetitions were required before the gulls took flight. Occasional reinforcement killing may be necessary.

Distress calls can be used to disperse starlings, blackbirds, and crows from night-roosting sites. Operators and equipment should be in position two hours before sunset. At least two sets of equipment should be used to vary the location of sounds, as two birds in distress signify a greater danger and therefore result in a quicker response.

If the roost is large and birds approach from several directions, more units may be necessary. Distress calls are then broadcast as each flock approaches the roost. Broadcast may become continuous near sunset. On the first night, a substantial number of birds may enter the roost despite the broadcasts of distress calls. As these birds will not disperse once they have settled into the roost, it is pointless to continue the broadcast; however, repetition of the procedure over three to five successive evenings should completely disperse the roost.

Advantages

- Because birds respond instinctively to distress cries, habituation tends to occur much more slowly than it does to man-made sounds.
- This technique can be used day or night—and in all weather conditions.

Disadvantages

- With few exceptions (see below), birds will only respond to distress cries of their own species. Some species do not emit distress calls.
- An assortment of tapes should be available, and the appropriate tape for each species should be used. Distress calls for some species are not yet available.
- Playback equipment should be of good quality for best results. Digital recordings are preferable.
- Some species, particularly gulls, may circle over the sound source to investigate the danger for several minutes before dispersing. The use of pyrotechnics can speed the dispersal once the birds are in the air.

Effectiveness

Used alone or in combination with pyrotechnics, distress calls are one of the most effective methods available for dispersing many bird species. There are, however, some variations in responsiveness both within and between species. As noted above, most birds—except for some gull species that spend much of the year in mixed flocks—respond only to calls of their own species. Mixed-flock gulls may respond to calls of the species with which they associate.

As noted above, even within a species, calls may vary with the location. One study showed that alarm calls that dispersed Herring Gulls in North America were ignored by Herring Gulls in Western Europe. If possible, it is advisable to

obtain recordings of distress calls that were recorded close to the area where they will be used.

LGL Ltd. studies conclude that distress calls are highly recommended for dispersing many bird species and should be an essential part of wildlife-control programs.

Gulls
Gulls can be effectively dispersed by distress-call playback. The birds may not flush for several seconds, but then will usually approach the sound source and circle for several minutes before dispersing. Once circling, the gulls can be more effectively dispersed with pyrotechnics. Gulls are likely to return some time after being dispersed by distress calls; the few reports available—based on observations at landfills—indicate that the time before return varies from 15 minutes to 90 minutes. Gulls often loaf rather than feed at airports, and as they are more attached to feeding areas, distress calls may prove relatively effective in dispersing these birds for longer periods.

Crows
Similar response to gulls; crows will approach the sound source before dispersing.

Starlings and Blackbirds
These species respond with immediate dispersal by the entire flock. One study, however—conducted at a stockyard where starlings were feeding in cattle troughs—found that distress calls dispersed only about half the birds, and that they returned within 10 minutes. There is no information on how long these species will remain away from less attractive areas. Distress calls can be effective in dispersing starling and blackbird roosts, but, as noted above, several days of effort may be required.

Herons
Black-crowned Night Herons are the only species of heron for which relevant information is available. Distress calls deterred this species from feeding at a fish hatchery, but many birds remained in nearby trees rather than dispersing.

Permits required
None.

Suppliers

Borror Laboratory of Bioacoustics, Ohio State University
Website: blb.biosci.ohio-state.edu
Email: borrorlab@postbox.acs.ohio-state.edu
Offers original recordings of many species from numerous areas, mainly in the United States. Recordings are available on 1/4-inch open-reel tape, on cassette, and on three-minute continuous loops.

Laboratory of Ornithology, Cornell University
Website: birds.cornell.edu/BRP/
Phone: 1-607-254-2408
Original recordings are available on cassette, 1/4-inch open-reel tape, and CD. Species available:

- Gulls: Ring-billed Gull, Western Gull, Herring Gull, Glaucous-winged Gull, California Gull.
- Blackbirds: Red-winged Blackbird, Yellow-headed Blackbird, Brewer's Blackbird, Common Grackle.
- Corvids: Common Crow, Black-billed Magpie, Blue Jay.
- Others: Canada Goose, Black-crowned Night Heron, European Starling, robin, Snow Bunting, and numerous other species not usually considered problems at airports.

Scientists studying bird behaviour or vocalizations in the biology, zoology, or ornithology departments of local universities and museums may have useful recordings that they would be willing to copy for use at airports.

Alarm Calls (highly recommended)

Use
Bird dispersal.

Description
Alarm calls are given by some gregarious birds species when a predator is detected. The normal response of flockmates in the open is to flush and fly for cover. Like distress calls, alarm calls are species-specific.

Application
Alarm calls are employed in the same way as distress calls. Using alarm calls in combination with pyrotechnics and occasional killing enhances effectiveness.

Advantages

- Because the response to an alarm call is instinctive, the probability of habituation is reduced.

Disadvantages

- Quality alarm-call recordings are not available for many species.
- Bird alarm calls are higher in pitch and lower in volume than other calls. As a result, alarm calls do not carry as well over wide areas.

Effectiveness

Because of the difficulty in obtaining quality alarm-call recordings, few assessments have been made. As the alarm calls of many species tend to be similar, it has been suggested that a generic call might have broad effectiveness. The study of a mixed-species flock feeding on grapes did find that all birds initially responded to the alarm call of one. Within a few days, however, this alarm call worked only on its own species. This suggests that the early response of the other species was to the sight of responding birds, rather than to the alarm call itself.

At least one species—the Herring Gull—is known to have a two-part alarm call. The first part alerts the flock; the second disperses it.

Permits required

None.

Suppliers

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Phone: 1-607-254-2408
Offers original recordings of many species from numerous areas. Recordings are available on cassette, 1/4-inch open-reel tape, and CD.

Scientists studying bird behaviour or vocalizations in the biology, zoology, or ornithology departments of local universities and museums may have useful recordings that they would be willing to copy for use at airports.

Predator Calls (limited recommendation)

Description
Calls given by hawks, falcons, and owls may be effective in dispersing birds.

Application
Predator sounds can be broadcast using the same equipment as distress or alarm calls. The use of these calls warns birds of the presence predators; birds respond with heightened awareness and, in some cases, take flight.

Advantages
- Habituation to the call of a natural predator is generally slow.

Disadvantages
- The predator call should specifically address the species to be dispersed.

Effectiveness
Only one perfunctory assessment has been conducted regarding the use of predator calls to deter birds. In that study, the calls of a Peregrine Falcon were successful in dispersing gulls at Vancouver International Airport. It should be noted, however, that predators usually hunt silently and do not announce their presence. The use of predator calls therefore seems to be an unnatural presentation of stimulus.

According to LGL Ltd. studies, it is difficult to evaluate the efficacy of predator calls because their biological nature remains unclear. This product does, however, warrant more research to determine its long-term effectiveness.

Permits required
None.

Suppliers

Borror Laboratory of Bioacoustics
Website: blb.biosci.ohio-state.edu
Email:
borrorlab@postbox.acs.ohio-state.edu

Cornell Lab of Ornithology
Website: birds.cornell.edu/BRP/
Phone: 1-607-254-2408

Auditory Deterrents
Avian Systems Corp.
Av-Alarm, Bird Guard AVA and ABC
Website: www.aviansystems.com
Toll Free: 1-888-828-9318

Scarecrow Bio-Acoustic Systems
Sound Deterrents
Website:
www.scarecrowbio-acoustic.co.uk
Email:
sales@scarecrowbio-acoustic.co.uk
Phone: 01.825.73.2601

Phoenix Agritech
Phoenix Wailer
Website: www.pheonixagritech.com
Email: info@pheonixagritech.com
Phone: 1-902-662-2441

Reed Joseph International
Pyrotechnics, Cannons
Website: www.reedjoseph.com
Email: sales@reedjoseph.com
Toll Free: 1-800-647-5554

Stoneco
Pyrotechnics
Website: theshellcracker.com
Email: c-stoney61@hotmail.com
Toll Free: 1-800-833-2264

Wildlife Control Technology
Pyrotechnics
Website: www.wildlife-control.com
Email: wct@wildlife-control.com
Toll Free: 1-800-235-0262

Margo Supplies Ltd.
Pyrotechnics, Cannons, Av-Alarm
Website: www.wildlife-mgmt.com
Email: margo@wildlife-mgmt.com
Phone: 1-403-652-1932

Predator calls
Borror Laboratory of Bioacoustics
Predator Calls
Website: blb.biosci.ohio-state.edu
Email:
borrorlab@postbox.acs.ohio-state.edu
Phone: 1-614-292-2176

Cornell Lab of Ornithology
Predator Calls
Website: birds.cornell.edu/BRP/
Phone: 1-607-254-2408

Chemical Repellents

Chemicals are used primarily to foul areas that are attractive to birds, such as perching, nesting, and loafing sites. Used with growing frequency for wildlife control at airports, chemicals either repel birds through taste, smell, or illness following ingestion. While certain bird-control products have proven effective at airports, mammal-repulsion products have had limited success; their development is ongoing.

A major advantage of this control method is that it is not subject to habituation. Most of these chemicals induce a physiological reaction to which animals do not generally become accustomed.

Taste repellents

Of the many kinds of chemical repellents that may be useful at airports, taste repellents are the most common. These bitter-tasting chemicals can be painted onto cables to prevent mammals from chewing. Taste repellents can also be used to deter deer from feeding on vegetation.

Behavioural repellents

The chemicals used to repel through ingestion may also be classed as poisons. Sufficient doses will kill individual birds. The most familiar and widely used of these chemicals is 4-aminopyridine, marketed in several strengths under the brand name Avitrol. As the erratic behaviours and distressing cries of treated birds may disperse other flock members, this chemical is also considered a behavioural repellent. Birds that ingest this product usually die.

Other limited-use repellents act through odour or fumigation. For example, naphtha flakes are sprinkled on favoured perching areas of House Sparrows. At present, there are no studies to support the effectiveness of this treatment.

Tactile repellents

This class of control applications discourages problem birds from landing and roosting on building structures. Tactile repellents are generally sticky mixtures and may include a chemical that mildly irritates birds' feet. The repellent properties do not stand up well to variable weather conditions and dust, so these materials are best used indoors. Some require specific application procedures and occasional renewal to be fully effective. While they appear to offer only limited effectiveness, they are not affected to any large extent by habituation.

All chemicals used in pest control in Canada must be registered by Health Canada's *Pest Control Products Act*. This applies to products used in both lethal control of wildlife, and to repellents. Registered chemicals undergo controlled testing to demonstrate their efficacy and safety. The labels of all chemical pesticide products must include both instructions for use and safety precautions—instructions that must be strictly followed.

Federal registration does not guarantee products will be available—or be permitted for use—provincially. For example, the Pest Control Products Act may register a product for commercial use, permitting its sale in large quantities; however, no licensing may be necessary under Federal law. Each province, however, has the authority to further restrict the use of that product to provincially licensed applicators.

Transport Canada strongly recommends that airport operators and wildlife-control personnel consult local pest-control company experts prior to the application of any chemical repellents.

Chemical products for birds

Tactile Repellents

There are several kinds of chemical repellents that may be useful for airport bird control. The most common are tactile repellents, which are sticky substances that discourage birds from roosting on ledges and other flat surfaces. Although application of the repellent is fairly labour intensive, the treatment is effective for up to one year.

Use

Prevents birds from roosting on ledges, window sills, and the tops of signs. Registered for control of pigeons and sparrows.

Description

These products consist of a soft sticky material that remains tacky through a temperature range of -9°C to 48°C. As a result, these products may be ineffective in many outdoor Canadian locations during the winter months. Birds attempting to land on treated areas are not trapped, but they are repelled by the stickiness of the product. Stickiness is retained for a year or more under most conditions.

Application

The substance is applied from cartridges with a caulking gun or from pails using a putty knife. Spray cans and small tubes are also available for application in small areas. Dust, loose paint, droppings, and dirt should be cleaned off surfaces before the repellent is applied; the pre-treatment of porous surfaces such as masonry and unfinished wood with silicone sealant or paint is also recommended. To ensure quick and easy clean-up, the product may also be applied over waterproof and oil-resistant tape.

Manufacturers' recommendations for use suggest applying a strip 1-cm wide and 1-cm high, 1.5 cm from the edge of the site, or along the highest point of a perching area. For wide spaces, two or more strips 10-cm apart are recommended. The application should be checked every six months to ensure that weathering has not affected the stickiness of the product. In some cases, scraping the surface will restore stickiness.

Advantages

- Remains effective for a year or more after application.
- Habituation is rare.

Disadvantages

- Initial and subsequent applications are labour intensive.
- All roosting ledges should be located and treated or birds may simply move to a new area.
- The products' ineffectiveness at temperatures below -9°C limit their value at Canadian airports during the winter months.
- The appearance of the material is not aesthetically pleasing, and may therefore be inappropriate for the exterior of some buildings.
- No quantitative efficacy reports have been completed on these products; their overall effectiveness remains undetermined.

Applying *"Hot Foot"*

Effectiveness
These products are effective in controlling pigeons, but relatively ineffective for sparrows. Sparrows require a very small area for perching, and may therefore be able to avoid contact with the repellent.

Even though these products are effective for the purposes claimed, they may not solve a bird problem if numerous roosting areas remain untreated. These products have been used in attempts to prevent raptors from perching on antennas, but there is no information on their effectiveness in this application. Should these products be employed at airports, it is imperative to monitor and record their success.

Behavioural Repellents (limited recommendation)

Behavioural repellents can cause visible signs of stress in birds, including disorientation and erratic behaviour. Frightened by such unstable behaviour, unaffected members of the flock often disperse.

Avitrol is the most common product available. The chemical should be placed in bait and eaten by the birds. Proper dilution of treated bait with untreated bait is therefore critical to prevent lethal control of large numbers of birds.

Use
Dispersing flocks of blackbirds, starlings, House Sparrows, pigeons, and gulls.

Description
Avitrol (4-aminopyridine) is a poisonous chemical that kill birds when they ingest a treated bait. This chemical causes visible signs of distress in birds when they are dying, causing other members of the flock to disperse.

Application
Blackbirds and Starlings
Commercial cracked-corn mixes of Avitrol are spread over feeding areas. The mix contains only six treated kernels per 100 so that only a small proportion of the flock is affected.

In one case, a blackbird roost in a cattail marsh was dispersed through the use of Avitrol. Bait trays were placed above the level of the cattails to feed incoming birds. The trays were pre-baited for three days with untreated corn. On the fourth day, Avitrol bait—at a ratio of 1:10 treated-to-untreated

kernels—replaced the pre-bait. Most of the birds were dispersed to other roost areas between 800 metres and 9.6 kilometres distant following four days of treatment. To protect non-target species, bait trays were placed two hours before sunset and removed in the morning.

Pigeons

Pre-baiting with untreated bait is essential for pigeon control. As well as accustoming pigeons to the bait, pre-baiting concentrates the population and draws the birds to preferred control areas. Elevated areas, such as roofs, are recommended as pre-bait areas; they are out of public view and deter non-target species such as Mourning Doves, which prefer to feed on the ground.

Pre-baits should be set out in numerous small piles of about 100 grams rather than in a smaller number of larger piles. On a roof 15 metres by 30 metres, 10 to 20 pre-bait piles are adequate. The response of the pigeons will dictate the duration of pre-baiting. If the pigeons have been exposed to Avitrol previously, and have become bait shy, as many as three to four months of pre-baiting may be necessary. Longer periods may also be required if an attempt is being made to move pigeons from their accustomed feeding areas. Normally, however, about two weeks of pre-baiting will be necessary.

Treated bait is provided once pigeons have been concentrated in the control area. Some pigeons may be killed by the bait. If there is concern about dead pigeons being found in public areas, the ratio of treated to untreated kernels should be 1:30. If this does not give adequate control after two weeks, the ratio should be increased to 1:20, and then to 1:10 after a further two weeks. If there is no particular concern about carcasses, treatments can begin at ratios of 1:15 or 1:10.

House Sparrows

A pre-mixed commercial grain is available specifically for sparrow control. Pre-baiting is necessary and should be carried out in areas where non-target species will not be attracted. At airports, pre-baiting can take place near buildings and away from natural-habitat areas such as bushes and grass.

Gulls

Pre-baiting—usually with bread—is necessary for gull control. Once the gulls are accustomed to feeding on the pre-bait, Avitrol-treated bread replaces the pre-bait at a ratio of 1:10 treated-to-untreated bait. Because pre-baiting may in fact attract gulls, Avitrol use on airports is of questionable value. Avitrol can be useful, however, to disperse gulls from landfills near airports. Where gull

populations are large, three treated bait stations should be placed at each of eight widely separated locations on the landfill. This treatment rate may be reduced by half at landfills with fewer gulls.

Advantages

- Flocks of birds can be dispersed by killing only a few birds if appropriate mixes are used.
- Avitrol can successfully disperse pigeons and House Sparrows—species for which other dispersal techniques are not effective.

Disadvantages

- Extensive pre-baiting may be necessary, and the pre-bait may itself attract additional birds.
- This product is recommended only for areas in which a direct threat to aircraft safety is not posed, as the direction of dispersal cannot be controlled. (Affected gulls and blackbirds, for instance, may circle upwards and fly erratically into aircraft flight paths.)
- Improper dilution can result in large numbers of dead birds, which may lead to a negative public perception of bird control.
- To prevent habituation or bait shyness, it is important to vary the pre-bait food source. Not only is this time consuming, it also poses a challenge to maintain a constant dosage level through changing food sources.

Effectiveness

Blackbirds and Starlings

Avitrol is quite effective in dispersing large blackbird flocks (over 1000 birds) in crops. At airports, Avitrol is likely to be useful only in agricultural lease areas and in roost dispersal. Transient flocks feeding on the airfield itself can be more effectively controlled through pyrotechnics.

Use of Avitrol at roosts in trees and bushes has not been tested, but delivery of the bait would likely be more difficult in this habitat. Starlings cannot be dispersed from roosts with Avitrol.

Pigeons and House Sparrows

Avitrol offers limited effectiveness in dispersing pigeons and House Sparrows. As long as food or shelter remains attractive, the same or new individuals will re-invade the treated area.

Gulls

Avitrol can be effective in dispersing gulls; however, gulls often return, and bait shyness can become a serious impediment to the continued effectiveness of the treatment.

Behaviourial repellents should be used in conjunction with other control methods as part of an overall management plan.

Permits required

Avitrol is a restricted chemical. Permits are required, and the agent should be administered by a licensed Pest Control Officer.

Benomyl (limited recommendation)

Use

Killing earthworms, particularly along runways and taxiways.

Description

Benomyl is a fungicide supplied as a wettable powder. This product can be used on and around runways to reduce earthworm populations.

Application

Benomyl should be sprayed annually at a ratio of 2.25-kg active ingredient per hectare in a 30 m band around runways and taxiways. This can be applied in conjunction with herbicides. LGL Ltd. states that because earthworm control is not a registered use for Benomyl, permits for this purpose are often difficult to obtain. Health Canada has advised, however, that the product can be used for its registered purpose as a turf-management agent at airports.

Advantages

- The reduction in earthworm populations results in a substantial reduction in the number of worms on paved areas in wet weather. This, in turn, reduces the attraction of birds, particularly gulls, that feed on worms.

Disadvantages

- As earthworms are no longer present to work the soil, there is often an increase in thatch from grass-cutting operations. This may increase the numbers of small mammals near the runway and, in turn, attract hawks and owls. The potential for this problem is not serious enough to overcome the advantages of worm reduction.

Effectiveness
Benomyl is effective in reducing numbers of earthworms.

Permits required
At airports, Benomyl should be used for its registered purpose as a turf-management agent.

Tersan (limited recommendation)

Use
Killing earthworms, particularly along the grass aprons of runways and taxiways.

Description
Tersan is a turf fungicide supplied as a wettable powder for pest control.

Application
Tersan is applied as a spray on grass aprons or turf areas. It requires thorough coverage, and should be applied every one or two weeks. This product should be used at airports where earthworms attract a significant number of birds.

Advantage
- Provides long-term protection.
- The reduction in earthworm populations results in a substantial reduction in the number of worms on paved areas in wet weather. This, in turn, reduces the attraction of birds, particularly gulls, that feed on worms.

Disadvantages
- As earthworms are no longer present to work the soil, there is often an increase in thatch from grass-cutting operations. This may increase the numbers of small mammals near the runway and, in turn, attract hawks and owls. The potential for this problem is not serious enough to overcome the advantages of worm reduction.
- This fungicide may cause eye, nose, throat, and skin irritation. It may also be harmful to grazers, and it may contaminate surface water. Because of these environmental concerns, Tersan is not widely used at Canadian airports.

Effectiveness
Tersan is effective in reducing the numbers of earthworms on and near runways. LGL Ltd. recommends this product for use where earthworm populations are creating major bird hazards near runways.

Permits required

At airports, Tersan should be used for its registered purpose as a turf-management agent.

Methyl Anthranilate – ReJeX-iT® (no available recommendation)

Use

Repels birds from unsafe airport feeding areas by inducing them to forage for food in their natural habitat.

Description

These products contain naturally occurring flavour additives that render treated food sources unpalatable to all species of birds. The products act as sensory repellents, affecting the behaviour of the birds without causing lasting physical harm.

Application

With appropriate equipment, ReJeX-iT can be sprayed on animal food and water sources such as ponds, landfills and turf. The product can also be used in fogging applications to disperse birds in hangars and other structures.

Advantages

- ReJeX-iT represents an alternative to the poisoning and shooting of nuisance birds.
- Its toxicity is extremely low.
- It is biodegradable in low concentrations.

Disadvantages

- If not used according to directions, discharge of high concentrations of the product into water bodies could cause environmental hazards.
- Excessive exposure to the product may cause eye and skin irritation.
- Large applications of ReJeX-iT can be costly.

Effectiveness

ReJeX-iT AP-50 may be used to repel birds such as Ring-billed Gulls, Canada Geese, and Mallards from landfills and temporary pools of standing water.

ReJeX-iT TP-40 may be used to repel starlings, Brown-headed Cowbirds, Ring-billed Gulls, Canada Geese, and Mallards at landfills and from standing water.

ReJeX-iT AG-36 may be used to repel Canada Geese from turf areas.

ReJeX-iT has the potential to provide control of specific problem bird species at airports. LGL Ltd. states that experimentation with varying formulations, application frequencies and concentrations may be required. Given the relatively high cost of ReJeX-iT applications, these experiments should be carried out on a small scale prior to full implementation of the product.

Permits required

In Canada, turf-applied products are registered for use against ground-feeding birds such as Canada Geese.

Suppliers

Flock Fighters Chemical Bird Aversion
ReJeX-iT
Website: www.flockfighters.com
Email: sales@flockfighters.com
or info@flockfighers.com
Phone: 1-219-447-0982
or 1-800-489-6651

Becker Underwood
ReJeX-iT
Website: www.bucolor.com
Email: request@bucolor.com
Toll Free: 1-800-232-5907

Canadian Sani-Corp
Hot Foot
Email: rspanier@csccanada.com
Phone: 1-604-985-7141

Bird X Inc
Bird Proof
Website: www.bird-x.com
Email: mail@bird-x.com
Toll Free: 1-800-662-5021

DuPont Canada
Benomyl, Tersan
Email: products@can.dupont.com
Website: www.dupont.ca
1-800-387-2122

Abell Pest Control
ReJeX-iT
Website: www.abellgroup.com
Email: sales@abellgroup.com
Phone: 1-416-675-1635
or 1-888-949-4949

PMC Specialties Group
ReJeX-iT
Website: www.pmcsg.com
Phone: 1-513-242-3300

Liphatech
Rodent Control
Website: www.liphatech.com
Toll Free: 1-800-558-1003

Chemical repellents for Mammals

Mammal repellents comprise chemical formulations that are placed in food, and—to protect against chewing damage—chemical applications that are used to coat cables and equipment. In both cases, animals are repelled by the offensive taste of the chemicals.

To repel foraging mammals, applications should cover the animals' preferred vegetation. These applications tend to be time-consuming and labour intensive. Additionally, these chemicals have a relatively short effective life span when used outdoors, so they should be reapplied periodically.

Taste repellents

Use

Taste repellents deter rodents and canids from chewing above-ground cables, and deter deer and Elk from inhabiting airport property by rendering forage plants unpalatable.

Description

Most repellent chemicals are dissolved in a liquid carrier that is either sprayed or painted on the area to be protected. The active ingredients in commercial repellents include thiram, ammonium soaps, putrescent egg solids, bone-tar oil, or a combination of plant extract oils. Many other substances are available, but are not sold for the specific purpose of repelling wildlife. These include tankage or feather meal (by-products of the meat-processing and chicken-processing industries), human hair clippings, mothballs, creosote, and predator fecal odours.

Application

These products are sprayed in diluted form or painted in the concentrated form that is supplied by the manufacturer. Manufacturer's labels give information on the correct application.

Advantages

- Once applied to cables and other non-edible items, some repellents will remain effective for a year or more.

Disadvantages

- Spraying of vegetation should be repeated every two or three months to counteract weathering and accommodate new plant growth.
- Products containing putrescent egg solids may attract Coyotes.

Effectiveness

Rodents

Repellents containing thiram at concentrations of at least 1:25 are effective in repelling ground squirrels. The concentrations required to repel other species have not been specifically reported. The period of effectiveness probably varies with the manufacturers' formulations, but there is no information on which formulations have the greatest duration.

Deer, Elk and Moose

Most testing on the effectiveness of repellents has been done on Whitetail Deer. Effective active ingredients include thiram, putrescent egg solids, ammonium soaps, tankage, and feather meal. Most commercial repellents seem to be effective for approximately two to three months, but heavy rains may reduce this duration significantly. Products that are *not* effective repellents include bone-tar oil, human hair, creosote, and mothballs.

Tests with Mule Deer indicate that fecal odours of deer predators are effective repellents; however, no commercial formulation of such odours is available. Research indicates that products containing putrescent egg solids are effective for both Mule Deer and Elk. Thiram seems to be less effective as an Elk repellent than putrescent egg solids.

Although certain products are demonstrably effective as repellents under experimental conditions, this does not necessarily translate to success under field applications. To date, the effectiveness of all repellents is measured in the *reduction* of damage to vegetation, not the elimination of damage. If there are no other food sources, or if treated vegetation is a preferred food, deer may continue to eat despite chemical applications.

Canids

To deter wild canids such as foxes and Coyotes, thiram seems to be the longest lasting and the most effective. Products containing putrescent egg solids are effective deer repellents, but will *attract* canids.

Permits required

None

Visual Repellents – Birds

Visual repellents have been used for many years, commonly in the form of scarecrows. While there have been many innovations for the protection of agricultural crops over the years, most are unsuitable or ineffective for airport control programs. Some recent developments have involved the use of predator models that are often animated. Unfortunately, rapid habituation means their acceptance as an effective control method has not been widespread.

When used in conjunction with taped distress calls and firearms, dead birds will sometimes scare away flocks of the same species. Placing fresh carcasses in open areas also offers limited effectiveness; however, scavengers will also be attracted to dead animals. Some wildlife officers report success in dispersing flocks simply by tossing a recently dispatched gull into the air while playing distress calls. Such acts should be carried out only with good judgment, and with consideration for any onlookers who might take offense.

Agony posture

Placing taxidermically-mounted gulls—prepared in what are termed *agony postures*—in open areas has also led to some success, although such models are unable to withstand harsh weather conditions.

Habituation is once again a major problem that is encountered in using these methods of control. Transient birds are the most likely to be scared by visual deterrents since the opportunity to habituate to these tactics does not arise. With problem resident birds, however, a combination of visual and auditory deterrents—usually exploders—will increase effectiveness.

Examples of visual deterrents include scarecrows, flags and streamers, flare pistols, strobe lights, predator models, hawk kites, gull models, and helium-filled balloons.

Scarecrows, Flags, and Streamers (limited short-term recommendation)

Use

Deterring birds from resting on airport property.

Description

The primary aim of a scarecrow is to resemble a predatory human as closely as possible. They can be constructed from such available materials as old clothes, grain sacks, and straw. Streamers and various flags are available commercially, but effective flags can be made on site as described below.

Scarecrows

Scarecrows should be brightly coloured, and move in the wind to appear life-like. Studies show that the most effective scarecrows possess realistic human facial features. Scarecrows should be placed every 4 to 6 hectares for best results. Birds will rapidly habituate to scarecrows unless they are moved at least every two to three days. Anecdotal evidence states that scarecrows are most effective when placed in fields immediately after harvest.

Flags

Flags are successfully used to protect crops from waterfowl. The most effective flags consist of a simple 60-cm x 90-cm sheet of 3-mm black plastic attached to a 1.2-m piece of lath. The short side of the plastic sheet is wrapped around the lath and stapled through a piece of cardboard to prevent ripping. The use of coloured plastic seems to lessen the effectiveness of these devices. Heavier plastic and larger flags are too rigid in the wind; smaller flags are not as visible. In areas where waterfowl have become accustomed to feeding, four flags are recommended per hectare, placed in an offset grid pattern. One flag per hectare suffices in areas frequented by waterfowl.

Reflective streamers

Streamers are useful for deterring blackbirds and House Sparrows from feeding in crops. Streamers are made from reflective mylar tape—an elastic, three-layered tape that has a silver metal layer on one side and a coloured synthetic resin on the other. The tape flashes when it reflects sunlight, and produces a noise as it flaps and stretches in the wind. In experimental applications, the best effect was achieved when tapes were strung three metres apart with two to four twists per 30 metres. Ensure there's enough slack to allow undulations of 0.5 to 1.0 metre at the centre. More twists and tighter streamers resulted in reduced movement and effectiveness. Placing streamers across rain ponds is an effective deterrent, especially for shorebirds and ducks.

Inflating balloons and placing them across ponds, approximately one metre above the ground is also effective.

Advantages
- These devices are inexpensive.

Disadvantages
- Scarecrows should be moved frequently to counteract habituation.
- As breakage occurs often and easily, flags and streamers should be replaced.
- Broken parts should be picked up immediately to avoid FOD.

Effectiveness
Evaluations are available only for reflective streamers. Although they substantially reduced the numbers of blackbirds, cowbirds, and House Sparrows feeding in fields, streamers did not completely deter these birds. No effect was observed for Goldfinches and Mourning Doves.

Black flags, as described above, are reported to be useful in deterring waterfowl, especially when used in combination with exploders and other noise-making devices. The effectiveness of scarecrows is also increased when combined with other methods. Scarecrows rapidly lose their effectiveness when used alone and left in the same location for several days.

Overall, visual deterrents are recommended for short-term small-area use and as minor components of wildlife-management programs.

Permits required
None

Predator Models (limited short-term recommendation)

Use
Deterring prey species from landing and resting at airports.

Description
Models range from very poor to excellent imitations of various predators.

Application
Models can be mounted on posts or other supports in areas where prey species roost or feed, but should be moved frequently to prevent habituation. Experiments

in the use of models show that placing a dead bird—or model—in the talons of the predator model increased the effectiveness of this technique. Effectiveness was further increased when a live starling was tethered to the model.

Advantages
- Models can be inexpensive.
- Associated labour costs are low.

Disadvantages
- Models should be moved frequently to prevent habituation.
- Owl models in open areas have been known to attract crows.

Effectiveness
Some species of birds are not particularly responsive to predator models, and the species of predator the model represents may affect the response to it. For example, in one study Mourning Doves were much less responsive to two taxidermically-mounted hawk species than were starlings or Blue Jays.

Predator models are only recommended for use at airports when they are part of integrated programs.

Permits required
None

Hawk Kites and Balloons (limited short-term recommendation)

Use
Deterring birds from landing at airports.

Description
These kites are similar to stationary models in their resemblance to predators. Kites may be either tethered to the ground, or suspended from helium balloons or flexible poles during periods in which there is no wind.

Application
Balloons are tethered to lines that are up to 60 metres long. Kites are attached to tether line with fishing swivels. In agricultural areas, one kite for each two to four hectares is effective in reducing bird damage. In one test of balloon longevity, polyurethane balloons were found to be more durable

than rubber balloons; blue balloons were found to deteriorate quicker than those of other colours.

Advantages

- Habituation does not occur as rapidly as with stationary models because the movement of the kite ensures a more realistic appearance.

Disadvantages

- At airports, kites and balloons may themselves be hazardous to aircraft should they be ingested into jet engines.
- Balloons and kites should be checked at least every second day to ensure proper operation, and to refill with helium if necessary.
- Kites and balloons deteriorate rapidly and should be replaced regularly. In one study of several types of weather balloons, none lasted longer than a week. More durable balloons are available—made primarily for advertising purposes—but cost several hundred dollars each.
- Kites and balloons can be damaged by high winds, as well as the wash generated by aircraft.

Effectiveness

All tests of kite balloons effectiveness were conducted in agricultural areas, particularly vineyards. These devices are effective in deterring some species of birds from areas of one to two hectares around the kite. Species that were effectively deterred included Blue Jays, Mourning Doves, and starlings. The overall numbers of birds in the areas tested were reduced between 27 and 65 percent. The lower reduction was achieved in a study in which the kites were left in the same position for six weeks.

Kites that were tethered to a five-metre flexible pole from a two-metre tether line were found to be less effective than kites tethered to balloons. Presumably, this result relates to the short distance the kite could travel in the ground-tethered position, compared to the 30- to 40-metre coverage that was afforded when tethered to a balloon.

Studies by LGL Ltd. conclude that kites and balloons can be useful as bird deterrents on airfields, but the effectiveness of these devices is limited by habituation. If these products are to be used, they should be supplemented with other scaring devices to ensure optimum effectiveness.

Permits required

None

Gull Models (limited short-term recommendation)

Use
Deterring gulls from loafing at airports.

Description
Models should be faithful replicas or actual dead specimens.

Application
Placement of the models should be determined on a case-by-case basis. Observations should be made of both where the gulls are loafing and whether they display a preference for one location over another. Models should be placed in areas where gulls rest and cause particular hazards. Models and dead gull specimens—both in agony positions—warn all other birds in the vicinity that danger exists. Ensure that if gulls are dispersed from the area where the models are placed, the birds are not simply moving to new airport loafing areas at which they will cause even greater hazards. Some gulls may even initially be drawn to models. In both these instances, supplementary deterrents, such as pyrotechnics, may be required.

Advantages
- Gull numbers should be reduced in areas where models are deployed.

Disadvantages
- Model effectiveness depends on the realism of the product; therefore, they should be custom made.
- In some cases, models will only encourage gulls to change their preferred loafing area, not disperse them entirely from airports.

Effectiveness
Experiments at airports in various parts of the world have shown that gull models and dead specimens can deter other gulls from loafing nearby for periods ranging from eight days to eight months. Effectiveness varies with the species and the geographic location, and may also be affected by the realism of the model and the state of the dead specimen (carcasses that are overly weathered may be ineffective). To enhance the effectiveness of gull models, they should be used in conjunction with other scaring techniques.

Permits required
None.

Falconry (no available recommendation)

Use
To disperse birds from airports.

Application
Falconry is a centuries-old art; however, it was not employed as a bird-control technique at airports until the 1970s. In this method, trained falcons—and occasionally other birds such as merlins and hawks—pursue, scare, and sometimes kill problem species. Although highly specialized and reliant on professional falconers, falconry has proven a successful airport bird-control method in some situations.

Falconry at airports

Falconry plays upon some birds' natural fear of raptors—their presence in the area is sometimes enough to temporarily disperse problem species. The natural reaction of most prey species is to form a tight flock and attempt to fly above the falcon. If this fails, they will fly for cover, often away from the airport. Caution should be exercised, however, as the direction of dispersal is not always controllable and flocks may fly along or across active runways.

Advantages
- Some birds have an innate fear of raptors and, as the danger is real, do not habituate to their presence. The biological basis of this control method is strong.
- Professional falconers can assist in developing a comprehensive wildlife-management program in which falconry is an integral component.

Disadvantages:

- Requires full-time employment not only of experienced falconers, but also suitable birds, which are at times scarce.
- Falconry cannot be employed in bad weather conditions such as fog, high temperatures, heavy rain, or high winds.
- Several falcons of different sizes are required to chase the various birds that are found at airports.
- The presence of any bird at airports can pose a risk to aircraft, so falconers should be in complete control of their birds—and in contact with control towers—at all times.
- Full-time falconry programs are costly.
- Large birds such as Canada Geese are not deterred by falcons.

Effectiveness

Studies by LGL Ltd. conclude that there is a biologically sound basis to the use of falconry for bird control. Pest birds are sometimes readily dispersed and habituation does not occur. The threat is increased when falcons are allowed to kill periodically.

Anecdotal evidence from major Canadian airports shows that falconry, while expensive, is an effective means for controlling birds. The practice offers real public relations benefits as well, since many animal-welfare groups look upon falconry as a humane method of wildlife control.

Falconry is not, however, a stand-alone solution; it should be used in conjunction with other wildlife-control measures.

Permits required

None-other than those obtained from Provincial authorities for keeping protected raptors.

Border Collies (no available recommendation)

Use

To disperse birds/deer from airports and prevent their return.

Application

It is reported that Border Collies can serve as an effective means of wildlife control in airfield environments by introducing a true predator into the ecosystem. Border Collies are canids, representing an actual, not perceived, threat to wildlife, thereby

eliminating the problems of habituation. Border Collies should be used by a handler who can either be a trained airfield employee or from a professional organization employing Border Collies, which can also provide a comprehensive wildlife-management program for the airport.

Since Border Collies are under the direct control of a handler, in theory they disperse wildlife only in prescribed areas and at the direction of the handler. Border Collies can be stopped at any point in time at the approach of an aircraft, avoiding potentially dangerous dispersals, by either recalling the dog to the handler or lying the dog down. This allows them to work during flight operations, even at the busiest of airfields. Dispersal of birds and wildlife relies on visual cues, so noise does not affect the efficacy of their actions.

Advantages

- Birds have an innate fear of wolves and canids and, as the danger is real, do not habituate to their presence. The biological basis of this control method is strong.
- Border Collies can work in almost all weather conditions and can travel over all forms of terrain, including following waterfowl into marshes or open water.
- Border Collies can work for long periods of time and can learn from various situations and adapt to changing circumstances as required.
- Border Collies have the instinct to herd animals but have been bred to avoid "going in for the kill". Since they do not harm the birds being harassed, they can be used to deter protected species of bird and wildlife.
- A single handler and Border Collie can cover extensive territory in conjunction with a vehicle. The dogs can be directed on command to change directions, lie down, approach the birds, back away, continue searching, or to quit working without the handler ever having to change position.
- Border Collies can be directed with relative precision, enabling directional dispersals of birds or wildlife. This avoids the tendency of birds, for example, to scatter and then to regroup in an area just behind their initial staging area.
- Border Collies have a lifespan of approximately 14-15 years. The dogs are capable of working as early as 1 year of age and may continue working until they are 11-12 years old.
- Border Collies are environmentally friendly and the positive public relations from a Border Collie program can be as valuable as their bird deterrence capabilities.

Disadvantages

- Use of a Border Collie requires full-time employment of trained handler(s), with ongoing training required for both dog and handler(s).

- The dogs are minimally effective against the smallest bird species such as swallows and Dunlin, and do not prevent gulls and other birds from flying over the airport or raptors from hunting on the airport.
- Border Collies require daily work and exercise, even without birds present, and so should be taken out every day for work.
- Both dogs and handlers should be professionally trained. Qualified dogs are expensive (equivalent to drug and bomb-trained dogs) and training for airport staff is considerable. Outsourcing of wildlife control with a professional organization employing Border Collies can also be costly.

Effectiveness
Studies by KLECE ecological consulting have shown a dramatic reduction in airfield bird populations after the employment of a single Border Collie. Further studies from Vancouver International Airport have shown birds visiting the airport dropped by almost fifty percent after the first year of utilizing Border Collies. Pyrotechnic usage also dropped dramatically, resulting in a substantial cost savings for the wildlife management program.

Cold Lake AFB has successfully eliminated runway incursions by deer through the use of a single Border Collie in their airfield environment. Border Collies are now being tried at airports and airbases all over the world.

Permits required
None

Radio-controlled Model Aircraft (limited recommendation)

Use
Bird dispersal.

Application
Standard radio-controlled aircraft can be used to harass and disperse birds from airports. While these aircraft can be painted to resemble falcons, models are now available in the shape of these birds. Radio-controlled aircraft have proven effective at some airports; however, well-trained operators are required. Computer simulators are available for a modest price and are highly effective tools for training airport staff in using the models. A high degree of hand-eye coordination is required but most individuals, with enough practice, can become adept at their control.

Advantages

- Radio-controlled model aircraft eliminate the hazards associated with flying live birds, which can be unpredictable in certain situations.
- Can be used at night.
- Effective on a broad range of species.
- A basic radio-controlled model aircraft program is relatively inexpensive to acquire and maintain.
- The steering capability of the model aircraft allows for the directional dispersal of birds away from active areas of the airfield.
- The dynamic presence of radio-controlled model aircraft prevents birds from returning to and landing in areas.
- Model aircraft can cover an extensive range away from the operator, limited only by line of sight.
- Radio-controlled model aircraft can be an effective means of dispersing soaring birds at higher altitudes, such as hawks and eagles.

Disadvantages

- Requires skilled operators.
- Response time is often slow. Radio-controlled model aircraft should be fueled, charged, and transported around the airfield at all times in order to be effective.
- Model aircraft cannot be used in heavy winds, and moderate to heavy rain and snow.
- Ineffective against geese resting on bodies of water. Radio-controlled model boats should be used instead.
- Habituation is not a problem but the deterrence effect is not long-term, as the birds often return the next day or many hours later.
- Air traffic control personnel are often hesitant to allow operation of radio-controlled model aircraft near active runways
- Nearby landing and refuelling areas are needed. Maintenance of aircraft can be time-consuming.

Permits required

None

Suppliers

Bird Control International Inc.
Falconry
Phone: 1-519-853-1771

Bird X Inc.
Predator Models, Bird Light, Streamers, Flags
Website: www.bird-x.com
Email: birdcontrol@nixalite.com
Toll Free: 1-800-662-5021

Border Collie Rescue Inc.
Border Collies
Website: birdstrike.bcrescue.org
Email: birdstrike@bcrescue.org
Phone: 1-877-SHEEPDOG
or 1-352-473-0100
Mobile: 1-352-281-0359

Current Corporation
Night Vision Products
Website: www.currentcorp.com
Email: dhoughto@currentcorp.com
Phone: 1-604-461-5555

Falcon Environmental
Falconry
Website:
www.falconenvironmental.com
Email:
info@falconenvironmental.com
Phone: 1-613-525-9998

Intercept Technologies Inc.
Falconry
Website: intercept-technologies.com
Email:
rennie@intercept-technologies.com
Phone: 905-936-5469

LeBaron Outdoor Products Ltd.
Predator Models
Website: www.lebaron.ca
Email: info@lebaron.ca
Toll Free- 1-800-567-3377

Margo Supplies Ltd.
Streamers, Flags, Scarecrows
Website: www.wildlife-mgmt.com
Email: margo@wildlife-mgmt.com
Phone: 1-403-652-1932

Reed Joseph International
Balloons, Streamers, Flags
Website: www.reedjoseph.com
Email: sales@reedjoseph.com
Toll Free: 1-800-647-5554

Section F

Active Management Using Exclusion Methods

Introduction

Airports provide the necessities of life—food, water, and shelter—for many wildlife species. Eliminating these necessities, and preventing access to them, dramatically reduces wildlife problems at airports.

Netting is an effective method to prevent birds from roosting and nesting in and on airport buildings. A grid of fine wires stretched above a source of food or water deters some species of birds by interrupting their flight patterns. An alternative to wires is Bird Balls™, a product described later in this section.

Many Canadian airports are already surrounded by security fencing, which is an effective means to prevent medium-sized and large mammals such as deer, Moose, and bear from entering airport lands. To be effective, however, security fencing must not only be high, it must also be kept clear of drifting snow, and subjected to frequent checks. Gates must close tightly and be snug to the ground.

If fencing does not surround airport perimeters, it can be used around selected wildlife habitats that are attractive to mammals. For example, fencing around ponds is effective in barring Beaver and Muskrat. Fencing also prevents access to crops that may be grown on airport lands.

Rodents present unique problems at airports, often chewing electrical cables; copper and steel cable-sheathing products are available to prevent this kind of damage. Metal flashing and grates are effective in preventing rodents from gaining entrance to airport structures.

Birds

Netting

Use

Netting may be used in a variety of ways to prevent birds from gaining access to food or roosting areas.

Description

Available nettings range from those that feature small 3- to 3.5-centimetre mesh openings, to fishnets with openings of several metres. Netting is generally available in 3- to 4-metre wide rolls that are 16 to 1200 metres in length. Lightweight netting—designed to protect crops from bird predation—is also

available. The manufacturers and distributors listed at the end of this section also supply netting that is resistant to deterioration by sunlight.

Application

To be effective, netting must prevent birds from gaining access to food, water, and shelter. If barred from access, birds are likely to leave airport lands and look elsewhere for attractive habitat.

Due to the sheer volume that would be required—and the resultant high cost—netting is only used to cover the most valuable and attractive crops, such as fruit. Netting is also effective in barring birds from small and temporary bodies of water.

At airport buildings, netting can be used to:

- make curtains that can be hung across open hangar doors;
- create covers for smaller holes and openings;
- isolate the ceiling support structure so that birds cannot nest or perch in beams and girders;
- hang at 45° angles beneath eaves to prevent nesting by swallows.

Advantages

- Barring birds from crops, as well as roosting and nesting sites, reduces the overall numbers of birds in the area.
- Netting provides a long-term solution when installed in hangars to deny birds access to beams and girders.

Disadvantages

- Polypropylene netting deteriorates in sunlight and needs to be replaced regularly.
- The installation and removal of netting is labour intensive.

Effectiveness

As part of an integrated management plan, netting is effective in barring birds from airport lands and buildings.

Permits Required

None

Porcupine Wire (Nixalite)

Use

Porcupine wire, typically marketed as Nixalite, prevents birds from perching and roosting on flat surfaces such as ledges and signs.

Description

Nixalite is a system of stainless steel strips that feature needle-like wire prongs. The prongs project from a 0.5 centimetre base and come in two lengths – 5 and 9.5 centimetres. Strips are available in either single (90°) or double (180°) radius.

Nixalite

Application

The manufacturer of Nixalite supplies the application hardware and provides instructions on spacing the strips. To remain effective, the prongs must be kept free of all debris, specifically leaves, garbage and twigs that can be used as nesting material. It can be applied with Velcro strips for easy removal when maintenance is required.

Advantage

- Nixalite permanently excludes many birds from areas where it is installed.

Disadvantages

- Nixalite is expensive.
- Unless all ledges are treated, birds are likely to move to a new location nearby.
- Some birds, such as Red-tailed Hawks, have sufficiently long legs to perch on Nixalite-covered surfaces.

Effectiveness

When properly installed and maintained, Nixalite effectively prevents birds from perching and roosting.

Permits Required

None

Bird-B-Gone

Use
Bird-B-Gone prevents birds from perching or roosting on ledges, signs and flat surfaces.

Description
Bird-B-Gone comprises strips of durable plastic porcupine wire that is resistant to ultraviolet light. The product is safe to install and prevents birds from perching and roosting on all surfaces.

Application
The manufacturer of Bird-B-Gone provides instructions on spacing the strips and recommends various installation techniques. Several tools required for installation are not included: a hacksaw to cut the base, and nails, screws, glue, ties, or Velcro to attach the base to chosen surfaces.

Advantages
- Bird-B-Gone permanently excludes birds from areas where it is installed.
- Bird-B-Gone is less expensive than Nixalite.

Disadvantage
- Unless all ledges are treated with the product, birds are likely to move to new locations nearby.
- Some birds may not be deterred.

Effectiveness
When properly installed and maintained, Bird-B-Gone effectively prevents some birds from perching and roosting.

Permits Required
None

Avi-Away

Use
Avi-Away prevents birds from roosting and perching on flat surfaces such as ledges. The product can be used to deter birds from entering large-door buildings such as hangars.

Description

The Avi-Away system consists of a control unit and cable installed along the area to be protected. When a bird lands on the cable, it completes an electrical circuit and receives a mild shock. The manufacturer claims that in addition to the repelling effect of the shock, the alarm call given by the bird disperses other birds in the immediate area.

Application

Avi-Away cables should be installed along ledges where birds congregate; control units must be installed indoors. The manufacturer supplies the system's mounting hardware, including extension brackets that allow installation below the top of hangar doorways and other large openings.

Advantage

- Avi-Away permanently excludes all birds from locations where it is installed.

Disadvantages

- Avi-Away requires periodic maintenance.
- Unless all ledges are treated, birds are likely to move to new locations nearby.

Effectiveness

Avi-Away's overall effectiveness is questionable, as the repellent effect of the product relies on birds landing on its cables; some birds will inevitably avoid the cables. Further, the manufacturer's claim that birds' alarm calls will repel other birds must be tempered with the knowledge that only birds of the same species may be affected.

Permits Required

None

Fine Wires (small-area applications)

Use

Fine wires prevent birds from roosting and perching on ledges, pipes, and flat surfaces.

Description

In this method, one-millimetre diameter stainless-steel wires are stretched across roosting and perching areas at a height of 2-4 centimetres.

Application
Attach wires at each end of the roosting and perching sites using "L" brackets. Use turnbuckles to ensure the wires are taut. "L" brackets should be welded in place, or attached to conduit and piping with cable clamps or aircraft hose clamps.

Advantage
- Fine wires permanently prevent some birds from roosting and perching.

Disadvantages
- Installation of wires is labour-intensive.
- Unless all sites are treated, birds are likely to move to new locations nearby.

Effectiveness
Fine wires effectively prevent some birds from roosting and perching along pipes, however the product is unlikely to deter smaller birds such as sparrows from using ledges.

Permits Required
None

Fine Wires (large-area applications)

Use
Fine wires extended over specific areas restrict the access of gulls, waterfowl and crows to sources of food and water.

Description
A grid of fine wires or monofilament strands (less than 0.5 millimetre in diameter) is installed at 2.5- to 12-metre intervals above sources of food and water. The wiring should be strung no less than 1 metre above ground or water.


Fine wires on water

Application
At airports, grids of fine wire should be installed over ponds, standing water and other wetlands. Wire grids can also

be installed over flat roofs where gulls congregate. In areas near airports, grids of fine wire should be used over landfills.

Several general guidelines apply:

- Wire must be 0.5 millimeter or less in diameter—small enough to be difficult for birds to see.
- Stainless-steel wire is the most durable, although monofilament line and steel-core Dacron line are also acceptable if installed inconspicuously.
- Strands of wire should be installed in parallel and on a horizontal plane.

Spacing between strands of wires will vary according to the species of bird the installation is intended to deter. Trials at one landfill, for instance, revealed that strands of wire strung at 6-metre widths reduced the numbers of Ring-billed Gulls, while wire spaced at 12 metres was even more effective at deterring Herring Gulls.

In a test at Calgary International Airport, wires spaced at 3.5 to 4 metres prevented most ducks from using a pond. As a result of the test, authorities recommended:

- reducing the wire spacing in an attempt to deter more birds;
- covering associated pond areas, including mud flats and aquatic vegetation; and
- installing additional wires around the periphery of ponds, specifically between the ground and the tops of the brackets to which the horizontal wires are attached.

It was also recommended that wires be installed before the arrival of waterfowl in the spring, since the grid seemed to be effective against transient waterfowl but not against those already nesting on the pond.

Advantages

- Following its initial installation, little labour is involved in maintaining the system.
- A grid of fine wires significantly reduces the attraction of water and food to many species of birds.
- Birds that gain access to areas covered with fine wires are extremely nervous and, therefore, more susceptible to scare techniques.

Disadvantages

- Wire systems must be checked regularly.

- Stainless-steel wire is difficult to handle during installation, as it frequently kinks and breaks.
- Monofilament wire deteriorates rapidly in sunlight.
- Some bird mortality may occur when birds fly into wires.

Effectiveness

Fine wire grids have been tested against Ring-billed and Herring Gulls, crows, waterfowl, pigeons, shorebirds, and some small birds. In general, fine wire grids are ineffective against shorebirds, pigeons, and such small birds as blackbirds, starlings, and swallows.

Wire is most effective against waterfowl when grids have been installed before waterfowl become attached to nesting territories. Unfortunately, fine-wire grids have not been tested against migrating waterfowl.

Due to the concentrated availability of food sources, it is difficult to disperse gulls from landfills. According to several studies, however, the use of widely spaced overhead wires has been effective in reducing the number of gulls at landfills, reservoirs, and ponds.

Permits Required

None

Bird Balls™

Use

Bird Balls prevent birds from landing on bodies of standing water.

Description

Bird Balls are designed as an alternative to netting and wires. When installed, the hollow-plastic balls cover the entire water surface. From the air, birds see a solid surface and move on to search for water elsewhere.

Advantages

- Bird Balls are easy to install.
- Unlike wires and netting, Bird Balls do not break or tear.
- Bird Balls are effective in all weather conditions.
- Bird Balls require little maintenance.
- Bird Balls adjust to fluctuating water levels.

Disadvantages

- Bird Balls are considerably more expensive than netting and wires.
- Bird Balls are only effective on bodies of standing water.

Effectiveness

To date, no independent studies of Bird Balls have been completed. LGL Ltd., however, states that the technology associated with Bird Balls is simple, straightforward, and sound.

Permits required

None

Suppliers

Abell Pest Control
Nixalite
Website: www.abellgroup.com
Phone: 1-416-675-1635

Bird X Inc.
Netting
Website: www.bird-x.com
Email: birdcontrol@nixalite.com
Toll-Free: 1-800-662-5021

Bird Barrier
Netting and wire
Website: www.birdbarrier.com
Email: jackwagner@birdbarrier.com
Toll Free: 1-800-503-5444
or 1-800-662-4737

Margo Supplies Ltd.
Streamers, flags and scarecrows
Website: www.wildlife-mgmt.com
Email: margo@wildlife-mgmt.com
Phone: 1-403-652-1932

Nixalite of America
Nixalite
Website: www.nixalite.com
Email: birdcontrol@nixalite.com
Toll Free: 1-800-624-1189

Wildlife Control Technology
Bird Balls™ and netting
Website: www.wildlife-control.com
Email: wct@wildlife-control.com
Toll Free: 1-800-235-0262

Mammals

Fences

Fences are the most important tool to control mammals at airports. A variety of fencing options are available to address the range of hazardous species:

A March 2000 study by Transport Canada and LGL Ltd. evaluated these fencing options, particularly for deer. These findings are summarized below.

The complete report is available online as an Aerodrome Safety Circular, ***Evaluation of the Efficacy of Various Deer Exclusion Devices and Deterrent Techniques for use at Airports,*** http://www.tc.gc.ca/CivilAviation/aerodrome/menu.htm

The report can be obtained by calling: 1-800-305-2059
or E-mail: http://www.tc.gc.ca/aviation

Non-electric Fences

Galvanized steel chain-link fence

Use

Used to prevent mammals from accessing airport lands.

Description and application

Used for security at airports throughout North America, galvanized steel chain-link fencing is the standard against which all other types of fencing are compared. It is described in detail in the Transport Canada *Airport Fencing Manual* (AK-70-21). This fencing is made of woven mesh, anchored by steel posts and topped with projecting arms that support multiple strands of barbed wire. Chain-link fencing provides a good physical barrier to deer.

Advantages

- Relatively maintenance-free following initial installation.
- Galvanized steel construction resists chewing, clawing, tearing, etc.
- Standard 2.4-metre height with 3-strand barbed-wire extension blocks access by most mammals.

Disadvantages

- At $43,000 per kilometer, cost may be prohibitive.
- Snowdrifts can reduce fence height in the winter months.

- Soil erosion and digging by canids can compromise the effectiveness of these fences.
- Can interfere with Instrument Landing systems (ILS).

Effectiveness

Galvanized-steel chain-link fencing is recommended for use at Canadian airports.

High-tensile fixed-knot fencing

Use

Used to prevent mammals from accessing airport lands.

Description and application

High-tensile fixed-knot fencing is used in areas where chain link disrupts ILS. This fencing comprises high-tensile wire that is available in weave widths between 7.6 and 15.2 centimetres, and in heights of 2.4 to 3.7 metres. Posts made from either galvanized steel pipe or pressure-treated wood is used to support the fence. The recommended post spacing varies from 6 to 7.6 metres.

Advantages

- High-tensile fixed-knot fencing lasts 20 to 30 years; maintenance is limited to soil-erosion control.
- Its tightly locked wire prevents mammals from squeezing through.
- 3.7-metre high fencing provides protection against White-tailed Deer (generally capable of jumping 3 metres).
- High-tensile fixed-knot fencing does not interfere with ILS.

Disadvantages

- At $30,000 per kilometre, cost can be prohibitive.
- Snowdrifts reduce fence height.
- Soil erosion and digging by canids can compromise the effectiveness of these fences.

Effectiveness

High-tensile fixed-knot fencing is recommended for use at Canadian airports. The 3-metre fence design, which uses smooth high-tensile wire to add height to the basic 2.4-metre fence, is effective at most airports. In areas where deer populations are high, 3.7-metre high fencing is recommended.

Gates

Cattle Gates

Use

Used in conjunction with perimeter fencing in areas where vehicular access is required.

Description and Application

Their name is misleading, as cattle gates actually comprise metal grids installed over ditches at gaps in airport fencing. The grids—constructed of 7.6-centimetre pipes spaced at 12.7-centimetre intervals—permit access by vehicles while providing inadequate footing to such large mammals as deer, whose hooves slide between pipes.

Effectiveness

Cattle gates are effective for deterring large mammals from accessing airport lands.

One-way gates

Use

Permit non-lethal removal of deer from inside airport perimeters.

Description and Application

When mammals—specifically deer—manage to enter areas surrounded by fencing, they are often unable to find their way out. One-way gates allow mammals to exit areas otherwise enclosed by fencing.

One-way gates use spring-steel bailer lines hinged and arranged to form funneling valves. This design permits easy passage from inside the fence while hindering access from outside.

Advantage

- One-way gates save wildlife control officials from having to trap or shoot mammals.

Disadvantages

- Maintenance costs are high in areas affected by frost heave, which causes these gates to slip from alignment.

- One-way gates hinges must be lubricated regularly.
- When panicked, mammals do not recognize one-way gates as escape routes.

Effectiveness

One-way gates are recommended for use in conjunction with perimeter fencing. Although one-way gates require frequent maintenance, they prevent the need to capture or kill mammals trapped inside perimeter fencing.

Electric Fences

ElectroBraid™ Fence

Use

Used to prevent mammals from entering airport lands.

Description and application

ElectroBraid™ fence features copper strands that are woven into its polyester cords, which are then strung 15 to 30 centimetres apart between fiberglass or wooden posts. The cords are then attached to the positive post of a grounded fence charger to produce 4,000 to 5,000 volts DC.

Advantages

- Mammals avoid this fencing after experiencing electric shock.
- ElectroBraid is visible enough to prevent accidental contact.
- It costs significantly less than traditional chain-link fence.

Disadvantages

- ElectroBraid requires frequent maintenance.
- Vegetation growing around this fencing can cause short-circuits.
- Snow must be regularly cleared from around this fencing.

Effectiveness

ElectroBraid™ fencing is recommended for long-term mammal control at airports. Regardless of the brand of electric fencing selected, routine checks must be conducted to repair damage from soil erosion, chewing, digging, and frost heave.

Snow accumulation must be considered when determining optimal fence heights.

Rodent-proof buildings and exteriors

Commensal rodents (rats and House Mice) often live year-round in buildings. Some wild rodent species, however, will invade buildings only in the fall as they search for winter nest sites. Plugging all access holes during careful summer inspections of these buildings proves highly effective in limiting those animals seeking fall access.

Physical abilities of rodents

Rats and mice are able to climb most rough, vertical surfaces, including wood, brick, and weathered sheet metal. These animals gnaw through a variety of materials, including lead and aluminum sheeting, wood, rubber, and hard plastic. Rats will not hesitate to dive through plumbing traps, and are capable of traveling considerable distances through sewer lines.

Results of rodent chewing cable

Rodent teeth curve slightly inward, making it difficult for them to gnaw on hard, flat surfaces. These animals will quickly exploit edges: rats will work to enlarge holes as small as 1 centimetre in diameter. Mice can slip through holes as small as 6 millimetres.

Preventing access

Rodents and birds enter buildings through drains, openings in ventilation systems, as well as holes around pipes and wiring. Small holes can be temporarily filled with packed steel wool, but permanent sealing is recommended using cement, 24-gauge (or heavier) sheet metal and 19-gauge hardware cloth (1.3-centimetre mesh for rats, 6.3-millimetre mesh for mice). Drains should be covered with fixed grates.

Rodents are able to crawl up the corrugations in some types of metal sheathing unless angle iron or metal flashing protects the bottom edges. House Sparrows will crawl into corrugations in sheet metal and nest within a wall, if the lower end is left open.

Suppliers

ElectroBraid™
Fencing
Website: www.electrobraid.com
Email: info@electrobraid.com
Toll Free: 1-888-430-3330

Geotek Inc.
Fencing
Website: www.geotekinc.com
Email: geosales@geotekinc.com
Toll Free: 1-800-533-1680

Margo Supplies Ltd.
Electric fencing
Website: www.wildlife-mgmt.com
Email: margo@wildlife-mgmt.com
Phone: 1-403-652-1932

Section G

Active Management Through Removal

Introduction

Removing wildlife from airports through the use of traps, poisons, and firearms is necessary and effective in certain circumstances; however, wildlife-control personnel should remember that animals are present at airports because of the availability of food, water, and shelter. The removal of individual animals—prior to eliminating these key attractants—may eliminate an immediate hazard but will not provide a long-term solution, as other animals will replace those that have been removed.

Wildlife removal may be effective in situations in which:

- the species involved is not mobile, and is unlikely to be replaced immediately;
- the species involved is of a solitary nature—high-density populations of this species are rare and unlikely to be found in areas surrounding airports;
- the immediate removal of a few animals is required—generally for short-term results;
- a large population of concealed animals (i.e., rodents) must be reduced; and the removal of a few animals by shooting enhances the effectiveness of non-lethal frightening tools such as pyrotechnics.

Rodents present a special case. Neither far ranging nor particularly mobile, rodents are also major attractants to such predators as foxes, Coyotes, and raptors—themselves hazardous species at airports. Rodent removal can be, therefore, highly effective in reducing the numbers of various problem species. Site-specific rodent problems should be professionally assessed prior to initiating large-scale lethal-control programs; the population dynamics of many species ensure that removed animals are replaced quickly.

The harsh nature of many removal programs requires sensitivity on the part of wildlife-control personnel. The integrity—and survival—of airport wildlife-management programs depend on the respectful treatment of all animals; in poisoning, shooting, and trapping, their suffering should be minimized.

When handling mammals, especially predators such as Coyotes and Raccoons, extreme caution must be exercised to protect against such animal-borne diseases as rabies. Wildlife-control personnel should be vaccinated, and wear heavy gloves at all times. If these measures cannot be followed, professional wildlife exterminators should be consulted.

Finally, wildlife is afforded various levels of protection under federal and provincial laws. While special permits and licenses are required to trap, shoot, and poison some species, endangered species have complete protection. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designates endangered and protected species in this country; their listings can be viewed at www.speciesatrisk.gc.ca/Species/English/SearchRequest.cfm.

Lethal Chemicals

Chemicals used to kill wildlife fall into three categories:

- acute toxins that kill after ingestion of a single lethal dose,
- anticoagulants and decalcifiers requiring the ingestion of several doses over a period of days, and
- fumigants that suffocate burrowing animals in the ground.

Poisons are generally confined to use on small animals, specifically rodents, because:

- bait placed in confined areas—including burrows—is not accessible by other animals,
- small amounts of poison treat large rodent populations at relatively low costs, and
- problems associated with rodent carcass disposal are minimized, as the carcasses are generally concealed in burrows, away from predators as well as the eyes of the public.

Occasionally, poisons are used against Coyotes, which sometimes damage electrical cables and pose strike hazards. Lethal chemicals are also registered for killing pigeons, House Sparrows, and starlings.

Safety
Knowledge of proper handling methods is critical to ensure the safety not only of the user, but also the environment and non-target species. All chemical pesticide product labels include safety precautions and instructions for use. These products should be used only as directed.

If not used properly, poisons may seep into soil and ground water. Poisoned animals may be consumed by predators; toxic carcasses could be eaten by scavengers, causing secondary poisoning. For these reasons, proper placement of poisons is critical, as is the removal of exposed dead animals.

All chemicals used in pest control—including those employed against wildlife—must be registered with the Pest Management Regulatory Agency of Health Canada, pursuant to the *Pest Control Products Act*. Registration applies to herbicides (weed control), insecticides (insect control), fungicides (mould and fungi control), as well as all animal and insect repellents—chemical and mechanical.

Registered chemicals undergo controlled testing to demonstrate their efficacy and safety. These tests determine:

- chemicals' toxicity,
- the qualifications required to handle chemical products,
- potential health hazards,
- possible adverse effects on food and drinking water, and
- overall environmental impact.

Federal pesticide regulations were implemented and enforced by Agriculture and Agri-Food Canada (Pesticides Directorate) until April 1, 1995. Federal regulation of pesticides was then transferred to the Pest Management Regulatory Agency of Health Canada, pursuant to the *Pest Control Products Act*. For further information on the *Pest Control Products Act*, telephone 1-800-267-6315 or visit the Health Canada website at www.hc-sc.gc.ca.

Provincial restrictions may be more stringent than those of the federal *Pest Control Products Act*, as each province also has the authority to restrict the use of chemical products. Furthermore, certain products registered for use by the federal government may not be available in some provinces.

Birds

Methods used to poison birds include poison perches, bait stations, and egg oiling, which suffocates developing bird embryos.

Ornitrol

Use/Description
Ornitrol affects the fertility of birds, ultimately reducing the size of local populations. In Canada, it is registered only for use on pigeons.

Application
The chemical is injected in corn baits. Pigeons should be pre-baited to ensure that as many birds as possible consume the chemical. The program should be carried out in early spring (March) and again in mid-summer (July).

Advantage
- Successful sterilization programs lower the overall local population of pigeons, reducing the need for other control methods.

Disadvantages
- Unless sterilization programs are carried out over wide areas, rapid re-population will occur.
- As female pigeons reproduce for five to 10 years, several years of treatment are necessary to effectively reduce pigeon numbers.

Effectiveness
In one study that compared Ornitrol's urban/rural effectiveness, reproduction was almost completely suppressed for three to seven months in rural pigeon populations. On the other hand, city numbers were reduced by only 10 percent, largely because untreated birds continually re-populated the area. For this reason, Ornitrol is unlikely to have substantial effects at airports, where large pigeon populations reside.

Although Ornitrol suppresses reproduction in blackbirds, it is an ineffective means of control at airports, as these birds flock from many breeding areas.

Permits required
As Ornitrol is a restricted chemical, only licensed pest-control officers may use this product.

Mammals

Rodenticides

Although marketed by several companies under a variety of names, only two acute-toxin rodenticide compounds are registered for use in Canada: strychnine and zinc phosphide. Both chemicals are restricted for use only by licensed pest-control operators. Mammals that ingest lethal doses of these chemicals usually die within a few hours.

The active ingredients in registered anticoagulant rodenticides include warfarin, diphacinone, chlorophacinone, brodifacoum and bromadiolone (often called bromone). These chemicals cause death through extensive internal bleeding. Rodents may not succumb for as long as 26 days after ingestion; most die within one to 10 days of initial poisonings. Many anticoagulant-rodenticides formulations can be purchased without a license.

The third group of rodenticides dissolves the calcium in mammals' bones, eventually causing heart failure. Cholecalciferol is the active chemical in these poisons.

These three groups of chemicals produce substantially different results. For example, although acute toxins—such as strychnine—may seem the most effective, their distinct tastes and fast action may deter substantial proportions of rodent populations from eating lethal amounts of bait. Surviving rodents then frequently become bait shy and cannot be controlled through the use of the same chemical.

First-generation anticoagulants (including warfarin, diphacinone, and chlorophacinone) have been in use since the late 1940s. They are much safer to use than acute toxins, due to their lower inherent toxicity. Further, an antidote is available in the event of accidental poisoning.

Persistent improper use of these first-generation anticoagulants can result in resistant rodent populations; directions should be followed closely.

More powerful second-generation anticoagulants came into use in the late 1970s. The active ingredient in these products is either brodifacoum or bromadiolone. For some species, particularly mice and voles, one feeding is sufficient to cause death. Resistance to second-generation anticoagulants is not widespread.

Application

Baits

Several factors should be considered when delivering rodenticide to target animals:

- palatability of the bait,
- placement of the bait so that target animals will find it,
- bait shyness or avoidance, and
- risks to non-target species.

Baits

Rodents have highly developed senses of taste and smell; both play a role in the acceptance of baits. Rodents finding unusual tasting or smelling bait are likely to feed sparingly on it or reject it. As a result, a less-than-lethal dose is consumed.

Rodents may reject baits under the following circumstances:

- The baits are mouldy.
- The fats or oils in the baits' formulations have become rancid.
- The baits have been stored in close proximity to herbicides, insecticides, fertilizers, and paint thinners and have taken on the flavours and odors of these volatile chemicals.
- The baits are contaminated by dust, bird droppings, or other foreign materials.
- The baits have aged and their moisture content has fallen below the level of fresh grains.
- The baits are insect-infested.
- Low- and high-quality baits have been mixed to save money; as a result, rodents reject the entire mixture.

Principles of bait acceptance and rejection

There are three general principles governing bait acceptance and rejection among rodents and other wildlife species:

- Animals must accept the taste and smell of the bait.
- As prey for a wide variety of animals, rodents are wary of anything new and potentially threatening, including food. This wariness is referred to as *neophobia*.
- Learned food aversions—including the avoidance of a particular food through association with discomfort or illness—is perhaps the most important factor governing bait acceptance and rejection. This principle provides the basis for

bait shyness. Learned food aversions can be acquired for a specific food after only one experience. These aversions are often strong and long-lasting.

Pre-baiting with non-toxic bait is recommended to overcome animals' natural wariness of unfamiliar bait, especially when acute toxins are to be used. This procedure conditions the rodents to accept the bait. While pre-bait should closely resemble the poisoned substance, compounds that mimic the taste of toxins are as yet unavailable. Even so, it is commonly accepted that pre-baiting increases the effectiveness of poisoning programs by establishing a momentum to consume, thereby reducing neophobia.

Pre-baiting is rarely necessary when using anticoagulants, since these products seldom induce food aversions.

Risks to non-target species

While there is comparatively little information on the secondary effects of acute poisons, most available research indicates that scavengers are unlikely to be seriously affected by eating the carcasses of rodents killed by anticoagulants.

Of greater concern—particularly in areas populated by endangered species—is the possibility that non-target species may eat bait that has been placed for rodents. Endangered species that may be attracted to grain baits include Plains Pocket Gophers, Black-tailed Prairie Dogs, Whitetail Jackrabbits, Whooping Cranes, and Greater Prairie Chickens. The best way to avoid poisoning non-target species—particularly birds—is through the use of enclosed bait stations, which also protect bait from inclement weather.

Slow-acting rodenticides – Anticoagulants

Uses

Anticoagulant rodenticides cause internal bleeding and kill such rodents as rats, mice, and ground squirrels.

Description

Several anticoagulant compounds are available. Products containing warfarin, diphacinone or chlorophacinone require multiple feedings to be effective. Products containing brodifacoum or bromadiolone often kill small rodents—such as mice and voles—through single feedings; two or more feedings are usually required to kill larger rodents.

Products containing cholecalciferol, which decalcifies rodents' bones, require more than one feeding. Although the toxic effect of cholecalciferol differs from anticoagulants, its application is identical.

These poisons can be purchased as pre-treated baits, or in bulk for on-site preparation. Pre-treated baits may be combined with grain, or formed into pellets or blocks in which the grain carrier is embedded in paraffin for protection from inclement weather.

Application

The general principles of poison bait use, discussed earlier in this section, should be followed when applying these particular poisons. Application techniques specific to larger mammals are discussed in succeeding pages.

Mice and Voles

The majority of airport rodent problems involve Deer and House Mice, as well as Meadow Voles. Deer Mice occasionally infest airport buildings in search of winter nesting sites, House Mice are more likely to infest airport buildings year-round.

Several studies have shown the active ingredients diphacinone, chlorophacinone and bromadiolone are all highly effective in controlling these and other rodents. All baits—including pellet baits, in which grain is embedded in a paraffin coating—should be broadcast only when dry weather is forecast for at least two days; even light rain will leach much of the active ingredient, and reduce its effectiveness. Use large numbers of small pellets containing low concentrations of the active ingredients.

Bait stations should be constructed of waxed paper tubes 12-centimetres long and 4-centimetres in diameter. Fasten the bait inside using edible glues. Bait stations must be checked every 48 hours, and restocked as necessary. Any grain bait can be used; however, Deer Mice prefer oats.

To reduce spilling and exposure to non-target species, and to protect bait from dust and moisture, use bait stations that feature only two openings, rather than open containers. Bait stations should be made of cardboard or plastic and feature openings on opposite sides, which allow rodents to see an escape route as they enter. Mouse-station openings should be 2.5 centimetres in diameter—rat stations, 6 centimetres. Bait stations should be placed along walls and known rodent travel routes, which can be detected by the presence of droppings.

Whether broadcasting bait or establishing bait stations, the following guidelines will help ensure successful outcomes:

- Place sufficient quantities of bait.
- Do not rush the process; allow as many rodents as possible to access the poison over time.
- Replenish bait on a regular basis.
- Place bait stations close together; mouse-bait stations should be spaced at 2-metre intervals. For rats, place stations within 7 to 10 metres of each other.
- Use palatable baits; rats will accept paraffin-treated blocks, while loose-grain and pellet baits are more palatable to mice.

Ground squirrels

Ground-squirrel control programs should be conducted in the spring—no less than two weeks after the first sightings of squirrels. Timing is critical, as baits are less effective once succulent new plant growth is available.

Since several feedings are necessary to control ground-squirrel populations, bait stations should be used. Several bait-station designs are available, including those constructed from discarded tires, which are cut in half and enclosed with wire.

Bait stations should be placed near runways, burrows and feeding areas, and spaced no more than 60-metres apart. Stations should also be checked and re-filled daily, as squirrels can recover from anticoagulants if more than 48 hours elapse between feedings. Mouldy and contaminated baits must be replaced.

Squirrels may require a few days to become accustomed to bait stations. Once the animals have begun eating, poisons may require at least a week to take effect. It is important, therefore, to ensure plentiful fresh bait remains available.

Some products provide anticoagulant baits in loose form. Where permitted by law, these baits may be scattered in the vicinity of squirrel burrows and replenished regularly. Ground squirrels do little feeding at their burrows, however, so baits should neither be placed in the burrows, nor piled at burrow entrances. Three to four alternate-day treatments are usually sufficient.

Although spring is the optimum time to bait, grain baits also will be readily taken in late summer. However by this time, populations may have greatly expanded.

Pocket gophers

Although chlorophacinone is available in Canada for use against pocket gophers, no Canadian information exists concerning its use and effects. Information supplied here is based on research completed in the United States.

Unlike ground squirrels, pocket gophers feed almost exclusively inside their burrows. The complexity of these burrow systems, however, make repeated baiting of underground tunnels difficult. Similarly, anticoagulants have proven ineffective in burrow applications, as moist soils tend to leach the active ingredient from bait.

Recent experiments, however, have shown that paraffin-treated bait blocks containing the active ingredient bromadiolone effectively control pocket gophers. In these experiments, 100 grams of cylindrical wheat baits were placed in burrows. Pocket gophers readily accepted the baits and frequently took them to their nests. In one case, a second pocket gopher, invading the burrow of a recently killed gopher, consumed the remainder of the bait and was also killed.

Several paraffin-treated baits should be placed in each burrow system. To ensure they can be easily manipulated by the animals, baits should weigh no more than 100 grams. Wildlife officers should note that pocket gophers will close any unwanted holes in their burrows, so openings made for bait placement should be carefully re-covered to prevent the animals from covering baits.

These experiments were conducted on a species of pocket gopher not found in Canada; however, the behaviour of Canadian species is similar.

Advantages

- Bait shyness is rare, since symptoms of poisoning occur well after bait ingestion.
- Many bait formulations are available.

Disadvantages

- Resistance may develop in populations repeatedly poisoned with the same active ingredient.
- Some baits may not be accepted.
- Repeated placement of baits may be necessary.

Effectiveness

These chemicals are highly effective when used properly.

Permits required
Consult Provincial regulations to determine whether permits are required for specific products.

Acute Rodenticides

Uses
Acute rodenticides kill all rodents, regardless of size.

Description
The active ingredients in these products are strychnine and zinc phosphide; both toxins are registered for killing rodents.

Application
For all species but gophers, application is similar to that of anticoagulants. Acute rodenticides are recommended for single annual applications and in outdoor situations only. Although only one baiting period is necessary, extensive pre-baiting with non-poisoned bait is highly recommended to overcome bait shyness.

Pocket gophers
For effective control of pocket gophers, toxic baits must be placed within burrow systems. Pocket-gopher burrows consist of a main burrow 30- to 45-centimetres underground, from which lateral burrows angle upward to the surface, ending in fan-shaped mounds of earth.

Baiting pocket gophers may be done either by hand or by using mechanical burrow builders. When baiting by hand, place baits at two or three locations throughout main burrow systems. Metal probes may be used to locate tunnels, which are then opened using shovels. Holes should be sealed completely after placing bait to prevent gophers from closing holes and—in the process—covering baits. Push-button bait dispensers—attached to hollow probes—serve as effective alternatives to shovels.

Burrow builders are drawn behind tractors, and automatically deliver bait to the tunnels they make. Spaced at intervals of up to 7.5 metres, artificial burrows should be constructed at the same depths as those of natural pocket-gopher tunnels. As these depths vary according to geographic area, local burrow measurements must be made. Tunnels should then be dug to intersect existing pocket-gopher burrows, allowing exploring gophers to find bait.

Advantage
- Only single baiting periods are required.

Disadvantages
- Bitter chemical tastes may prevent rodents from ingesting enough bait to cause death.
- Surviving rodents may experience bait shyness.
- The high level of toxicity in acute rodenticides, compared to anticoagulants, increases both handling hazards and likelihood of killing non-target animals.
- Purchase and application costs are high.
- Use of burrow builders is restricted by soil conditions. Good burrows will not be formed in dry soils; wet soils accumulate on packer wheels and, as a result, tunnels are closed improperly.

Effectiveness
These chemicals are effective when rodents take bait in sufficient quantities. Baits broadcast on grain lose approximately one-half their toxicity within one week.

Studies indicate the effectiveness of zinc phosphide and strychnine against pocket gophers depends on geographic location; presumably, this reflects variations in the susceptibility of pocket-gopher populations. Nonetheless, effective control using strychnine is thought to rely on bait concentrations of at least one percent.

Permits required
Strychnine is restricted under federal law. Zinc phosphide is not classified as a restricted chemical by Health Canada; however, several provinces have imposed their own conditions upon the chemical's use. Check with local authorities prior to use.

Tracking Powders

Uses
Tracking powders are used to kill rats and House Mice.

Description
Tracking powders combine zinc phosphide with inert ingredients. Rodents pick up the powder on their fur and then ingest the poison while grooming.

Application
Tracking powders are spread along rodent travel paths and placed in specially designed stations.

Advantage
- Tracking powders may be used on bait-shy rodents.

Disadvantages
- For indoor use only.
- Must be kept away from food storage and preparation areas.
- Airport personnel may come in contact with tracking powder.

Effectiveness
The dispersal of tracking powder is difficult to control, making the product an unattractive alternative to toxic baits.

Permits required
Structural Exterminator licenses are required by federal law. Provincial regulations vary. Check with government and local pest-control authorities.

Fumigants

Use
Fumigants kill rodents and moles in their burrows.

Description
Ignited cartridges or pellets reacting with soil moisture in burrows produce lethal gases.

Application
Rodents
Adequate gas must be generated to fill entire burrow systems. Therefore—to ensure thorough fumigation—all rodent entrance holes must be located. Between two and five entrance holes exist for most Groundhog burrows. Due to the size of these burrows, fumigant devices must be placed in each entrance, which may be as much as 15 metres apart.

Ground squirrel holes are much closer together. There may be as many as eight entrances to the burrows of Richardson's Ground Squirrels, the main problem species on the Prairies. Similarly, the Columbian Ground Squirrel—a problem

species in the Rocky Mountains—has as many as thirty-five entrance holes. Thanks to the relatively small size of their burrow systems, however, placing pellets or cartridges in two or three entrances usually proves sufficient.

Fumigation will not be effective unless rodents are in their burrows. As these animals are unlikely to be present in their holes during the day, night fumigations are most effective. Daytime fumigation can be done if the rodent is observed entering a burrow.

Pellets or lit cartridges should be placed—not thrown—as far down entrance holes as possible. Be sure to seal holes with sod after stuffing wadded newspaper into the entrances—this reduces the likelihood that pellets or cartridges will be accidentally covered. Sand or earth placed around the sod prevents gas from escaping. After sealing off the entrances, observe the surrounding areas for escaping smoke, and close off any holes or leaks.

Moles

Moles search for worms and insect larvae by swimming through soil near the surface. Moles live much deeper, however, and may not be accessible through surface feeding tunnels. Attempts to kill moles are rarely successful when fumigants are placed in the mounds of soil that result from feeding activity.

Advantages

- Animals die in their burrows, making carcass recovery unnecessary.
- Unlike other lethal baits, fumigants are effective against Groundhogs.

Disadvantage

- Locating holes and active feeding tunnels is time-consuming and labour-intensive.

Effectiveness

Fumigants are effective in the control of Groundhogs; however, given the difficulty locating all entrances to burrow systems, trapping may be a better alternative. Against ground squirrels, poisoning is more effective and less labour-intensive than fumigants. For moles, fumigation is the only chemical control method available. Its effectiveness is low, therefore fumigation is not recommended.

In the case of all species, fumigation is most effective when soil moisture is high.

Permits required
Requirements vary according to product type. Fumigant cartridges may be purchased by anyone. Calcium cyanide use is restricted in some provinces.

Coyote Fumigants

Use
Fumigants are used to kill Coyotes inside their dens.

Description
Gas cartridges—containing 65-percent sodium nitrate and 35-percent charcoal—produce carbon monoxide, carbon dioxide, and other nitrous gases when ignited.

Application
Fumigants should be used only during periods in which Coyotes are in their dens with pups—usually from late March to late June. At other times, trapping is the preferred control method. Den activity may be measured through the presence of tracks, by listening for sounds from within dens, and by observing pups lounging outside den entrances.

Advantages
- Fumigants kill all Coyotes inside dens.
- Fumigation is less labour-intensive than trapping.

Disadvantages
- Fumigation is only useful when Coyotes are inside their dens with pups.
- Public education and awareness programs may be required to ensure the public is properly informed.

Effectiveness
As noted above, fumigation is only effective against Coyotes from late March until late June—when the animals are in their dens.

Permits required
Structural Exterminator licenses are required under federal regulations. Check with Provincial authorities to ensure no additional regulations exist.

Additional acute poisons for other wildlife

Although rodenticides form the largest group of lethal control chemicals registered for use in Canada, two other acutely toxic compounds are registered for use against Coyotes: sodium monofluoroacetate (compound 1080) and strychnine, which is also used to control pigeons and pocket gophers.

Application

Strychnine for pigeons

Effective control programs using strychnine must include pre-baiting using non-toxic bait that is identical to the strychnine carrier. Pre-baiting not only ensures pigeons become familiar with the feed, the process also establishes feeding locations—rooftops, for example—that protects non-target species and the public from exposure to baited poisons.

The length of time required for pre-baiting depends on pigeons' responses. If pigeons are bait shy as a result of previous exposure to strychnine, three to four months of pre-baiting may be necessary. Longer periods may also be required to move pigeons to preferred control areas.

Poisoned bait can be introduced once pigeons are accustomed to feeding in control areas. Both pre-bait and poisoned bait should be placed in 100-gram piles no more than two-metres apart.

Sodium monofluoroacetate or strychnine for Coyotes

Sodium monofluoroacetate or strychnine is mixed with meat baits and placed in locations frequented by Coyotes.

Advantage

- These highly toxic compounds quickly kill any animal ingesting baits.

Disadvantages

- These compounds are as dangerous to humans as they are to animals.
- Carcasses must be located and removed immediately.

Effectiveness

Control programs using these chemicals are sometimes highly effective.

Permits required

Use of these chemicals is restricted to licensed personnel only. Furthermore, use of sodium monofluoroacetate is subject to approval of Provincial wildlife authorities, who also control its distribution.

Lethal Chemical Suppliers

Abell Pest Control
Chemical control methods
Website: www.abellgroup.com
Phone: 1-416-675-1635

Gardex Chemicals
Fumigants, tracking powder, rodenticides, Avitrol and perches
Website: www.gardexinc.com
Email: sales@gardexinc.com
Toll-Free: 1-800-561-7302

Liphatech
Rodent control
Website: www.liphatech.com
Toll-Free: 1-800-558-1003

PMC Specialties Group
Chemical control methods
Website: www.pmcsg.com
Phone: 1-513-242-3300

United States Department of Agriculture
Equipment for use with rodenticides and fumigants
Pocatello Supply Depot
Website: www.aphis.usda.gov
Email: APHIS.Web@usda.gov

Traps

Two types of traps are available: kill and live traps. Kill traps dispatch animals quickly and efficiently. Live traps may simply restrain animals; complex live-trap devices include those in which animals are captured and then killed through such secondary means as drowning. Live traps are often employed to capture and transport wildlife to release areas away from airport lands. As this method is time-consuming and costly, it is used mainly for protected and high-profile species.

When using traps, careful handling is critical. Trap placements must be logged and mapped to ensure people frequenting the areas know where the devices are located. Trap locations should also ensure that the capture of non-target species are minimized. Check traps at least daily to minimize the suffering of snared animals, and to prevent scavengers from feeding on carcasses.

As effective trap use requires some knowledge of animal behaviour, airport personnel who are considering trapping programs should consult professional trappers and pest-control agents. Airport personnel must also determine which species are protected from trapping, and obtain any required permits.

Kill trapping
Kill traps are generally used on small animals. Although not strong enough to dispatch larger animals, these traps can still be dangerous when handled improperly.

Airport personnel may trap rats, mice, moles, Groundhogs, and pocket gophers after consulting with knowledgeable authorities. Larger animals—such as Beavers, Muskrats, foxes, Coyotes, and deer—should be left to experienced trappers.

Live trapping
Live traps range from simple restraining snares and leg-hold devices to box and barrel traps used to trap various sizes of animals, from sparrows to bears. Live traps should be frequently checked to minimize the discomfort of trapped animals. Airport personnel should consult reference guides and knowledgeable authorities to learn proper methods for setting and baiting traps.

Live trap – birds

Live trap – mammals

Birds

Live traps, as well as raptor traps, are used to capture birds that are then either killed or transported to pre-approved release areas away from airports. Time consuming and costly, live trapping is often employed against protected and high-profile species that are relocated from the airport.

Live traps

Use

Live traps are used to capture sedentary birds such as pigeons and House Sparrows. Other birds—such as starlings, blackbirds, and crows—may also be captured; however, trapping these species is often not an effective method for lowering their population numbers.

Description

A wide variety of traps are commercially available, including traps that use decoy birds and devices that catch several birds at once.

Application

Pigeons

Pigeons are easily trapped where they feed. Pigeon traps should be left open and baited for two or three days before being set. Decoy birds improve the effectiveness of pigeon traps. Pigeons are not easily trapped at their night-roosting sites.

House Sparrow

House Sparrows are readily trapped when bait areas are established prior to placing traps. When placing traps, the baited areas should surround the traps. Allowing some trapped sparrows to remain in the baiting area will cause other sparrows to respond to the distress calls.

Advantages

- Live trapping of pigeons and House Sparrows is the preferable control method in airport public areas.
- Live trapping has proven to be the only effective way to remove House Sparrows.

Disadvantages

- Live trapping is labour-intensive.
- Traps must be checked at least once daily to remove birds and replace baits.
- Birds must be dispatched or moved to release areas.
- It is unlikely that all problem birds will be captured through live-trapping programs. Furthermore, unless the attractants are removed, captured and released birds may return.

Effectiveness

Live traps are effective for capturing sparrows and pigeons. To trap sparrows, trigger devices—as well as those that deposit birds into a holding chamber when sprung—are more effective than funnel traps.

Permits required

None

Raptor Traps

Use

Used to capture hawks, falcons, and owls for release away from airport lands.

Description

Raptor traps are difficult to obtain commercially; however, plans are available from the *Journal of Wildlife Management*, issue 35:832-835.

Application

Set traps in open locations and either stake or weight down the bait cages to stabilize them against winds. Place one or two prey animals (pigeons, House

Sparrows, or mice) in each bait cage. Provide food and water for the bait animals. Traps must be checked at least twice a day; trapped raptors must be moved immediately to holding facilities or directly to release locations.

Raptor-trapping programs should be undertaken only following consultation with wildlife officials or others with experience handling these birds.

Raptor trap

Advantages

- As permits to kill these birds are rarely granted, live trapping may be the only way to reduce raptor numbers at airports.
- Raptors can be trapped without harm.

Disadvantages

- Facilities must be provided in which to house these birds prior to their transfer to release sites.
- To reduce the chance that raptors may return to airports, release sites must be at least 30 kilometres distant.

Effectiveness

Trapping is often ineffective as long as food and other attractants remain plentiful at airports. Many adult birds simply return, even if they are released at considerable distances. When trapped birds do not return, their removal often allows less-experienced and therefore more hazardous birds of the same species to move onto airport lands.

Trapping is most effective in winter, when raptors tend to be sedentary. In summer, few raptors are present at airports unless they are nesting in the immediate area. In spring and fall, many raptors are migrating and, if removed, are replaced at airports by other birds.

Permits required

Permits from Provincial authorities are required to trap raptors.

Goshawk Perch Trap

Often used by wildlife-control officers to capture raptors, goshawk perch traps are made of two pieces of wood that are hinged together. A spring mechanism made of elastic shock cords is used to pull in the sides. Attached to poles, the

trap jaws close to capture birds. Although well-padded, these traps often injure birds. A variation is the Swedish goshawk trap, which closes over raptors when sprung.

Swedish Goshawk Trap
A variation of the goshawk perch trap, the Swedish goshawk trap consists of a trigger mechanism enclosed in a large, open "A" frame and mounted on a bait cage. Pigeons, starlings, rats, and mice serve as decent lures. A bird dropping into the trap will activate the trap to close and snare the bird safely.

Bal-chatri Trap
This small and modifiable trap is comprised of 1-inch chicken wire formed into a cage and numerous small nylon nooses attached to the wire. Bait is placed in the cage, and the nylon nooses entangle the birds' feet upon landing on the cage. The trap should be attached to a nearby branch or bush to prevent the bird from dragging the trap too far.

Sliding Padded-Pole Trap
A padded leg-hold trap is placed at the top of 5- to 10-foot poles where the bird would perch. The jaws of the trap must be well-padded to prevent injury, and 12-gauge steel wire should be attached to the trap chain ring and the bottom of the post to allow the trap to slide to the ground and the bird to rest.

Mammals

Live Traps

Use
Live traps are used to capture mammals as large as deer, bear, Raccoons, and feral dogs.

Description
Most live traps are made of galvanized wire, and are open at one or both ends. A trigger is tripped when mammals enter these traps, closing the door. Traps used to capture deer and bear are more specialized.

Live mammal traps

Application

Traps are set near dens, in travel paths and at feeding areas of target mammals. Pre-baiting with traps that are fixed open increases the probability of capture. Trap manufacturers provide bait suggestions for several species.

Trapped mammals should be removed to release areas at least 15 kilometres from airports. When releasing mammals, traps should be opened from a distance using a long piece of twine; this protects the handler and minimizes stress upon the animal.

Although capturing most mammal species is straightforward, skunks pose obvious problems. To minimize the likelihood of spraying, place a tarpaulin or other cover over traps to provide a dark and secure environment for skunks. Once caught, skunks usually do not spray as long as traps are handled gently.

Following each use—and the capture of all animals—traps should be steam cleaned to remove scents and odours.

Advantage

- Protected and high-profile problem mammal species may be captured and removed alive.

Disadvantages

- Live trapping is labour-intensive and highly inefficient in removing large numbers of mammals.
- Building or buying large numbers of traps is expensive.
- Live trapping often requires the expertise of trained personnel.

Effectiveness

As live trapping is too labour-intensive for use in the removal of abundant species, the technique is best applied for the removal of individual problem animals from airports.

Permits required

Provincial wildlife authorities may require permits to live-trap fur-bearing species, including Beavers, Muskrats, and foxes.

When bears roam onto airfield properties, Provincial wildlife-control personnel should be called upon to capture the animals through live trapping or controlled hunting. Grizzly Bears have been assigned a special status by the Committee on

the Status of Endangered Wildlife in Canada and cannot be killed without formal hunting protocols.

Live Trapping – Deer

Use

Live traps are used to capture deer for relocation elsewhere.

Application

There are two main types of deer traps: corral traps and box traps. Traps should be placed near perimeter fencing and baited, as deer generally follow fence-lines once inside airport grounds. When bait is taken, doors are triggered shut, trapping the deer inside. Deer are then tranquilized and relocated off airport lands. Professional wildlife-control officers should be called upon to assist in these live-trap programs.

Advantage

- Deer can be removed alive from airport lands.

Disadvantages

- The effectiveness of live traps declines in summer and fall as natural food sources become more abundant.
- Qualified wildlife-control officers are required to trap and relocate deer.
- Despite the non-lethal intent of this procedure, deer often die due to the stress of capture and relocation.
- Sites suitable for deer relocation are often limited near urban airport settings.

Effectiveness

Deer traps are most effective in winter and spring, when natural food is scarce and baits are attractive. The effectiveness of these traps, however, decreases in summer and fall when natural food sources become readily available.

Drive-netting

Use

Used to capture deer located inside airport fences for relocation elsewhere.

Application

Deer are directed into portable nets that are extended from vehicles and raised by hand. When herding deer, people are positioned to block potential exit routes. Once captured, the animal's feet are tied and their eyes blindfolded, subduing them until they reach relocation areas. At night, lights improve the effectiveness of drive-netting, allowing personnel to direct the deer into the traps.

Advantages

- Effective when relocating several deer.
- Deer can be removed alive from airport lands.

Disadvantages

- Drive-netting is an extremely labour-intensive live-capture technique; many trained wildlife-control personnel are required.
- Despite the non-lethal intent of this procedure, deer often die due to the stress of capture and relocation.
- Sites suitable for deer relocation are often limited near urban airport settings.

Effectiveness

Drive-netting is effective in winter when deer are easily located by tracking and when their movements are somewhat restricted by snow.

Permits required

Permits issued by Provincial natural-resource ministries are required before airports can implement any deer control program involving lethal or non-lethal trapping. All control programs involving firearms must be undertaken by licensed specialists. Federal law strictly regulates the acquisition and use of firearms. For information regarding the requirements under federal law, contact the Canadian Firearms Centre at 1-800-731-4000 or www.canadianfirearms.com.

Rat and Mouse Traps

Use

Used to kill rats and mice. Standard snap-traps kill rodents individually; more elaborate multiple traps can kill up to 30 mice.

Application

Snap traps

Snap traps should be placed on rodent travel paths—usually along walls or at the edges of open areas—with triggers set against walls. When using double-traps, set them side-by-side with their triggers against the wall, or end-to-end with their triggers facing out. Mousetraps should be placed no further than 1.8 metres apart. As rats travel more widely, their traps may be spaced at greater distances.

Mouse traps

Effective snap-trap baits include bacon, nutmeats, peanut butter, and marshmallows. When mice are nesting in fall, cotton balls also serve as effective bait.

More wary than mice, rats initially should be allowed to take bait from unset traps to reduce trap shyness.

Multiple-capture traps

Several varieties of mechanical traps—which catch up to 30 mice at one setting—are available. Some multiple-capture traps attract mice to large bait reservoirs, while other devices merely take advantage of the tendency of mice to enter small dark holes. These traps should be set in areas of greatest mouse activity; the trap entry hole should be placed near the wall. Traps should be checked frequently. Drown live mice by emptying them into buckets of water.

Advantage

- Carcasses are readily found and removed.

Disadvantage

- Trapping is labour-intensive.

Effectiveness
Traps are effective when used properly.

Permits required
None

Mole Traps

Use
Mole traps are used to kill moles while they feed in surface tunnels.

Description
Mole traps are simple spring-operated traps that either impale or crush moles.

Application
Moles feed on worms and insect larvae by swimming through soils near the surface. The actual living area of the mole, however, is deeper in the soil and consists of one or more enlarged burrows. Relatively straight connecting tunnels link these burrows to feeding areas. As feeding tunnels may be used only once, traps should be placed in connecting tunnels near areas where fresh digging is evident.

For traps that crush moles, dig out portions of tunnels and insert traps, packing soil firmly under the traps' trigger pans.

For traps that impale moles, dig out the tunnels and pack soil firmly where trap triggers rest. Raise the traps' springs, set safety catches and push supporting stakes into the ground on either side of the tunnels. Trigger pans should just touch the packed earth replaced in tunnels. Releasing the safety catches allows springs to force traps' spikes into the ground. This ensures that the spikes penetrate the tunnel when traps are sprung.

Set both types of traps to spring easily. Do not disturb any other part of the tunnel system. Moles spring traps by heaving soil up in an attempt to re-open tunnels.

Effectiveness
Although labour-intensive, trapping is the most effective way to reduce mole populations.

Permits required
None

Pocket-gopher Traps

Use
Used to kill pocket gophers.

Description
There are two types of pocket-gopher traps: metal-jawed traps that act as modified snap-traps, and box traps that snare pocket gophers.

Application
Pocket-gopher traps must be placed in gophers' burrow systems. These systems consist of main burrows 10 to 45 centimetres below the surface, and lateral burrows that angle upward to the surface, ending in fan-shaped mounds.

In lateral burrows, set one trap with the trigger facing down. In main burrows, set two traps end-to-end with triggers facing out. In both cases, anchor traps at the surface with wire and stakes.

Seeking to keep their tunnels closed off from the surface, gophers are attracted to traps by incoming air. Holes above box traps should be closed enough to make tunnels dark, while still allowing air to enter through the trap's shielded vent. Experimentation may be required with jawed traps to determine whether or not the hole can be covered.

Advantage
- Trapping is the only non-chemical method available to reduce pocket-gopher populations.

Disadvantages
- Trapping is labour-intensive.
- Unless the population is small, trapping is unlikely to be effective.

Effectiveness
The effectiveness of pocket-gopher trapping varies according to geography and time of year and, as a general rule, is too labour-intensive to be an effective means of control. In dealing with small, localized populations, however—and following poisoning programs—this method can be beneficial.

Permits required
None

Fur-bearing Animal Traps

Use/Description

Leg-hold, conibear, snare, and other specialized traps are useful in capturing and killing medium-sized fur-bearing animals, such as Muskrats, Beavers, and foxes. As alternatives to leg-hold traps, several recently developed models trap and kill animals immediately.

Application

Successful trapping of fur-bearing animals requires both knowledge of the behaviour of target species and skill in trap placement. Accordingly, professional trappers should be contracted to deal with most fur-bearing animals at airports.

Groundhogs, however, are easily caught by placing traps at the main entrance of active burrows. As Groundhogs are more likely to see and avoid traps when they are entering their burrows, traps should be set at night or, in hot weather, during the middle of the day, when the animals are underground.

Advantage

- Traps are useful for removing animals that cannot be poisoned—such as Groundhogs, Muskrats, and Beavers—or against animals that airport personnel may be prohibited from poisoning, such as foxes and Coyotes.

Disadvantage

- Trapping fur-bearing animals requires the skill of professional trappers.

Effectiveness

Trapping is effective when traps are set properly.

Permits required

Permits issued by Provincial ministries of natural resources are required to trap fur-bearing animals.

Glue Boards

Use

Glue boards are used to trap and kill rodents inside airport buildings.

Description

Glue boards are trays containing sticky substances that adhere to rodents' feet and fur when the animals step on these boards. Rodents trapped by glue boards will frequently suffocate after burying their noses in glue. Nevertheless, glue boards should be checked frequently to ensure that rodents do not die lingering deaths due to starvation.

Application

Glue boards should be placed flush against walls or along rodent travel paths.

Boards for mice should be at least 10 centimetres long with glue 2 to 3 millimetres thick; these measurements should be doubled for rat boards. Glue boards are ineffective in extreme temperatures—below 2°C or above 49°C.

Although available commercially, glue boards may also be prepared on site using bulk glue and convenient materials such as plywood, floor tiles, and paper plates.

Pipe versions of these traps are also effective. For mice, use 30-centimetre lengths of 30- to 50-millimetre diameter PVC pipe. For rats, use 75-millimetre diameter PVC pipe. Spread glue on heavy paper and insert it in the pipe. Glue handling is made easier by keeping a thin film of soapsuds on both hands and tools.

Use covers to keep glue boards free of dust, grease, and water. Although glue odour does not repel rodents, offensive odours can be absorbed from nearby solvents or pesticides. Glue boards made of non-absorbent materials such as plastic are recommended.

Advantages

- Unlike poison, glue boards may be used in food-preparation areas.
- Location and disposal of rodent carcasses is straightforward.

Disadvantages

- Temperature and dampness can reduce the effectiveness of glue boards.
- Rodents caught on glue boards may die slowly after considerable struggle.

Permits required

Provincial authorities should be consulted prior to using glue boards.

Trap Manufacturers and Distributors

Animal Management Inc.
Website: www.animalmanagement.com
Email: ami@animalmanagement.com
Toll-Free: 1-888-744-8173

Bert 'Ram' Trap Ltd.
Phone: 1-204-842-5189
Fax: 1-204-842-3287

LeBaron Outdoor Products Ltd.
Website: www.lebaron.ca
Email: info@lebaron.ca

Margo Supplies Ltd.
Website: www.wildlife-mgmt.com
Email: margo@wildlife-mgmt.com
Phone: 1-403-652-1932

Reed Joseph International
Website: www.reedjoseph.com
Email: sales@reedjoseph.com
Toll-Free: 1-800-647-5554

Tomahawk Live Trap Company
Website: www.livetrap.com
Email: trapem@livetrap.com

Live-ammunition Shooting

Firearms are heavily restricted, and should be used only after all other control methods have failed, or in cases in which immediate removal of persistent animals is required. If firearms must be used, education programs should be instituted to raise public awareness.

Although limited in their application, shotguns act in support of scare and dispersal tactics. With flocking birds such as gulls, for instance, the occasional shooting of one bird may be needed to illustrate the significance of loud, sharp noises to the rest of the flock.

In removing large and particularly dangerous animals, firearms are required to deliver immobilizing drugs. This technique is particularly useful for removing problem bears, which are usually first snared or caught in culvert traps.

When using firearms, empty casings should always be recovered; they can cause serious damage when ingested into turbine aircraft engines.

Effectiveness

For maximum effectiveness and safety, integrated control programs involving firearms require close cooperation among airport staff and skilled field biologists experienced with guns.

Due to their short lethal range, shotguns are preferred over rifles. Shotgun volleys are also less likely to ricochet off flat surfaces such as runways.

Permits required

Airport personnel must receive special permits to kill such persistent and highly hazardous species as gulls and starlings; many other birds are protected by federal and provincial law.

All control programs involving firearms must be undertaken by licensed specialists. Federal law strictly regulates the acquisition and use of firearms. For information regarding requirements under federal law, contact the Canadian Firearms Centre at 1-800-731-4000 or www.canadianfirearms.com.

Surfactant Water Sprays

Use

Used to kill birds or disperse them from roosts.

Description

Surfactants, such as PA-14, are added to water as it is sprayed at roosting sites. The surfactants allow water to penetrate bird feathers. Once the birds become wet, their body temperatures drop and, in cold weather, they are likely to die of hypothermia. Studies indicate water mixed with PA-14 has been successful in the control of both blackbirds and starlings. Spraying is typically done at night when birds are roosting.

Advantages

- The water-spray method is inexpensive, requiring minimal labour and maintenance.
- Surfactants are non-toxic.
- Spray can be directed at specific problem areas.

Disadvantage

- Despite the benefits noted above, water spraying is a more complicated bird-dispersal method than pyrotechnics.

Effectiveness

LGL Ltd. recommends water spray with or without surfactants for lethal control or dispersal of birds, particularly in cold temperatures.

Wildlife-control Products Manufacturers and Distributors

Bert 'Ram' Trap Ltd.
Phone: 1-204-842-5189
Fax: 1-204-842-3287

Margo Supplies Ltd.
Website: www.wildlife-mgmt.com
Email: margo@wildlife-mgmt.com
Phone: 1-403-652-1932

Bird X Inc.
Website: www.bird-x.com
Email: birdcontrol@nixalite.com
Toll-Free: 1-800-662-5021

Nixalite of America
Website: www.nixalite.com
Email: birdcontrol@nixalite.com
Toll-Free: 1-800-624-1189

PBI Gordon Corp.
Website: pbigordon.com
Toll-Free: 1-800-821-7925

Avian Systems Corp.
Website: www.aviansystems.com
Toll-Free: 1-888-828-9318

Phoenix Agritech- Phoenix Wailer
Website:
www.fox.nstn.ca/~phoenix/phoenix/html
Email: phoenix@fox.nstn.ca

Reed Joseph International
Website: www.reedjoseph.com
Email: sales@reedjoseph.com
Toll-Free: 1-800-647-5554

Stoneco
Website: theshellcracker.com
Email: c-stoney61@hotmail.com
Toll-Free: 1-800-833-2264

Wildlife Control Technology
Website: www.wildlife-control.com
Email: wct@wildlife-control.com
Toll-Free: 1-800-235-0262

Trillium Windmills Inc.
Website: www.trilliumwindmills.com
Email:
go4wind@trilliumwindmills.com

Weitech Electronic Pest Control
Website: www.weitech.com
Email: info@weitech.com
Toll-Free: 1-800-343-2659

Flock Fighters Chemical Bird Aversion
Website: www.flockfighters.com
Email: sales@flockfighters.com

Becker Underwood
ReJeX-iT
Website: www.bucolor.com
Email: request@bucolor.com
Toll-Free: 1-800-232-5907

Canadian Sani-Corp
Email: rspanier@csccanada.com
Phone: 1-604-985-7141

Abell Pest Control
Website: www.abellgroup.com
Phone: 1-416-675-1635

PMC Specialties Group
Chemical
Website: www.pmcsg.com
Phone: 1-513-242-3300

Liphatech
Rodent control
Website: www.liphatech.com
Toll-Free: 1-800-558-1003

The Current Corporation
Night vision products
Website: www.currentcorp.com
Email: dhoughto@currentcorp.com

T.C. Management
Falconry
Email: Falconry@Highlands.com
Phone: 1-914-295-5002

Bird Control International Inc.
Falconry
Phone: 1-519-853-1771

Falcon Environmental
Website:
www.falconenvironmental.com
Email:
info@falconenvironmental.com

Reed Joseph International
Website: www.reedjoseph.com
Email: sales@reedjoseph.com
Toll-Free: 1-800-647-5554

Scarecrow Bio-Acoustic Systems
Website:
www.scarecrowbio-acoustic.co.uk
Email:
sales@scarecrowbio-acoustic.co.uk

Bird Barrier
Website: www.birdbarrier.com
Email: jackwagner@birdbarrier.com
Toll-Free: 1-800-503-5444
or 1-800-662-4737

Wildlife Control Technology
Bird Balls™
Website: www.wildlife-control.com
Email: wct@wildlife-control.com
Toll-Free: 1-800-235-0262

Electro-Braid Fencing
Website: www.electrobraid.com
Email: info@electrobraid.com
Toll-Free: 1-888-430-3330

Geotek Inc.
Website: www.geotekinc.com
Email: geosales@geotekinc.com
Toll-Free: 1-800-533-1680

Tomahawk Live Trap Company
Website: www.livetrap.com
Email: trapem@livetrap.com

Animal Management Inc.
Website:
www.animalmanagement.com
Email: ami@animalmanagement.com
Toll-Free: 1-888-744-8173

LeBaron Outdoor Products Ltd.
Website: www.lebaron.ca
Email: info@lebaron.ca

Borror Laboratory of Bioacoustics
Website: blb.biosci.ohio-state.edu
Email:
borrorlab@postbox.acs.ohio-state.edu

Cornell Lab of Ornithology
Website: www.birds.cornell.edu/BRP/
Phone: 1-607-254-2408

Integrated Control Methods — Birds Profiles

Effective control of birds at airports can only be achieved once existing species have been identified. Bird-identification skills, therefore, should be developed among wildlife-control personnel. Appropriate control measures—such as modifications to bird habitats—can then be implemented.

Most birds can be identified by specific behavioural characteristics or unique physical markings, including:

Size	Season and time of day	Voice
Shape	Geographic distribution	Feet
Colour and pattern	Group size	Bills and beaks
Habitat	Flight pattern	Habits

Observing both the bills and feet is particularly important when examining bird remains. Bills provide information concerning the feeding habits of birds, while feet give evidence of habitats. Understanding feeding habits and habitat preferences helps wildlife-management personnel understand what has attracted specific birds to airports.

Bird-identification techniques

Field guides

Providing pictures, range maps, and written descriptions of birds, field guides are invaluable tools in bird identification. A number of excellent field guides to North American birds are available. The three commonly used guides in Canada are *The Golden Guide*, *The Peterson Guide*, and *The National Geographic Society Birds of North America*. Each book groups birds into families based upon such physical and behavioural characteristics as beak and body shape, and food and habitat preferences.

A basic profile of various problem bird species is provided later in this section; additional resources are listed in Section K.

Bird-remains identification

The remains of birds involved in aircraft strikes are often difficult to identify, especially when they have been ingested by jet engines. Identification in these circumstances relies on a number of techniques, usually associated with the identification of feather remains. Feather identification is not only an important tool in wildlife control, it is also a useful aid to manufacturers who apply the

knowledge acquired through the various techniques in the design and modification of aircraft engines, windshields, and airframes.

Pursuant to an agreement with the United States Air Force and the Smithsonian Institution, Canadian airports receive feather-identification services free of charge. To identify birds involved in Canadian bird-strikes, airport personnel are advised to seal any feathers in a plastic bag and send them to:

Carla Dove
Smithsonian Institution, Division of Birds
NHB E-605, MRC 166
Washington, DC
USA 20560

A detailed description of the Smithsonian Institution Feather Identification Program is contained in the April 2001 issue of *Flying Safety*, which is available on-line at http://safety.kirtland.af.mil/magazine/htdocs/aprmag01/menu.htm. The Aerodrome Safety Information Circular describing the feather identification process is available online at: http://tcinfo/aviation/aerodrme/circulars/english/97_001i_e.htm.

Ranking the hazard levels of birds and other wildlife

Although all birds and mammals are potential hazards at airports, each species poses a different level of risk. Wildlife-management programs are most effective when they take into account the comparative risks posed by problem species. For instance, control priorities are generally established according to the risk of collision—and the impact damage-potential—posed by particular species. Ranking these species assists authorities in determining their wildlife-control priorities and assigning resources to combat problem species.

A ranking of hazardous species in Canada (see Figure H.1 and H.2) has been adapted from the work of Dr. Richard Dolbeer, who conducted similar work in the United States. Dr. Dolbeer's system ranks species' risks according to three factors:

- percentage of strikes causing damage,
- percentage of strikes causing major damage, and
- percentage of strikes causing effect-on-flight.

Using this method, each species found at Canadian airports is scored according to an ascending hazard scale between one and twenty-one. For example, due

to their large body mass and flocking behaviour, Canada Geese pose greater threat to aircraft safety—and therefore receive a higher score—than swallows. As a result, wildlife-control authorities understand that if flocks of geese and swallows are present at the airport, they should give priority to countering the presence of the geese.

H.1 Ranking the Hazard Level of Candian Bird Species 1993-1999

Species	Number of Incidents	Rank
Geese (all species)	138	1
Gulls(all species)	1604	2
Hawks (buteos)	175	3
Ducks (all species)	150	4
Owls (all species)	76	5
Rock Dove	53	6
Eagles (Bald & Golden)	30	7
Sandhill Crane	17	8
Sparrows/ Snow Bunting	623	9
Shorebirds	155	10
Blackbirds/Starlings	407	11
Crows/Ravens	139	12
Swallows	309	13
Mourning Dove	65	14
Herons (all species)	9	15
Vultures (turkey)	3	16
American Kestrel	20	17

Adapted from: Dolbeer, Richard et al. Ranking Wildlife Hazards to Aviation. January 1999. (unpublished)

H.2 Ranking the Hazard Level of Canadian Mammal Species 1993-2000

Species	Number of Incidents	Rank
Deer	43	1
Coyote	78	2

Weather

Weather conditions affect both bird movement and behaviour. The short-term forecasting of bird movements can benefit from information available at meteorological offices. Keep in mind, however, that bird behaviour is influenced by weather not only near airports, but also by conditions tens or hundreds of kilometres away. For example, migratory waterfowl will stage in northern regions of Canada. When a cold front passes through, these birds will ride the winds aloft that follow the passage of the front, thereby conserving energy required in the flight south. By tracking cold front conditions in the fall, therefore, airport operators to the south can often predict when waves of migratory waterfowl will enter their areas.

Wind

Three wind factors affect bird movement and behaviour:

Wind-chill: Birds expend a great deal of energy maintaining normal body temperatures in cold weather. To avoid winter winds, therefore, birds move to the shelter provided by airport buildings.

Wind direction: As previously described, birds often preserve energy by delaying migration until winds are blowing in the direction of their flight. Determining wind direction can be helpful in predicting the numbers of birds on airfields and along proposed air routes.

Wind speed: As a rule, wind speed is greater at high altitudes as opposed to low altitudes, where friction caused by the ground decreases wind speed. As a result, birds flying at lower altitudes take more time to travel given distances when facing strong head winds—thereby increasing their time in the air and the likelihood of strikes.

Temperature

Temperature plays a significant role—especially as it affects bird migration patterns—in determining the food sources available to birds. Seed-eating birds, for instance, will migrate earlier when faced with a shortage of food, and gulls will vacate an area when surface water freezes.

Although many birds feed on airfield grass areas, only birds with particularly strong beaks can penetrate the baked and frozen grounds that result from extreme hot and cold conditions. High temperatures also drive insects deeper below ground, further decreasing food availability.

Extreme heat also creates unique meteorological effects, such as thermals. These rapidly rising currents of heated air are sometimes over 1000 metres in height; birds—especially raptors—harness these thermals to quickly gain altitude. As they often occur over the open asphalt found at airports, thermals contribute to a heightened risk of strikes between birds and aircraft.

Visibility

In poor visibility—in mist and fog, for instance—birds are reluctant to leave familiar surroundings. Bird dispersal under these conditions can therefore be difficult. It should be noted, however, strikes are less likely in these conditions, as bird movements are minimal. Obviously, any birds attempting to rest on runway surfaces during these conditions must be dispersed.

Rainfall

An obvious hazard to aircraft flight, rain also poses the following indirect hazards:

- In wet weather, invertebrate animals—such as worms—rise to the surface and provide an attractive food supply for insectivorous bird species.
- After rainfall, birds may be drawn to the driest areas, which may include the short grass adjoining runways and taxiways, or the tarmac itself.
- Rainwater collects in puddles and ponds, in which birds bath.

Bird Profiles

The following guide provides fundamental tables and descriptions for use in the identification of various problem bird species. More detailed identification resources are available through the references provided in Section K.

For the purposes of this basic guide, information concerning each bird species falls under the four headings outlined below.

Biology

Describes and discusses:

- sizes,
- appearances,
- body, bill, head and wing shapes,
- legs and feet,
- common colour forms,
- flight and movement characteristics,

- geographic locations,
- preferred habitats, and
- major behavioural characteristics such as typical flock size, human interaction, feeding actions, and habits at airports.

Food and attractants
Lists typical sources of food and other common attractants.

Control
Wildlife-control methods are recommended pursuant to those outlined in Sections C through G.

Similar species
Lists species with similar attributes.

The birds addressed in this section fall into 12 groups:

1. Waterfowl (geese and ducks)
2. Gulls
3. Raptors (hawks, owls, kestrels, and eagles)
4. Swallows
5. Pigeons and Doves
6. Shorebirds (Dunlins, sandpipers, and plovers)
7. Crows and Vultures
8. Herons and Cranes
9. House Sparrows
10. Starlings
11. Other Small Birds (Snow Buntings and blackbirds)
12. Miscellaneous Birds (pheasants, flickers, robins, larks, and Peregrine Falcons)

1. Waterfowl

Geese

Biology

Snow Goose *(Anser caerulescens atlantica and A.C. caerulescens*)

- Male: 2744 to 3450 grams (6 to 7.5 lbs)
- Female: 2517 to 3087 grams (5.5 to 6.5 lbs)

Canada Goose *(Branta canadensis moffitti and other subspecies*)

- Male: 4741 grams (10.5 lbs)
- Female: 4044 grams (9 lbs)

Brant *(Branta bernicla*)

- Male: 1370 grams (3 lbs)
- Female: 1230 grams (2.5 lbs)

Geese

Their flocking behaviours and large sizes make several species of geese particularly hazardous to aircraft in Canada. The greatest number of these geese is observed during the spring and fall migratory periods, when flocks comprising hundreds of geese take flight in their familiar V-formations. These flocks rest and feed in marsh areas as well as both barren and agriculturally developed fields.

The Snow Goose—white and blue-gray in colour—and the Brant breed only in Canada's far north. During spring and fall migratory periods, however, these birds appear further south in tidal flats, lakes, marshes, open fields, and grain stubble.

Canada Goose populations have grown dramatically in North America, and pose increasing problems at many Canadian airports. Between 1985 and 1997, the North American Canada Goose population increased by 54 percent; today, the total population is estimated at over five million. The majority (60 percent) of Canada Geese are migratory; the remaining 40 percent reside in large urban centers, such as Vancouver and Toronto.

Canada Geese adapt quickly to changing food sources and nesting locations. As a result, the species has extended its winter range further north, increasing the need to control geese not only during peak migratory periods but year-round.

Food and attractants

Airports along their migratory routes provide geese with extremely attractive resting and feeding areas. Geese also inhabit other areas of dry open land, such as grass fields, tundra, and corn and grain fields, as well as areas of open water. Geese feed primarily on vegetation, aquatic plants, grass shoots, seedlings, sprouts, and the stubble of many grains. Airport grass can be a strong food attractant.

Controls

- During peak migratory periods, pyrotechnics are effective for clearing birds from airports. Scare tactics work best when they combine a range of products, such as gas cannons reinforced with live ammunition. Screamer shells have also proven both effective and cost-efficient in dispersing Canada Geese.
- Distress and alarm calls are highly recommended for the dispersal of geese. There is a strong biologically based link between alarm calls and escape responses in birds. Furthermore, birds habituate slower to distress and alarm calls than to pyrotechnics.
- The use of Border Collies has proven to be an effective means of dispersing waterfowl at a number of airports around the world.
- Wet areas should be eliminated. Enclose drainage ditches and fill temporary pools that form after rainstorms and during spring melt.
- Remove aquatic and edge vegetation from open water areas through cutting, dredging or herbicide use.
- Erect physical barriers around areas of open water.
- Cover areas of open water with wire or netting hung 18 centimetres above the surface and at 36-centimetre intervals. To avoid injuring birds, hang streamers from the barrier. When covering water, fences should also be constructed around the edges to prevent geese from walking under overhead wires.
- Cover small industrial ponds with floating plastic balls (such as Bird Balls™), which prevent geese from seeing these bodies of water from the air. Balls are easy to install, adjust to changing water levels and survive various climatic conditions.
- Ensure airport ponds have 4-to-1 shoreline slopes. Geese find such ponds less attractive, as on-shore predators are harder to observe from the water.
- At Vancouver International Airport, extremely long grass up to 75 centimetres high has proven effective in keeping both geese and ducks off airport lands. Studies completed recently in the United States, however, indicate typical long grass (10 to 20 cm) does not deter geese. To ensure their effectiveness, therefore, long-grass programs should only be implemented following site-specific studies.

- Replacing grass with herb-rich vegetation—otherwise known as *poor-grass regimes*—has been an effective control measure at airports in the Netherlands. High wildflowers-to-grass planting ratios provide benefits similar to those of long-grass programs. Botanical expertise should be sought in applying both poor-grass regimes and wildflower-control methods.
- All nests of Canada Geese and other waterfowl found on airport property should be removed immediately, preferably before eggs are laid. Adults tending the nests should be dispersed. If the birds persist in returning, they should be shot or otherwise removed. A permit is required for this control measure if eggs are destroyed or geese are shot or captured.
- Many residents living near airports feed geese and perceive of them as positive additions to the urban environment. These people should be informed of the hazards geese pose to aircraft. This may be accomplished through communication campaigns that include public meetings and the distribution of awareness and education materials. Local ordinances may also be passed.
- Encourage farmers near airports to modify their practices, eliminating attractive crops—such as corn and other grains—and ploughing under stubble, thereby reducing the food supply available to geese.
- Lethal-control programs are often required in areas where geese take up permanent residence. Although not as effective as lethal control programs, some airports remove geese using trap-and-relocation programs. These initiatives are becoming much more difficult to implement, as very few communities in North America will accept relocated Canada Geese.

Similar species
Tundra Swan and White-fronted Goose

Ducks

Biology
Mallard (*Anas platyrhynchos*):
- Weight range: 720 to 1580 grams (1.5 to 3.5 lbs)

Although several duck species pose hazards to aircraft, the Black Duck—found primarily in central and eastern Canada—and the Mallard—found in central and western Canada—typify the wildlife-control challenges presented by these birds in Canada.

Food and attractants

Ducks are attracted to ponds, lakes, and slow streams—shallow-water bodies that provide submerged and emergent vegetation and good edge cover. Ducks nest in this habitat throughout their range, which stretches north into tundra regions. Temporary water arising from both spring melt and prolonged rains also attracts these birds.

Ducks

During nesting season, ducks remain solitary or in pairs. During fall migration, however, they gather by the hundreds in flocks. They feed in shallow water on submerged aquatic plants and aquatic insects, and in agricultural fields on grain and corn stubble.

Controls

- Enclose drainage ditches and fill temporary pools to eliminate wet areas that form after rainstorms or during spring melt.
- Erect physical barriers around areas of open water.
- Cover areas of open water with wire or netting hung 18 centimetres above the surface and at 36-centimetre intervals. To avoid injuring birds, hang streamers from the barriers. When covering water, fences should also be constructed around the edges to prevent birds from walking under overhead wires.
- Cover small industrial ponds with floating plastic balls (such as Bird Balls™), which prevent ducks from seeing these bodies of water from the air. Balls are easy to install, adjust to changing water levels and survive various climatic conditions.
- The use of Border Collies may be an effective way to disperse ducks that have settled on the ground.
- Encourage farmers near airports to modify their practices, eliminating attractive crops—such as corn and grain—and ploughing under stubble, thereby reducing the food supply available to ducks.
- Plant corn and grain away from airports in small plots known as lure areas. The roosting and flight patterns of ducks should be studied prior to establishing lure areas to determine the effectiveness of this control strategy.
- During peak migratory periods, scare tactics—such as shell crackers—have proven effective in clearing ducks from runways and taxiways.

2. Gulls

Biology

Ring-billed Gull *(Larus delawarensis)*
- Male: 566 grams (1.3 lbs)
- Female: 471 grams (1 lb)

Herring Gull *(Larus agentatus)*
- Male: 1226 grams (2.5 lbs)
- Female: 1044 grams (2.3 lbs)

Franklin's Gull *(Larus pipixcan)*
- Weight range: 220 to 335 grams (0.5 to 0.75 lb)

Glaucous-winged Gull *(Larus glaucescens)*
- Weight range: 730 to 1400 grams (1.5 to 3 lbs)

Ring-billed Gull

Gulls are a high-risk species. Since 1993, they have been involved in more strikes at Canadian airports than any other bird. Their large size, slow speed, flocking behaviour—and rapid habituation to most control measures—combine to make gulls particularly hazardous. The flat, wide-open areas found at airports also provide ideal resting and feeding sites for gulls.

Depending on the species, gulls nest in colonies numbering in the thousands, usually at waters' edge. Gulls often arrive at roosts after nightfall, a behaviour pattern that creates serious strike risks after dark.

Gulls pose unique wildlife-control challenges. Usually appearing in late summer, immature gulls are relatively ignorant of aircraft. Although most gulls migrate south in the fall, many spend the winter months in southern areas of Canada near such food sources as landfills, and will often remain as long as there is some open water. Gulls will often travel considerable distances in search of good feeding areas—some have been known to travel up to sixty kilometers between feeding and roosting sites.

Ring-billed Gull
A major problem species at airports in the Great Lakes region, Ring-billed Gulls are medium-sized birds noted for the black ring around the end of their beaks; young Ring-billed Gulls also have a distinct black band on their tails. These birds are extremely social and have been known to travel long distances daily in search of food.

Herring Gull
Found throughout much of Canada, Herring Gulls are large birds that are distinguished by the red dot on their beaks. Herring Gulls are not as sociable as Ring-billed Gulls, and are unlikely to stray far from water.

Franklin's Gull
Common to the Prairies in spring, Franklin's Gulls are small, black-headed birds that feed primarily on insects found in prairie fields. This species closely resembles Bonaparte's Gull, found primarily in the northern Prairies.

Glaucous-winged Gull
Found along the Pacific coast, Glaucous-winged Gulls are large white birds with dark wing tips.

Food and attractants
Gulls feed and nest in lakes and ponds, and on flat, open areas. After feeding, gulls tend to loaf in parking lots and on runways. As scavengers, gulls eat a variety foods, including insects, earthworms, grubs, sprouting vegetation, food waste, small animals (dead and alive), fish, berries, and other small fruits. Gulls forage for these foods in many habitats, including short-grass fields, freshly ploughed fields, garbage dumps, restaurants and picnic areas, beaches, shorelines, shallow water, waste-treatment plants, and airports.

Controls
Although gulls easily habituate to most control methods, the following measures have proven effective, particularly when used in combination as part of a comprehensive control program.

- As gulls prefer to loaf on short grass and pavement, cutting airport grasses no shorter than 10 centimetres reduces the attraction to gulls. Gulls find it difficult to observe predators in long grass. These birds also have difficulty accessing small invertebrates—convenient sources of food—in long grass. As long grass may not be appropriate at all airports, Transport Canada recommends that each airport determine the most effective grass heights

based on local conditions. Airports should constantly monitor grass management programs to gauge their effectiveness. Other control measures should be used in concert with long grass. Pyrotechnics, for instance, prevent gulls from loafing on runways; insecticides control insect populations.

- Improved drainage reduces standing water, which provides drinking and bathing sites.
- Store garbage indoors, or in well-sealed outdoor dumpsters.
- Scare tactics and persistent harassment are effective in reducing the number of gulls. Shell crackers and flares, for instance, should be reinforced with live ammunition, distress-cry tapes, and falconry. Scare tactics should also be modified regularly to prevent habituation, and used in conjunction with habitat modification techniques.
- When necessary to remove gulls with live ammunition, #4 steel shot is recommended. Target gulls flying at the head of flocks to best demonstrate the danger to other birds. Placing dead birds at strategic locations and in agony postures also reduces the likelihood that other gulls will return. Lethal control is a necessary part of any gull control program, and it is used as a means to reinforce non-lethal control techniques.
- Suspend wires over bodies of water and preferred nesting sites to prevent gulls from landing. As with waterfowl, wires should be suspended at 36-centimetre intervals approximately 18 centimetres above water.
- Spray chemicals such as Tersan and Benomyl along runways to kill earthworms. This will decrease the availability of food and drive gulls elsewhere. Neither Tersan nor Benomyl—both available from DuPont Canada—are registered for killing earthworms, and therefore should be used for turf management purposes.
- Encourage nearby farmers to modify agricultural practices. Night ploughing, for instance, significantly reduces strike hazards in the vicinity of airports because birds do not normally feed at night.

Similar species

Bonaparte's Gull, Great Black-backed Gull, and several other gull species.

3. Raptors

Red-tailed Hawk

Red-tailed Hawk

Biology

Buteo jamaicensis

- Male: 1028 grams (2 lbs)
- Female: 1224 grams (2.7 lbs)

Found across Canada—and north to the tree-line—Red-tailed Hawks reside in rural areas year-round. Red-tailed Hawk colours vary depending on the region—paler in the Prairies, darker in the Northwest.

Red-tailed Hawks are able to soar to great heights. They usually hunt for small animals while perched on utility poles, fence posts and dead trees. In winter, Red-tailed Hawks have been known to travel great distances in search of prey. Alone or in pairs during the summer, large numbers may gather during migration or in areas containing abundant food.

Food and attractants

Red-tailed Hawks hunt for mice, rats, voles, birds, ground squirrels, Woodchucks, rabbits, hares, and Muskrats in open areas such as agricultural fields and airport lands. These birds are often attracted to airports through the availability of prominent perching sites.

Controls

- As the hawk is a perching bird, the removal or modification of perching sites is recommended. The sharp projections of porcupine wire or a single spike —both placed on post tops—effectively discourage perching.
- Minimize food supplies by reducing small-animal populations through vegetation and water-body management. Given the broad diet of hawks—and the difficulty managing all their food sources—food-supply management should be considered only one aspect of an overall control program.
- Use rodenticides to control specific problem species such as ground squirrels and voles.
- Employ live trapping for removal from airport lands. Following the implementation of such programs in Toronto and Windsor—where hawks were trapped, banded and released 50 kilometres away—only four percent

of birds returned to the airports. Adult, territorial birds are more likely to return than are juvenile birds. Unfortunately, the removal of experienced hawks from airports often results in their replacement by migratory and non-resident birds, which may pose greater risks to aircraft. It is important to ensure that whatever technique is used for Red-tailed Hawk management in fact reduces the strike rate for this species.

Similar species

Rough-legged Hawk, which inhabits the far North in summer, and migrates south in fall. Swainson's Hawk ranges through the Yukon, Saskatchewan, Alberta, and British Columbia. The Ferruginous Hawk is found in the Prairies.

Great Horned Owl

Biology

Bubo virginianus

- Male: 1318 grams (3 lbs)
- Female: 1768 grams (4 lbs)

Great Horned Owl

Great Horned Owls are common throughout Canada, and range as far north as the tree-line. During the day, they prefer to roost in forested areas. During twilight hours and at night, they hunt over open fields, marshes, wet areas, and agricultural fields. Great Horned Owls usually winter in their home area, but may travel some distances in search of food. These owls establish nests early in spring in tall trees.

Food and attractants

Large and powerful, Great Horned Owls hunt many animals, including mice, rats, squirrels, rabbits, hares, birds, Woodchucks, skunks, and snakes. These birds prefer open areas—fields, agricultural areas, and airports—where there is an abundance of food.

Controls

- Eliminate perch sites and replace them with perch barriers and tactile repellents.
- Use night-vision technology to study and monitor local owl behaviour.

- Eliminate nesting sites, such as those found in derelict buildings.
- Engage wildlife-control officers to live-trap and relocate owls that have become comfortable at airports.
- Modify agricultural practices and clean up garbage. Although they do not feed on garbage or agricultural products, owls are attracted by rodents that favour such food sources.

Similar species
Short-eared and Long-eared Owls

Snowy Owl

Biology
Nyctea scandiaca
- Male: 1806 grams (4 lbs)
- Female: 2279 grams (5 lbs)

A large, predominantly white bird found in the far North, Snowy Owls spend summers in Canada's treeless tundra regions. These birds will, however, wander southward in winter in search of prey.

Snowy Owl

Perching on low mounds, snow banks, and fence posts rather than in trees, Snowy Owls are usually seen alone or in pairs. Unlike many owls, they are active primarily during the day.

Food and attractants
When they venture south, Snowy Owls are attracted to airfields, as the open spaces resemble the birds' natural habitat—tundra. Perching low or gliding silently over the ground, Snowy Owls hunt for such small animals as mice, rats, rabbits, ptarmigan, lemmings, and ground squirrels.

Controls
- Eliminate perch sites, replace them with perch barriers, or treat them with tactile repellents.
- Engage wildlife-control officers to live-trap and relocate owls that have become comfortable at airports.

- Modify agricultural practices and clean up garbage. Although they do not feed on garbage or agricultural products, owls are attracted by small rodents that favour such food sources.
- Grade and eliminate low mounds and rubble heaps to reduce available perches.

Eagle (Bald and Golden)

Biology
Bald Eagle (*Haliaeetus leucocephalus*)
Golden Eagle (*Aquila chrysaetos*)
- Male 3477 to 4130 grams (7.5 to 9 lbs)
- Female 4913 to 5350 grams (11 to 12 lbs)

Eagles are the largest bird of prey found in North America. Although not a common problem at Canadian airports, eagles were involved in 27 reported incidents between 1993 and 1999; their large size and tendency to soar make them significant hazards.

Food and attractants
Eagles feed on rodents, and are attracted to the open areas that provide these sources of food. Eagles will soar in thermals over airports.

Controls
Few products or techniques have proven effective to control eagles. When used by trained wildlife-control personnel, however, the Ruggieri CAPA anti-bird-strike cartridge is a safe, long-range, and reliable scare method. For greatest effectiveness, however, use pyrotechnics sparingly.

Note: Eagles are a protected species in Canada. The use of toxins or other lethal control measures against these birds is prohibited by law.

American Kestrel

Biology
Falco sparverius
- Male: 111 grams (0.25 lb)
- Female: 120 grams (0.25 lb)

American Kestrels, also known as Sparrowhawks, are small falcons found throughout Canada. They range north to the tree-line in the summer, and migrate to southern Canada during the winter.

Food and attractants
Commonly seen alone or in pairs along roadsides, in agricultural areas and at airports, American Kestrels often perch on—and observe prey from—utility wires, small dead trees and posts near open-field areas. They also fly over fields in search of such animals as mice, voles, and small birds, as well as large insects, such as grasshoppers and crickets.

Controls
- To eliminate habitat that attracts small animals and insects, establish vegetation and drain water from airfields.
- Remove dead trees and modify perches using porcupine wire and other tactile repellents.

Similar species
Merlin

Turkey Vulture

Biology
Cathartes aura
- Average Weight: 1135 to 1589 grams (2.5 to 3.5 lbs)

Once common only to areas south of Canada, Turkey Vultures are now found throughout the countryside, as well as in many cities of southern Canada. Turkey Vultures tend to roost in large numbers on rock ledges, cliff faces, hollow trees, and even in abandoned buildings.

Although presently a low-risk bird in Canada, Turkey Vultures have been involved in only three reported strikes between 1993 and 2000; the Turkey Vulture population in Canada continues to increase. The large body mass and low-level soaring behaviour of these birds makes them an increasing strike threat at Canadian airports.

Food and attractants
Turkey Vultures feed primarily on carrion and are often found at landfills.

Controls

As noted above, Turkey Vultures are considered low-risk birds at Canadian airports, as the species is not yet common in Canada. These birds have, however, been involved in a number of aircraft losses during low-level flying missions undertaken by the United States Air Force. While work is being done in the United States to better understand Turkey Vulture behaviour, pilots should be advised to avoid areas frequented by soaring Turkey Vultures.

4. Swallows and Nighthawks

Swallow

Barn Swallow

Biology

Barn Swallow (*Hirundo rustica*)

- Male: 16.2 grams (0.03 lb)
- Female: 15.8 grams (0.03 lb)

Cliff Swallow (*Hirundo pyrrhonota*)

- Weight range: 17.5 to 26.7 grams (0.03 to 0.05 lb)

These small flocking birds are found throughout southern Canada, the Yukon, and western Northwest Territories. Swallows are easily identified by their small size and erratic, swerving flight. Two species are airport hazards: Barn Swallows, with their forked tail, build mud nests in protected areas on building ledges, under eaves and against walls; Cliff Swallows prefer to build their jug-like nests under eaves. Both species also nest inside buildings, such as hangars, barns, and garages. Swallows are not considered high risk, although these birds have been involved in a large number of bird-strikes at Canadian airports; strikes against flocks, in particular, can result in significant aircraft damage.

Food and attractants

Swallows catch and eat insects while in flight. These birds are attracted to areas that produce large insect populations, such as wetlands and cut grass. Large numbers of swallows also reside at airports located near water, where the birds feed on aquatic insects such as crane flies that are blown over airport lands.

Controls

- Nest removal is the most effective way to control swallows at airports. Airport buildings and structures should be checked regularly for nests, which should be removed immediately. Hidden nests can be located by watching the ground in preferred nesting areas for accumulated bird droppings and straw.
- Block and screen holes, cavities, vents, and ledges to prevent access to the interiors of airport hangars and buildings. The application of screen and plastic or metal sheeting prevents nests from adhering to the underside of eaves.
- Eliminate insect-breeding areas—such as slow-moving water—through vegetation management.
- Consult with area farmers to determine effective aerial spays for eliminating insects. Of note, a study at Vancouver International Airport has shown that chlorpyrifos eliminates crane-fly populations. The study also found that the insecticide's ecological impact was minimized when applied in the spring.
- Use falconry as a scaring technique.
- When using pyrotechnics, vary the sounds and locations daily to avoid habituation.

Similar species

Tree Swallow, Bank Swallow, and Purple Martin

Common Nighthawk

Biology

Chordeiles minor

- Male and female: 62 grams (0.12 lb)

In summer, Common Nighthawks range throughout Canada and as far north as the tree-line; in winter, they migrate to South America. These birds are active primarily at dusk and during the night, although they are occasionally seen during the day. In shape and size, they resemble small falcons; however, Common Nighthawks are distinguished by their nocturnal habits, predominantly dark colour, erratic flight patterns, and insect-eating behaviour.

Food and attractants

Common Nighthawks are commonly seen in small groups of five to ten. They feed entirely on moths and other insects captured in flight near such insect-attracting and insect-producing sites as light towers, wet areas, and damp fields.

Control

- Eliminate habitats that produce or attract insects, establish vegetation, and drain water from airfields. Consult nearby farmers to determine effective insecticides.

Similar species

Small falcon

5. Pigeons and Doves

Common Pigeon (Rock Dove)

Biology

Columba livia

- Male: 369 grams (0.8 lb)
- Female: 340 grams (0.7 lb)

Year-round inhabitants of urban areas throughout southern Canada, pigeons—or Rock Doves—roost and nest on sheltered ledges inside and outside buildings. Pigeons are prolific breeders of particular concern at airports, where they are commonly found around hangars and terminals.

Flocks of up to 50 birds are common, producing abundant and unsightly droppings that may contain various disease-causing agents. Clean-up and disposal of these droppings should be done only when wearing proper protective gear, including gloves, respiratory masks and goggles.

Food and attractants

Although tight flocks may be seen flying rapidly over the countryside, pigeons rarely venture far from specific buildings upon which they have chosen to roost. Pigeons feed on grains, seeds, garbage scraps, and seedlings, and are attracted to gravel areas by the availability of grit.

Controls

- Remove all nests promptly. Nests are commonly found in hangars, on ledges, under bridges and, in some cases, in parked aircraft.
- Reduce available nesting and roosting sites by modifying buildings to limit ledge space; close entry holes through the use of screens and boards.
- Use scare tactics and pyrotechnics in concert with other control methods.

- Live-trapping, according to an Israeli study, is the most cost-effective, environmentally-friendly method for the long-term control of pigeons. Live-trapped pigeons should be removed and killed because pigeons have a strong homing instinct.
- Air rifles have proven to be highly effective in lethal-control programs at airports.
- Use chemicals to kill or drug pigeons for removal. Avitrol-treated corn kills pigeons ingesting the treated corn and disperses other members of the flock. Alpha chlorase-treated corn can be used to drug pigeons so they can be captured and killed humanely.
- Hire local pest-control companies. These firms deal with pigeons on a regular basis and are licensed to use various chemical products.

Mourning Dove

Biology

Zenaida macroura

- Male: 123 grams (0.25 lb)
- Female: 115 grams (0.25 lb)

Mourning Dove

Similar in overall appearance to pigeons, the smaller Mourning Doves are, however, brown with long pointed tails. They are common throughout most of rural southern Canada, and are normally seen in tight flocks of up to 20 birds. Flocks of up to 1,000 birds have also been observed. Most Mourning Doves migrate south in winter, although some birds remain in the extreme southern parts of Canada.

Food and attractants

Mourning Doves are attracted to open areas near forests, woodlots, and agricultural fields and—unlike pigeons—often roost on telephone wires. Mourning Doves feed on seeds and insects found in agricultural areas and open fields. They also forage for grit in gravel pits and along roadsides.

Controls

- Noises and shell crackers are effective in dispersing Mourning Doves.
- Remove weeds from fields.
- Ensure stubble and split grain is not left on agricultural fields.

6. Shorebirds

Plovers

Plover

Biology

Golden Plover *(Pluvialis fulva)*

- Weight range: 122 to 192 grams (0.25 to 0.4 lb)

Various types of small to medium-sized shorebirds are common to all regions of Canada. The Killdeer and Golden Plover are particularly common at airports, preferring open habitats with little undergrowth; both species nest in dry, short grass and gravel-rich fields—Golden Plover in tundra regions of the far North and the Killdeer throughout southern Canada. Being migratory birds, plovers are most often observed in flocks during the fall. Throughout the summer, however, Killdeer are commonly seen in pairs or small groups. Plovers resemble sandpipers, but are distinguished by their short beaks and short, thick necks and bodies.

Food and attractants

Most plovers feed on small insects, crustaceans, grubs, and worms they find in shallow water and in the surface soil of wet fields and mud flats. The Killdeer and Golden Plover, however, prefer dry areas, such as short-grass fields, freshly ploughed fields, and areas rich in gravel.

Controls

- Improve drainage to eliminate attractive wet areas, such as ponds and other wetlands.
- Maintain long grass, as plovers prefer short grass or gravel—areas that provide clear views of predators and better access to food.
- Scare tactics, such as shell crackers, gas cannons, and falconry should be used in peak migratory periods.

Similar species
Black-bellied Plover, Ruddy Turnstone, Semipalmated Plover, and Sandpipers

Sandpipers/Dunlins

Biology
Upland Sandpiper
(Bartramia longicauda)
- Male: 137 grams (0.3 lb)
- Female: 164 grams (0.4 lb)

Dunlin *(Calidris alpina sakhalina)*
- Male: 55 grams (0.1 lb)
- Female: 60 grams (0.1 lb)


Sandpiper

Various species of sandpiper are common to all regions of Canada. Although similar to plovers in several ways, sandpipers have longer beaks and more slender necks and bodies.

As a rule, sandpipers prefer wetlands, such as ponds, lake shorelines, and mudflats. The exception is the Upland Sandpiper, which prefers the dry, grassy fields found in western and south-eastern Canada. Of particular concern to airport wildlife authorities, Upland Sandpipers migrate south in flocks during fall.

The Dunlin is another problem species—a common shoreline species that breeds in the far North, but is seen farther south in flocks during fall and winter, particularly along the Pacific coast.

Food and attractants
Sandpipers feed on a variety of grubs, worms, crustaceans, and insects found in the soil of mud flats, wet-grass areas, beaches and fields. Upland Sandpipers are often seen perching on fence posts.

Controls
- Improve drainage to eliminate attractive wet areas, such as ponds and other wetlands.
- Maintain long grass, as sandpipers prefer short grass or gravel—areas that provide clear views of predators and better access to food.

- At Vancouver International Airport, pyrotechnics—such as screamers and whistlers—have proven effective in dispersing Dunlins. Propane cannons, meanwhile, were found to drive birds upwards rather than out of the area.
- Falconry is an effective but costly method of scaring shorebirds.

Similar species
Common Snipe and Long-billed Curlew

7. Crows

American Crow

Biology
Corvus brachyrhynchos
- Male: 458 grams (1 lb)
- Female: 438 grams (1 lb)

American Crows are large, black birds commonly seen across Canada and north to the tree-line. Adaptable to many habitats—including forests, agricultural areas, cities, towns, open fields, and garbage dumps—American Crows are often seen alone, in pairs or in flocks ranging from five to 50 birds. Owls are an arch enemy, and large numbers of crows often congregate during the day to harass roosting owls.

Food and attractants
American Crows eat a variety of foods, including grains, stubble, sprouting plants, vegetables, and berries, as well as small rodents and dead animals, which they find in fields, garbage dumps, and along roadsides. At airports, American Crows will generally roost in tall, prominent trees.

Controls
- Limit available foods by enclosing refuse containers, removing animal carcasses, and cleaning picnic areas.
- Distress calls and pyrotechnics are useful to disperse crows, especially when roosting.

Similar Species
Raven (north and far north) and Northwestern Crow (west coast)

8. Herons, Cranes and Egrets

Great Blue Heron

Great Blue Heron

Biology

Ardea herodias

- Male: 2576 grams (5.7 lbs)
- Female: 2204 grams (4.8 lbs)

Tall, wading birds commonly found throughout southern Canada—the Great Blue Heron feeds along the edges of shallow ponds, rivers, lakes, marshes, and swamps as well as in grassy fields. While hunting, Great Blue Herons are often difficult to see; they move slowly in shallow marshes looking to spear small animals. Great Blue Herons are often seen flying at dusk and dawn—beating their wings slowly with their necks curved back against their bodies as they fly. These are solitary birds, except during migration, when they are often seen in pairs.

Food and attractants

Great Blue Herons are attracted to still and slow moving waters—such as ditches and ponds—that are abundant with edge and aquatic vegetation. In these habitats birds feed on most small aquatic animals, including fish, frogs, snakes, insects, salamanders, and crayfish. Great Blue Herons will also frequent open fields, including airports, to feed on rodents such as voles and mice.

Controls

- Improve drainage to eliminate attractive wetlands, such as ponds and marshes.
- Suspend wires and netting or use Bird Balls™ to cover large ponds that cannot be drained or filled.
- Reduce rodent populations in grassy areas.
- Reduce available food supply by eliminating the vegetation that surrounds water.
- Scare tactics, such as shell crackers, are effective when used in conjunction with other control methods.

Similar species

Sandhill Crane and Whooping Crane

Sandhill Crane

Sandhill Crane

Biology

Grus canadensis tabida

- Male: 5797 grams (13 lbs)
- Female: 5345 grams (12 lbs)

Sandhill Cranes are tall wading birds that summer in the far north as well as in areas of central and western Canada. These birds are often seen in flocks through southern Canada during fall migration. Sandhill Cranes nest in wetlands, such as marshes, bogs, wet fields, and on the weedy edges of lakes. They forage for vegetation and small animals in wetlands, open fields, and agricultural areas—usually following harvest. Often confused with the Great Blue Heron, Sandhill Cranes are slate gray with red-capped heads; young birds are brown. More commonly seen in flocks than Great Blue Herons, Sandhill Cranes are characterized in flight by rapid wing beats and outstretched necks.

Food and attractants

Sandhill Cranes are attracted to marshes, bogs, and the weedy edges of lakes. They also prefer open fields and freshly ploughed earth. These birds feed on a variety of small animals, including frogs, fish, mice, snakes, grasshoppers and grubs. During the fall, Sandhill Cranes enjoy resting in fields that offer the stubble of wheat, barley and oats.

Controls

- Improve drainage to eliminate wetlands, such as ponds.
- Cover drainage ditches and fill in temporary pools created by heavy rain and spring melt.
- Use insecticides in grassy areas to decrease the availability of food.
- Encourage nearby farmers not only to plough under grain stubble, but also to plough at night.
- Use scare tactics, such as shell crackers and noise makers.
- Sandhill Cranes are a protected species in Canada; it is illegal to use lethal means to control these birds without Federal permit.

Similar species

Great Blue Heron and Whooping Crane

9. House Sparrows

Biology
Passer domesticus
- Male: 28 grams (0.06 lb)
- Female: 27 grams (0.06 lb)

House Sparrows are commonly found in flocks of various sizes in cities and towns throughout southern Canada. They nest in holes and cavities both outside and inside buildings, and in dense vines and shrubbery near buildings. House Sparrows will winter in buildings such as airport hangers, maintenance garages, and storage sheds if food sources are available nearby.

Food and attractants
House Sparrows feed on seeds, grain, small fruits, and garbage scraps.

Controls
- Block or screen any holes, vents, and cavities in hangars and other buildings.
- Limit available food by cleaning up garbage and enclosing refuse containers.
- Remove sparrows through trapping and the use of Avitrol.
- Scare tactics disperse House Sparrows quickly from runways and taxiways.

House Sparrow

10. European Starlings

Biology
Sturnus vulgaris
- Male: 85 grams (0.18 lb)
- Female: 80 grams (0.17 lb)

European Starlings are a flocking species found throughout farms, parks, cities, and towns in southern Canada. These birds are, however, gradually expanding their range northward. They are able to squeeze through openings less than two inches wide to nest in holes or cavities outside and inside buildings, including mailboxes, ventilation ducts and aircraft-engine intakes and ports.

During fall, large flocks of European Starlings gather to roost in trees, reed beds, under bridges, and on buildings. These birds spend winters in areas that provide adequate food and shelter, including farms and cities in southern Canada. Their winter plumage is spotted white; in summer, they are predominantly dark in colour. Their dark winter bills change to yellow during breeding season.

Food and attractants

European Starlings are attracted to short-grass fields, barnyards, freshly-ploughed fields, granaries, berry-producing bushes, and food-processing plants. These birds feed on insects, seeds, grains, small fruits, and food scraps.

Controls

- Remove all nests found in airport buildings. Prevent future nesting by sealing cracks and holes and placing screen vents over other openings.
- Discourage roosting by closing buildings and placing porcupine wire on ledges, rooftops, and rafters. Netting or wires can also be placed over indoor roosting areas. Tactile perches are also recommended.
- Cut back or remove trees used for perching.
- Spraying roosting birds with water in cold weather is both a dispersal method and a lethal control, as wet birds are likely to die in low temperatures.
- Keep grass long to decrease the ability of small birds to see prey and find food. As European Starlings feed on insects, aerial spraying of insecticides is effective in conjunction with long-grass programs.
- Eliminate fruit and berry-producing vegetation to minimize food supply.
- Encourage farmers to feed livestock in open sheds during the late afternoon, and to keep water for these animals at low levels.
- Use scare tactics, such as shell crackers and distress-cry tapes, to disperse birds. Scare tactics should be modified and varied frequently to avoid habituation.
- Lethal controls include the use of Avitrol, starlicide, and live-ammunition shooting.
- Trapping is largely ineffective against the high numbers of European Starlings generally found near airports.

11. Other Small Birds

Snow Bunting

Snow Bunting

Biology

Plectrophenax nivalis

- Weight range: 34 to 56 grams (0.07 to 0.12 lb)

White with black wing tips, Snow Buntings are sparrow-like flocking birds that migrate to southern Canada from the far North.

Food and attractants

In winter, flocks of 50 to 100 Snow Buntings are attracted to exposed weeds and low bushes in wide-open areas where they feed on weed seeds and dried berries. Snow Buntings often find food and grit at runway edges exposed by snowplows.

Control

- In late summer and fall, reduce standing weeds—particularly adjacent to runways—through cutting or a seasonal-herbicide application.
- Scare tactics, such as shell crackers and noisemakers, work well against Snow Buntings, although the flocks are often simply moved from one part of the airport to another.
- Fill holes and cavities and place screens on vents to prevent Snow Buntings from entering airport buildings.
- Halifax International Airport recently devoted half of its wildlife-management program resources to falconry—with effective results against Snow Buntings. The hunting characteristics of the falcon used at Halifax were similar to those of the Gyrfalcon—a species Snow Buntings fear innately.

Similar species

Various sparrows, Horned Lark and Lapland Longspur

Blackbirds

Yellow-headed Blackbird

Biology

Red-winged Blackbird
(*Agelaius phoeniceus*)
- Male: 64 grams (0.14 lb)
- Female: 42 grams (0.09 lb)

Common Grackle (*Quiscalus quiscula*)
- Male: 127 grams (0.28 lb)
- Female: 100 grams (0.22 lb)

Cowbird (*Molothrus ater*)
- Male: 49 grams (0.1 lb)
- Female: 39 grams (0.09 lb)

Yellow-headed Blackbird
(*Xanthocephalus xanthocephalus*)
- Male: 80 grams (0.17 lb)
- Female: 49 grams (0.1 lb)

These four species of blackbirds are common throughout specific regions in Canada:

- Red-winged Blackbird: southern Canada, the Yukon and North-west Territories.
- Yellow-headed Blackbird: southern Canada west of Ontario.
- Cowbird and Common Grackle: southern Canada.

Migrating in flocks numbering in the thousands, all four species are attracted to wet, marshy areas surrounded by such vegetation as bulrushes, willows, and cattails. The Common Grackle and Cowbird are also found in open areas near forests and parkland.

Food and attractants

All species of blackbirds are attracted to short-grass fields, pastures, barnyards, corn and grain fields, and fruit-producing bushes. These birds feed on insects, grains, and soft fruits.

Controls

- Improve drainage to eliminate wetlands.
- Eliminate vegetation surrounding permanent wetlands, such as ponds and ditches.
- Eliminate fruit- and berry-producing vegetation.
- Encourage nearby farmers to modify agricultural practices and eliminate corn and grain stubble.
- Combine long-grass programs—in which lengths are maintained between 10 and 15 centimetres—with regular pesticide applications to control insect infestations.
- Use scare tactics, such as shell crackers and distress-cry tapes, to disperse birds. This technique is best employed in the early morning and late afternoon when blackbirds are actively feeding; scare tactics should also be modified and varied frequently to limit habituation.
- Lethal-control methods include the use of Avitrol and live ammunition.

Similar species

Rusty Blackbird and Brewer's Blackbird

12. Miscellaneous Birds

Ring-necked Pheasant

Ring-necked Pheasant

Biology

Phasianus colchicus

- Male: 1317 grams (3 lbs)
- Female: 953 grams (2 lbs)

Generally seen in pairs or groups up to five, Ring-necked Pheasants are common in many parts of southern Canada. Because of their size and potential to damage aircraft, pheasants should not be allowed to nest or feed on airports.

Food and attractants

Ring-necked Pheasants prefer dense undergrowth in open country, forest edges near agricultural areas, and marshes and ditches offering sufficient cover.

These birds feed on weed seeds, sprouting plants, berries, insects and crops such as corn, grain stubble, soybeans, and alfalfa.

Control

- Pyrotechnics quickly disperse persistent birds.
- Eliminate brush from open areas.
- Encourage nearby farmers to modify agricultural practices and eliminate corn and grain stubble.
- Trained dogs were used successfully to locate nests at the former Canadian Forces Base in Lahr, Germany.

Flicker

Biology

Colaptes auratus auratus

- Male: 135 grams (0.3 lb)
- Female: 129 grams (0.3 lb)

Flickers reside as far north as the tree-line throughout Canada. In southern British Columbia and Alberta Flickers are yellow in colour; elsewhere they are generally orange-red. Small groups of three to five Flickers are often seen in favourable feeding areas.

Food and attractants

Flickers nest in cavities in dead trees and fence posts. These birds feed on insects—such as ants—that they find in open fields, on fence posts, and in rotten logs and trees.

Control

- Eliminate potential nesting sites, such as logs and dead trees.
- Combine long-grass programs with regular pesticide applications to control insect infestations.
- Use scare tactics to disperse Flickers from runways.

Robin

Biology

Turdus migratorius

- Weight range: 64 to103 grams (0.13 to 0.25 lb)

In summer, Robins can be found as far north as the tree-line throughout Canada. Small groups of three to five may be seen in favourable feeding areas. Large flocks are rarely observed—even during migration.

Food and attractants

Robins prefer nesting in stands of trees found in parkland and residential areas. They feed in open fields and short grass, eating small berries and fruits, grubs, insects, and earthworms—particularly after rainstorms.

Control

- Combine long-grass programs—in which lengths are maintained between 10 and 15 centimetres—with regular pesticide applications to control insect infestations.
- Eliminate berry-producing shrubs and bushes.
- Use scare tactics to disperse Robins from runways.
- Use earthworm-inhibiting chemicals, such as Benomyl or Tersan, in extreme cases only.

Meadowlark

Biology

Eastern Meadowlark (*Sturnella magna*)

- Male: 102 grams (0.22 lb)
- Female: 76 grams (0.16 lb)

Western Meadowlark (*Sturnella neglecta*)

- Male: 112 grams (0.25 lb)
- Female: 89 grams (0.2 lb)

During the summer, Meadowlarks are found across most of southern Canada, except in the Maritimes. Although they are sometimes observed in small groups in favourable feeding areas, flocks of Meadowlarks are rare.

Food and attractants

Meadowlarks prefer the abundant long grass and weed growth of open fields, where they feed largely on insects, berries, and seeds.

Control

- Employ habitat-management techniques through grass cutting and general clean-up of old field habitats.
- Eliminate weeds.
- Use scare tactics to disperse Meadowlarks from runways.

Horned Lark

Horned Lark

Biology

Eremophila alpestris

- Male: 32 grams (0.07 lb)
- Female: 31 grams (0.06 lb)

Horned Larks are sparrow-sized birds commonly found throughout Canada, including the Far North. During the fall, Horned Larks form flocks and migrate to southern Canada and the United States.

Food and attractants

A ground species, the Horned Lark prefers open, gravel-rich fields that provide grass and weed clumps for cover, as well as weed seeds and insects for food.

Controls

- Cut grass and modify habitat to decrease available food sources.
- Eliminate weeds and establish turf species.
- Use scare tactics to disperse Horned Larks from runways.

Peregrine Falcon

Biology

Falco peregrinus

- Male: 611 grams (1.3 lb)
- Female: 952 grams (2 lbs)

Once found throughout most of Canada, Peregrine Falcon populations declined to very low numbers by the 1970's. Although populations have increased in recent years, they are still considered endangered everywhere in Canada and in many regions of the United States. Successful programs have been conducted to re-establish Peregrine Falcons in southern Canada through the release of captive-bred birds in many major centres.

Peregrine Falcons are large birds with long, slender, pointed wings and slender tails that assist them in flying rapidly and directly. They breed primarily on high cliffs, building ledges and bridge girders, but can be seen hunting during fall and spring migrating periods in open areas—such as airports—where prey is abundant. Young birds are predominantly brown.

Food and attractants

Peregrine Falcons are attracted to open areas, where they feed on small and medium-sized birds such as pigeons, ducks, shorebirds, blackbirds, Mourning Doves, and gulls.

Controls

Given their low population numbers, Peregrines Falcons are not considered a problem species at airports, nor are they likely to become significant strike hazards in the near future. Nonetheless, it is illegal to kill or disturb Peregrine Falcons in their nesting areas in both Canada and the United States. If Peregrine Falcon carcasses are found—or they are involved in aircraft strikes—reports should be filed with the Canadian Wildlife Service.

Similar species

- Prairie Falcon: found in the southern Prairies and British Columbia
- Gyrfalcon: found in the far North
- Merlin

Protected Species

The federal government of Canada protects most native bird species. Prior to implementing control programs, wildlife-control personnel are advised to consult the listing of protected species at www.speciesatrisk.gc.ca/Species/English/SearchRequest.cfm.

Furthermore, Appendix D of Transport Canada's *Sharing the Skies* (TP 13549E) provides a complete listing of legislative and regulatory measures governing wildlife management and the environment, along with relevant website addresses at which further information can be found.

Section I

Integrated Control Methods — Mammal Profiles

Mammal Profiles

Mammals can be categorized as posing either direct or indirect strike hazards to aircraft. Due to their size, large mammals such as deer or Coyotes are generally considered direct threats. Smaller mammals, including rodents, are categorized as indirect threats because they attract direct-threat predators such as raptors and Canids.

Mammals also pose an assortment of airport-maintenance problems, such as chewing through electric cables, burrowing—which can damage mowing machinery as well as weaken aircraft movement areas—and tunneling under fences.

Most mammal-control programs comprise these key methods:

- fencing to exclude large mammals.
- poisoning through the use of lethal chemicals that repel or kill animals, and
- trapping and shooting to remove or disperse animals.

When developing and implementing mammal-control programs at airports, several general principles should be considered:

- Install effective security fencing to prevent large mammals from entering airport lands.
- Eliminate broad-leaved plants—such as weeds, clover, and alfalfa—on all areas within 300 metres of runway centre lines.
- Apply herbicides regularly to prevent the recurrence of broad-leaved plant cover.
- Close all fence gates when not in use.
- Install cattle gates where fence openings are frequently used.
- Ensure all necessary Federal, Provincial, and Municipal permits are obtained before mammals are killed or removed.
- Inform the nearest Canadian Wildlife Service office whenever endangered species are involved.
- Maintain mammal-control files to ensure a log of interaction with these species.
- Report all mammal strikes by completing and submitting Transport Canada's Bird/Wildlife Strike form.
- Maintain and keep available a list of the names and telephone numbers of local wildlife authorities.

This section provides an introductory guide to the following mammals considered hazardous to aircraft in Canada:

- Deer and other Ungulates (Elk, Moose, and Caribou)
- Bears (Grizzly Bears, Black Bears, and Polar Bears)
- Canids (Coyotes, Wolves, and Foxes)
- Muskrats and Beavers
- Leporids (Hare and Rabbits)
- Moles
- Squirrels and Woodchucks
- Pocket Gophers
- Mice
- Rats
- Raccoons, Badgers, and Skunks

Readers are presented with cursory descriptions of the mammals and their behaviour, as well as effective control methods to employ against these animals.

Deer and other Ungulates

Biology

Ungulates are hoofed mammals that shed their antlers once a year. These animals pose extremely serious hazards to aircraft, straying onto active runways and taxiways, and disrupting the schedules and budgets of airlines. Strikes can significantly damage aircraft.

Food and attractants

Ungulates are attracted to airports by:

- cover provided by broad-leaved vegetation, such as trees and shrubs;
- food, particularly grasses and legumes, such as clover and alfalfa; and
- protection afforded by open airport lands.

Whitetail Deer

Whitetail deer

Biology
Height: approximately 1 m (3 ft) (The height of all Ungulates is measured to the shoulder)
Weight (males): up to 182 kg (400 lbs)
Weight (females): up to 90 kg (200 lbs)
Location: Whitetail Deer are found throughout southern Canada in swamps and young-growth forests.

Features:
- Flagging tails.
- Coats are reddish in summer and blue-gray in winter.
- Males have two-beam antlers with prongs.

At airports, deer disrupt operations, delaying takeoffs and landings and temporarily closing runways. Strikes can cause significant damage to aircraft.

Food and attractants
Deer are attracted to the large open tracts of land available at airports—land that is isolated from heavily populated areas. The diet of Whitetail Deer consists mainly of grass, twigs, and buds.

Similar Species
Mule Deer

Mule Deer

Mule deer

Biology
Height: approximately 1 m (3 ft)
Weight (males): up to 180 kg (400 lbs)
Weight (females): up to 68 kg (150 lbs)

Features:
- Coats are reddish in summer and blue-gray in winter.

- Tails are white with black tips; they have a white patch on their hind.
- Antlers on males rise vertically, then divide evenly and slant backward at the first fork.

Food and attractants
Mule Deer prefer coniferous-forest and grassland habitats, where they eat grass, twigs, and buds.

Similar Species
Elk, Whitetail Deer

Control measures and management techniques

In March 2000, LGL Limited conducted a study for Transport Canada to determine the most effective means of preventing deer strikes at airports. The authors examined existing literature and proceedings from wildlife-management conferences, and communicated with wildlife workers, including airport managers, game-farm owners, and staff at public zoos.

Several deer-exclusion devices and deterrent techniques were reviewed and rated; the findings regarding recommended fencing are summarized throughout this section. Fencing is also discussed in Section F.

The report is available online as an Aerodrome Safety Circular, ***Evaluation of the Efficacy of Various Deer Exclusion Devices and Deterrent Techniques for use at Airports***: http://www.tc.gc.ca/Civil Aviation/aerodrome/menu.htm.

The report can be obtained by calling: 1-800-305-2059 or
E-mail: http://www.tc.gc.ca/aviation

Perimeter fencing
Effective perimeter fencing is the most important component of successful deer-control programs—especially when combined with habitat-management techniques, such as vegetation removal.

Electric fencing
Electric fencing administers a rapidly pulsed charge of 4,000 to 5,000 VDC. Its 80-percent effectiveness rate declines rapidly when fences are poorly maintained; weed growth and snow cover, for instance, can short-circuit electric fences. Furthermore, the stresses of high populations, the fall rutting season, and the

Airport fence with hole

presence of hunters can motivate deer to cross these fences regardless of the pain these barriers inflict.

Electro-Braid™

Electro-Braid is a recent Canadian product developed for both horse ranching and deer control, Electro-Braid is essentially copper wire that has been braided into polyester rope. Placed 15 to 30 centimetres apart, seven to nine strands of this rope are strung horizontally between fiberglass or wooden posts. The strands are then attached to the positive post of a grounded fence charger producing 4,000 to 5,000 VDC. Electro-Braid is highly visible, ensuring fewer accidental contacts by deer.

Non-electric fencing

Non-electric fencing must be at least three metres high to provide effective physical barriers to deer. To remain effective, this fencing should be patrolled regularly, and cleared of accumulated snow and underbrush. Non-electric fencing must also be durable enough to resist damage by chewing or ripping.

Galvanized-steel chain-link fencing

Galvanized-steel chain-link fencing is described in detail in *Transport Canada Airport Fencing Manual (AK-70-21)*. Galvanized-steel chain-link fencing is used at most international and regional airports in Canada and is recognized as an effective, long-term measure for deer control at airports. This fencing is comprised of 2.4 metre-high woven steel mesh supported by well-anchored steel posts and topped by three strands of barbed wire. The height and strength of this fencing combine to create an effective physical barrier to deer. The relatively high initial cost, however—approximately $43,000 per kilometre—may prove prohibitive for some airports.

High-tensile fixed-knot fencing

High-tensile fixed-knot fencing is effective in areas where galvanized-steel chain-link fencing disrupts Instrument Landing Systems. Sold under several brand names, including Solidlock® and Tightlock®, this fencing is made of

high-tensile horizontal wires. The spacing of the wire widens toward the top of the fence, at which deer contact is less likely.

This fencing controls a variety of wildlife, including Moose, deer, Elk, wolves, and Coyotes. The tightly locked wires resist distortion and prevent animals from crawling beneath or squeezing through. To be effective, these fences should be at least 3.7 metres in height (Whitetail Deer have been known to jump three-metre fences).

Cattle gates
Cattle gates should be installed when fence openings must be maintained for vehicle traffic. These barriers are essentially steel grates placed in the ground between fence posts. Cattle are discouraged from crossing as they are unable to gain footings on the open piping that comprises these grates, which are nonetheless strong enough to support vehicle traffic.

Visual- and auditory-deterrent techniques

Deer will respond to visual and auditory removal techniques, such as pyrotechnics and flags, on a short-term basis. Most deer, however, adapt to sound or visual markers and learn to ignore them if they are not associated with real danger. Visual and auditory deterrents, therefore, are not recommended for long-term deer control at airports.

Pyrotechnics can provide short-term effectiveness when deployed by trained personnel. As habituation occurs quickly, however, long-term solutions should be implemented.

In areas where hunting is permitted, deer avoid the sound of gunfire. The effectiveness of this auditory deterrent is likely due at least in part to the seasonal nature of hunting activities, to which deer do not have the opportunity to habituate.

Deer-removal methods

One-way gates
One-way gates are used in conjunction with perimeter fencing to allow deer to exit fenced areas. As they permit deer to escape on their own, these gates reduce the dangers to deer posed by trapping and handling procedures. Gates

should be installed in areas of highest deer traffic. One-way gates require regular maintenance.

Drive Netting
Through this practice, deer are directed into 15-metre long 17.8-centimetre rectangular nylon mesh nets that are either extended from vehicles or quickly raised by a number of people. The deer are then blindfolded and their feet secured prior to relocation. Although expensive and labour intensive, drive netting is recommended when many deer must be quickly removed from airport properties.

Drive netting is often more effective in winter, when fresh tracks assist in locating deer.

Live trapping
The live capture of deer for relocation is accomplished using corral and wire-box traps. Corral traps are 30- to 75-metre circles of 3-metre high wire mesh that is secured against trees. A single door, hinged at the top to open inward, is triggered to close when deer enter.

Wire-box traps are triggered to close when deer enter a wire enclosure while seeking bait. Deer trapped by both devices are tranquilized and relocated by trained wildlife managers.

Live traps are particularly effective during winter and early spring when deer are susceptible to baiting. Accordingly, the effectiveness of live traps declines as seasonal food sources become more abundant.

As the practice requires the expertise of professional wildlife biologists, live trapping may not be affordable at airports with limited wildlife-control budgets.

Shooting
In some circumstances, it is necessary to use firearms in the removal of deer from airports. Baits such as shelled corn and alfalfa can be used to attract deer to locations at which the animals are shot.

Population control
Several Canadian airport managers, in co-operation with Provincial authorities, allow legal seasonal hunting to reduce local populations of deer. In areas where deer populations are high—or population migration from other

areas is a source of concern—hunting specific deer populations near airports is an effective control method.

Elk

Elk

Biology
Height: up to 1.5 m (5 ft)
Weight (males): up to 450 kg (1,000 lbs)
Weight (females): up to 270 kg (600 lbs)

Features:
- pale yellowish patches on their rump.
- brown bodies with small white tails.
- In fall, males have huge spreading antlers, which they shed in spring.

Elk are active in the morning and evening in groups of 25 or more. Bulls congregate in groups during summer. In spring, Elk move up mountains for food and cover, returning when snow covers their feeding areas.

Food and attractants
Elk eat grass, herbs, twigs, and bark.

Similar species
Moose, deer

Moose

Moose

Biology
Height: up to 1.8 m (6 ft)
Weight (males): up to 500 kg (1,100 lbs)
Weight (females): up to 360 kg (800 lbs)

Features:
- Dark brown bodies with gray legs.

- Large snouts with a hairy-looking bell on their throats.
- Antlers are flat with small prongs, and are shed early in the year.

Generally active at night, Moose are often seen feeding in ponds and other wetlands.

Food and attractants
Moose feed on marsh vegetation, twigs, and bark.

Similar species
Elk and caribou

Woodland Caribou

Biology
Height: up to 1.2 m (4 ft)
Weight (males): up to 270 kg (600 lbs)
Weight (females): up to 160 kg (350 lbs)


Woodland Caribou

Features:
- heavy set, dark brown bodies.
- white rumps and necks.
- large feet with round hooves; above each hoof is a white band.
- all males and some females have semi-palmated antlers with a prominent tine over the nose.

Woodland Caribou move up and down mountains in small groups searching for food.

Food and attractants
Woodland Caribou feed on all plant life.

Similar species
Mule Deer

Controls (all Ungulates)
- Install appropriate perimeter fencing.
- Remove tree, shrub, and ground cover.
- Mow grass areas regularly.

- Conduct controlled hunting and live-trapping programs.
- Monitor seasonal herd movements and implement control programs before hazards to aircraft develop.
- To ensure Ungulates are not attracted to airport lands, encourage minimal destruction of suitable habitat in surrounding areas.

Bears

Biology
Length: up to approximately 2.5 m (8 ft)
Weight: up to 680 kg (1,500 lbs)

Features:
- All bears have thick coats of hair and rounded ears.
- They generally have poor eyesight, but excellent senses of smell.
- Bears walk flat-footed on all four feet, which have five toes each.
- When not too heavy, most bears are able to climb trees.

Bears are the largest living carnivores—excellent swimmers who spend much of their time catching spawning fish. These animals eat a variety of plants and animals, depending on availability, and will roam great distances when food is scarce.

The females pick den sites, where they give birth to young. During winter, most species hibernate in the dens, from which they will occasionally emerge.

Black Bear

Grizzly Bear

Black Bear

Biology
Weight: up to 400 kg (900 lbs)

Features:
- Either black or cinnamon brown in colour.
- They often have a white spot on their chest.

Black Bears are primarily nocturnal. They mate during July and August of every second year; cubs are born between late December and February.

Food and attractants
Black bears feed on carrion, small animals, berries, fish, and garbage.

Similar species
Grizzly Bear (B.C., Yukon and Alberta)

Controls
- Discouraged berry crop production, beehive operations, and garbage disposal at and near airports.
- Install adequate perimeter security fencing.
- Eliminate tree, shrub and broad-leaved plant cover—particularly plant species that produce fruit and berries.
- Employ scare tactics such as pyrotechnics in peak periods.
- Conduct controlled hunting and live-trapping programs. Whenever possible, bears should be relocated to distant locations. Qualified Provincial or Federal government wildlife officers should be consulted prior to the institution of any hunting or live-trapping programs.

Note: Having been assigned special status by the Committee on the Status of Endangered Wildlife in Canada, Grizzly Bears may not be hunted except under established Provincial hunting protocols.

Canids

All canids are dog-like in general appearance, with five toes on their front feet and four on their back. These animals are primarily nocturnal, and often hunt for large game in pairs or in packs. Canids are of concern as a strike hazard, as they may be attracted to runways by the smell of rubber.

Grey Wolf

Biology
Weight: 32 to 55 kg (70 to 120 lbs)
Length: 1 to 1.2 m (43 to 48 inches)
Location: found throughout Canada in wilderness areas, forests, and tundra

Features:
- More dog-like than the Coyote.
- Usually dark grey or black in colour; Grey Wolves in the Arctic are nearly all white.
- When running, Grey Wolves hold their fully fluffed dark-tipped tails high in the air.

Food and attractants
Grey Wolves eat both plants and animals. When hunting large animals, such as deer and caribou, Grey Wolves move in pairs or groups.

Similar species
Coyote

Coyote

Biology
Weight: 9 to 23 kg (20 to 50 lbs)
Length: 0.8 to 0.9 m (32 to 37 inches)
Location: found throughout Canada except in the Atlantic provinces

Features:
- Coyotes are grey or reddish-grey with rusty-coloured legs, feet and ears, and a white throat and belly.

Coyote

Coyotes run with their tails hanging down between their legs and, in the evening, call to one another using high-pitched yaps. Urban Coyote populations, specifically in the Greater Toronto Area, are on the rise as these animals adapt to human environments.

Food and attractants

Coyotes eat birds, vegetables, fruits, small rodents, and rabbits. In populated areas, they will often raid vegetable gardens in search of food. The abundance of small mammals and other prey animals, as well as the availability of shelter, attracts Coyotes to airports.

Well-drained soils provided in gravel berms, for instance, make suitable sites for Coyote dens. Airports located in urban or semi-urban settings also provide habitats in which there is minimal human disturbance.

Controls (wolves and Coyotes)

- Remove accumulated gravel and sand that provide potential den sites for Coyotes.
- Dismantle existing Coyote dens, a practice best undertaken in summer.
- Reduce the number of birds, small mammals and other sources of food through habitat- and grass-management techniques.
- Protect cables from being chewed above and below ground through the use of stainless-steel braid or BX-cable sheathing. Copper, bronze, and aluminum cable sheathings are not suitable.
- Apply chemical repellent coatings to electrical cables above ground to prevent damage from chewing.
- Install barbed-wire aprons around the base of fences to discourage digging.
- Fumigate Coyote dens. (See Section G)
- Remove persistent Coyotes through controlled hunting and trapping programs.

Similar species

Dogs and wolves

Red Fox

Biology

Weight: 5 to 7 kg (10 to 15 lbs)
Length: 0.5 to 0.6 m (22 to 25 inches)
Location: found throughout Canada in both forest and open country

Features:

- Roughly the size of small dogs.
- Generally reddish-yellow with darker hair on their backs, and white bellies.
- Tails are dark, bushy and white-tipped.
- Legs and feet are black.
- Eyes are elliptical, while dogs' eyes are round.

Red Fox

Food and attractants

Red Foxes eat mice, rabbits, ground squirrels, birds, eggs, insects, fruit, and berries. They will eat some clay and gravel in small quantities for the vital minerals. Red Foxes also raid garbage dumps in search of carrion.

Red Foxes often find airports attractive because of:

- the abundance of small mammals and other prey;
- well-drained den sites, such as those provided by gravel berms;
- the absence of humans; and
- shortages of suitable habitat in areas adjacent to airports.

Similar species

Grey Fox

Controls

- Destroy the dens of problem animals. Gravel and sand berms not associated with essential roadways, runways, and taxiways should be eliminated to reduce the number of potential den sites.
- Reduce the number of birds, small mammals, and other sources of food through habitat- and grass-management techniques.
- Protect cables from being chewed above and below ground through the use of stainless-steel braid or BX-cable sheathing. Copper, bronze, and aluminum cable sheathings are not suitable.
- Apply chemical repellent coatings to electrical cables above ground to prevent damage from chewing. Studies in the United States have shown that quinine hydrochloride prevents foxes from gnawing on hoses and wire.

- Remove foxes from airports using controlled hunting and live-trapping programs. Note: the Grey Fox and Swift Fox are endangered species; non-lethal control methods must be employed against these species.
- Encourage minimal destruction of suitable fox habitats in areas near airports.
- Employ extermination programs using hydrogen-cyanide, sodium monofluoro-acetate, or strychnine baits. Equally hazardous to humans, these chemicals should be handled by properly trained personnel only.

Muskrat and Beavers

Muskrat

Biology
Weight: up to 2.2 kg (5 lbs)
Length: 0.2 to 0.25 m (8 to 11 inches)
Location: Found throughout Canada, except in northern areas of both Quebec and Newfoundland

Features:
- Bodies are blackish brown, blending to reddish on the sides and light-coloured bellies.
- Throats often feature a white flash.
- Eyes are small; ears are short and barely visible.
- Front feet have four clawed toes; each rear foot has five partially webbed toes.
- Tails are long, naked, black, and flattened on the sides.

Muskrats are mostly nocturnal, but they do appear at times during the day. Although largely an aquatic species, Muskrats will move over land between habitats.

Unlike Beavers, Muskrats build poorly-constructed shelters. First, they heap available rushes and weeds until the pile rises above the waterline. They then chew a cavity in the centre of the mound to create a nest chamber; each chamber also has an underwater entrance. In constructing homes, Muskrats often cause considerable damage by undermining streams and ditches.

As prey, Muskrats attract other mammals and raptors.

Food and attractants
Muskrats feed on the roots and stems of water plants, corn and clover. In summer, Muskrats eat aquatic vegetation; in winter, they eat clams and frogs. If food is scarce, Muskrats will eat the inner walls of their den.

Similar species
Beaver

Beaver

Biology
Weight: up to 29 kg (65 lbs)
Length: 0.7 to 1 m (30 to 40 inches)
Location: Found throughout Canada, except in northern areas of both Quebec and Newfoundland

Beaver

Features:
- Feet all have five toes; hind feet are fully webbed.
- Tails are broad, flat and scaly.
- Underfur is brown and covered with long stiff guard hairs.
- Belly and head are lighter in colour than the rest of the body.
- Teeth are large; Beavers must gnaw continually on wood to keep teeth at proper length.

The largest rodent found in Canada, Beavers build dams to form artificial ponds in areas where there is plentiful Poplar and aspen. Beavers may be seen most often in the mornings or evenings but will work all night to build or repair dams using twigs, mud and logs. Entrances into Beaver homes are always underwater.

Beavers pose problems at airports through their dam-building activities, which cause flooding and draw other species that are attracted to water. As prey, Beavers attract larger mammals to airports. Finally, Beavers also burrow into the banks of ditches, promoting erosion.

Food and attractants
Beavers eat small twigs and the bark of aspen, poplar and birch trees.

Similar species
Mountain Beaver

Controls (Muskrat and Beaver)
- Install and maintain standard security fencing to prevent Beavers from entering airport lands.
- Protect trees in areas around waterways by wrapping their bases with hardware cloth, mesh wire or other metal barriers.
- Remove all cattails, trees and shrubs within 200 metres of all bodies of water; replace them with a cover of low, sparse-growing grasses that have small seed heads.
- Eliminate all unnecessary bodies of water. Remove aquatic vegetation from areas that cannot be drained or filled.
- Remove problem animals using live-trapping and kill programs. Destroy all lodges and dams after Beavers have been removed.
- Grade banks of drainage ditches and bodies of water to 4-to-1 slopes.

Whitetail Jackrabbit

Leporids

Rabbits and hares pose significant indirect threats at airports, as they attract predatory birds—such as hawks and eagles—and such mammals as wolves, Coyotes, and foxes.

Differences between hares and rabbits
- Jackrabbits and hares belong to the genus *Lepus*, while rabbits belong to the genus *Sylvilagus*.
- Hares are larger than rabbits in every way; hares have longer ears, hind legs and feet than rabbits.
- The fur on the soles of hares' feet is much denser than that of rabbits.
- Hares have a divided upper lip.

- Rabbits nest in burrows or in well-defined nests in depressions, while hares nest above ground.
- Rabbits are born naked and sightless, whereas hares are born with fur and good vision.
- Newborn rabbits remain in their burrows, while hares are ready to move about in a few hours.

Food and attractants

Leporids are attracted to broad-leaved plant cover and forbs, such as legumes, clover, and alfalfa.

Controls

- Discourage Eastern Cottontail Rabbits and Snowshoe Hares by removing all trees and shrub cover.
- Eliminate broad-leaved plant cover, such as weeds, clover, and alfalfa, to ensure airport lands are less attractive to Whitetail Jackrabbits and European Hares.

Snowshoe Hare (also known as the Varying Hare)

Biology

Weight: 1 to 2 kg (2 to 4 lbs)
Length: 0.3 to 0.5 m (13 to 18 inches)
Location: found in swamps, forests and thickets throughout the southern regions of both Ontario and Quebec

Features:

- Ears are small, but feet are extremely large.
- Coats are yellow in colour; the tips of the fur turn white in winter.

Food and attractants

Snowshoe Hares eat vegetation in summer and twigs and bark in winter. They find these foods in fencerows and shrub areas, where they also hide from predators.

Similar species

Whitetail Jackrabbit, Prairie Hare, European Hare (an introduced species), and Eastern Cottontail

Moles

Moles are virtually blind and have no external ears. These animals are found mostly in wet, loose soil in which they dig tunnels in search of food. The tunnels act as food traps for worms and burrowing insects. Additional tunnels, dug one to two feet below ground, serve as their living spaces.

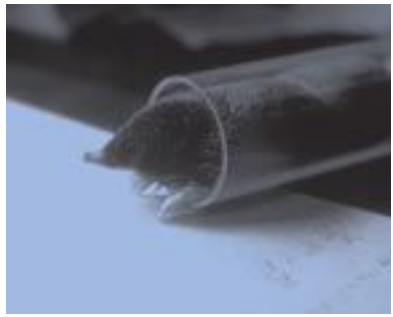
Moles dig tunnels with their front feet, which are usually turned outward. They push dirt behind them and through an outlet hole to mounds on the surface, which often interfere with grass-cutting operations.

Moles rarely leave their tunnels, and are therefore more attractive prey to mammals than birds. When moles do venture above ground—usually to collect grass for nests—they quickly close openings on their return.

Starnose Mole

Biology
Length: up to 20 cm including 7 cm tails (8 inches, including three-inch tails)

Features:
- Coats are dark brown or black.
- Noses are tipped with a naked fringe of 22 rose-coloured feelers used for detecting food in their tunnels.



Townsend Mole

Food and attractants
Starnose Moles eat worms and insects.

Similar Species
Townsend Mole (Western Canada) and Hairy-tail Mole (Eastern Canada)

Squirrels

Woodchucks, prairie dogs, ground squirrels, and tree squirrels are all members of the squirrel family. Primarily active during the day, they have four toes on their front feet and five toes on their back feet. The tails of squirrel species are always covered with hair.

Some squirrels create intricate underground burrow and tunnel systems that feature living quarters and several entrance holes. These burrows have only one escape route, used for quick getaways in times of immediate danger. The entrances to these escape routes, which are kept clear of dirt, drop straight down for two feet or more. In inclement weather, squirrels are able to remain underground for extended periods of time.

Red Squirrel

Red Squirrel

Biology
Weight: 225 grams (0.5 lb)
Length: 20 cm plus 15 cm tail
(8 inches plus 6 inch tail)
Location: found across Canada, primarily in areas containing evergreen or mixed-hardwood trees in which they build their nests

Features:
- Coats are predominantly red.
- Bellies are white; a black line runs along their side in summer.
- Backs become paler in winter.

Raptors are attracted by the presence of these squirrels.

Food and attractants
Red Squirrels eat cones, seeds, nuts, and fungi. They store their food in tree cavities and under loose bark, or bury it in the ground. They locate hidden food not through memory, but their acute sense of smell.

Similar species
Grey Squirrel, Fox Squirrel, and Ground Squirrels

Ground Squirrels

Biology
Length: 17 to 50 cm (7 to 20 inches)
Location: found in western Canada

Features:
- Coats are smoke grey, and are either mottled, speckled, or striped.
- Eyes are large.
- Ears are set low on their heads.

Each year ground squirrels burrow underground networks of tunnels that feature many entrance holes. All dirt excavated from tunnels is carried out in their cheek pouches. At night, all entrances are plugged with grass or sod. On cloudy and dark days, ground squirrels are likely not to venture from their burrows.

Unlike many other small mammals, ground squirrels are true winter hibernators. During hibernation, their body temperatures and heartbeats drop to minimum levels; by spring, these animals will have lost nearly one-half of their body weight.

As attractive prey to many carnivorous mammals and raptors, ground squirrels should be eliminated from airport lands.

Richardson Ground Squirrel

Biology
Location: found primarily on the Prairie plains

Features:
- Coats are drab smoke-gray washed with cinnamon buff.
- Backs may feature a variety of colours, including red, brown, and black.
- Bellies are pale or white.
- Underside of their tails are clay coloured to light brown, with white buff borders.
- Front feet have long claws, used for digging.

Food
In spring and summer, Richardson Ground Squirrels eat green vegetation; in fall, they eat seeds.

Similar species
Columbian Ground Squirrels are larger with dark red feet and legs, and a mottled gray underbelly. This species is a mountain- and Arctic-tundra dweller that does not hibernate.

Thirteen-lined Ground Squirrel

Biology
Weight: 150 to 340 grams (5 to 9 oz)
Length: 11 to 15 cm plus 6 to 12 cm tail
(4.5 to 6 inches, plus 2.5 to 5 inch tail)
Location: found primarily on the Prairie plains

Features:
- Bodies are brown and feature 13 to 15 whitish stripes on the sides and backs

Thirteen-lined Ground Squirrels are a small, solitary species named for the stripes described above. The openings of their burrows—built in short-grass areas—are carefully concealed.

Food
Thirteen-lined Ground Squirrels eat seeds, insects and, occasionally, other small mammals.

Similar species
Chipmunk (which is smaller and striped differently)

Woodchuck

Biology
Weight: up to 4 kg (9 lbs)
Length: 40 to 50 cm (16 to 20 inches)
Location: found in open woods, fields, and rocky ravines across Canada—but in greatest abundance in the east.

Features:
- Coats range in colour from yellowish to darker brown.
- Bellies are lighter.
- Noses are white tipped.

Woodchucks are large, heavy-bodied marmots with short legs. They are diurnal and hibernate from October to February in dens that contain many tunnels, which they stock with green fodder.

Woodchuck

As attractive prey to carnivorous mammals and raptors, Woodchucks should be eliminated from airport lands. Woodchuck burrows also can undermine pavements and building foundations and interfere with mowing operations.

Food
Woodchucks eat grass, roots, tubers, and garden crops.

Similar species
Hoary Marmot and Ground Squirrels

Pocket Gophers

Pocket gophers are small to medium-sized mammals found in the four western provinces. They have enlarged front claws, short naked tails and small ears and eyes—all well suited to their underground environment. Although predominantly brown in colour, some pocket gophers are also black or white—making identification of individual species difficult.

External, fur-lined, reversible cheek pouches in which they carry food are easily visible—when filled—as slits on either side of their mouths. Their large, yellow incisor teeth are always visible, as their lips close behind them.

All species in this family are burrowers and are seldom seen above ground. When pocket gophers do exit their burrows, they rarely roam more than a few feet from the openings. They are loners and will kill any other pocket gopher entering their burrows—except in breeding season, when males enter females' burrows.

One pocket gopher—its den up to six feet underground—is able to construct a maze of tunnels covering an entire acre of land. Although the openings are immediately plugged after use, pocket-gopher burrows can be located by seeking out fan-shaped mounds of soil.

Pocket gophers are able to run backwards as quickly as forwards, their tails being endowed with tactile organs that enable them to feel their way through tunnels. Pocket gophers maintain underground stores of food for winter, but do not hibernate.

Northern Pocket Gopher

Biology
Weight: 78 to 130 grams (2.75 to 4.5 oz)
Length: 13 to 15 cm (5 to 6 inches)
Location: found across central Canada in grassy plains and meadows

Features:
- Males are larger than females.
- Coats are grayish in colour, often with a brown wash.
- The backs of their ears have black patches.

Food
Northern Pocket Gophers eat roots, tubers, and plants.

Similar species
Townsend Pocket Gopher and Plains Pocket Gopher

Mice

The common House Mouse arrived in North America from Europe with early settlers during the 1700's. They then spread across the continent. Mice destroy property, endlessly gnawing and burrowing in search of food and safe places to live. House Mice have tails with little hair, a yellow underbelly and protruding eyes.

Mouse

As attractive prey to most carnivorous mammals and raptors, mice should be eliminated from airport lands.

Meadow Vole

Biology
Weight: 28 to 70 grams (1 to 2.5 oz)
Length: 8 to 13 cm including 4 to 6 cm tail
(3 to 5 inches including 1.5- to 2.5-inch tails)
Location: found in low, moist areas or high grasslands across Canada.

Features:
- Coats vary in colour from gray-brown to dark brown, and feature long, soft fur.
- Bellies are a silvery colour.

Meadow Voles nest above ground and breed throughout the year; females bear young up to eight times annually.

As attractive prey to most carnivorous mammals and raptors, Meadow Voles should be eliminated from airport lands.

Food and attractants
Meadow Voles eat grass, sedges, seeds, bark, and grain.

Similar species
Mountain Vole and Tundra Vole

Rats

Norway Rats arrived on ships from Europe in the mid-1700's and spread rapidly through much of North America.

Norway Rat

Biology
Weight: 200 to 283 grams (7 to 10 oz)
Length: 18 to 20 cm plus 20 to 25 cm tail (7 to 8 inches, plus 8 to 10 inch tail)
Location: found across Canada

Features:
- Coats are brown.
- Bellies are pale.
- Tails are long and scaly.

Norway Rats are medium-sized rodents that produce as many as 12 litters each year. Active control is required to prevent rapid population increases.

Food
Norway Rats are omnivorous, eating anything they can digest. They tend to feed in garbage dumps and live in buildings, junkyards, burrows, or in riprap along shorelines.

Similar species
Black Rat

Other Problem Mammals

Raccoon

Biology
Weight: 5.5 to 16 kg (12 to 35 lbs)
Length: 45 to 70 cm (18 to 28 inches)
Location: found in southern regions throughout Canada


Raccoon

Features:
- Coats are salt-and-pepper coloured.
- Tails are long and bushy with alternating rings of yellow, white, and black.
- Eyes feature a black mask of fur.
- Feet each have five toes with non-retractable claws.

Raccoons do not hibernate, dwelling year-round in hollow trees, warm rock caverns, and buildings. In addition to creating havoc around airport buildings, Raccoons are attractive prey to large raptors and such mammals as wolves, foxes, and Coyotes, and should be eliminated from airport lands.

Extreme care should be exercised when handling Raccoons, as they may be infected with a new strain of rabies that has moved north from the United States.

Food and attractants
When not feeding on garbage or refuse around buildings, Raccoons hunt at night, mostly around water. Good swimmers, Raccoons catch fish, crayfish, frogs, and other water creatures. They raid cornfields and nests, consuming eggs and young birds. Raccoons also eat mice and berries.

Similar species
None

Badger

Biology
Weight: 6 to 11 kg (13 to 25 lbs)
Length: up to 0.5 m (up to 22 inches)
Location: found from the Great Lakes region to British Columbia in open habitat


Badger

Features:
- Coats feature a white stripe running from their noses over the tops of their heads.
- Ears have single black spots in front.
- Cheeks are white.
- Bellies and tails are yellow.
- Feet are black.

Badgers are strong, heavy-bodied, short-legged, short-tailed animals. When hunting for gophers or ground squirrels, Badgers will dig holes straight into rodent lairs faster than their prey can vacate them. When attacked by larger animals, Badgers retreat through long tunnels to lairs deep beneath the ground.

Badger den holes interfere with airport grass-cutting operations. They also present hazards to taxiing aircraft at small airports.

Food
Badgers eat small rodents, rabbits, and birds.

Similar species
None

Skunks

Skunks have long, slender bodies and short legs. They are predominantly nocturnal. In winter, female skunks den together during gestation.

When skunks are disturbed, they will stamp their foot and raise their tail with the tip hanging down. If disturbances continue, skunks will raise the tips of their tails and spray from two large musk glands at the bases of their tails. Skunks can spray as many as six times per encounter, each to a distance of 3 metres.

Striped Skunk

Biology
Weight: 3 to 6 kg (6 to 14 lbs)
Length: 33 to 45 cm (13 to 18 inches)
Location: found throughout Canada, except in Newfoundland and the Yukon

Features:
- Bodies are black.
- Coats feature a narrow white stripe that runs up the middle of the forehead, broadens at the nape, divides into a V at the shoulder and continues to the tail, which often has a white tip.

Skunk

Skunks prefer semi-open country and areas on the perimeters of human habitat. In addition to their distasteful odour and the havoc they cause around airport buildings, skunks are attractive prey to large raptors such as Great-Horned Owls and such mammals as wolves, foxes, and Coyotes. All skunks should be eliminated from airport lands.

Food and attractants
Skunks eat small mammals, eggs, carrion, insects, grubs, and garbage.

Similar species
None

Other Small Mammals

Attractants

Small mammals are attracted to airport lands by:

- the availability of food;
- the absence of humans; and
- the shortage of suitable habitat near airports.

Controls

- Ensure existing plant cover minimizes the attractants to small mammals. Use chemical poisons to eliminate attractant plant species. Reduce or eliminate broad-leaved plant cover, such as trees and shrubs. Mow grassy areas regularly. Use low, sparse-growing, small seed-head grasses.
- Eliminate attractive burrow sites, such as well-drained berms preferred by ground squirrels.
- Reduce damage to above- and below-ground electrical cables through the use of armoured sheathing. Stainless-steel or BX-metal sheathing should be used to protect cables from mice, pocket gophers, ground squirrels, and other small mammals.
- Apply chemical repellent coatings to above-ground electrical cables to reduce chewing damage caused by ground squirrels, pocket gophers, moles, and mice. Coatings should be re-applied every two years, or sooner, as rain and sunlight reduces effectiveness. See below for descriptions of suitable chemicals.
- Reduce the number of small rodents through poisoning programs conducted soon after spring thaws. The arrival of new rodents to previously treated areas may necessitate one or two additional applications. See below for descriptions of suitable chemicals.

The following chemical repellent coatings may be applied to above-ground electrical cables to reduce chewing damage:

Alphachlorohydrin

Repellent coating, moderately effective against small rodents and leporids

Thiram (Skoot)

Repellent applied as a paint-based mix, moderately effective against small rodents and leporids.

The following chemicals are recommended for use in poisoning programs against small mammals and rodents:

Chlorophacinone/diphacinone
Anticoagulant poison, moderately to highly effective against all small mammals.

Fumarin
Anticoagulant poison, moderately to highly effective against all small mammals.

Pindone
Anticoagulant poison, moderately to highly effective against all small mammals.

Warfarin
Most commonly used anticoagulant poison, highly effective against all small mammals.

Sodium monofluoro-acetate
Highly effective acute poison, toxic to all mammals and humans.

Strychnine
A restricted product, highly lethal to all mammals; its effectiveness is considered low due to poor bait acceptance.

Zinc phosphide
Acute poison, highly effective against all small mammals.

Aluminum phosphide
A restricted acute poison highly hazardous to humans; comes in tablet form that releases phosphine gas; moderately effective on ground squirrels and pocket gophers.

Hydrogen cyanide
A restricted, highly effective acute poison applied as dust and pumped into ground-squirrel and pocket-gopher burrows.

Section J

Improving Awareness of Wildlife-management Issues

Roles and responsibilities

Effective, comprehensive wildlife-management programs depend on the participation and co-operation of all airport personnel. While airport field personnel require precise operational awareness of specific measures at their airports, relevant working knowledge of wildlife-management policies and procedures should also extend to air-traffic service providers (ATS), airport-maintenance, planning, finance, marketing, and airline personnel. Authorities should ensure that awareness programs are in place to properly inform all airport workers.

The critical minute-to-minute operational communication between ATS providers and airport field personnel should also include co-ordination in planning efforts. Not only should ATS providers be involved in the development of wildlife-control programs, but also they should be consulted and informed regarding any changes to these initiatives.

Measures should be in place to ensure that airport-development practices are obliged to carefully consider the ramifications for wildlife control. Such wildlife hazard reviews ask key questions aimed at ensuring a safe environment.

- Are new hazards being created?
- Will existing hazards be compounded?
- Will existing wildlife-control programs be affected?
- What are the budgetary considerations for wildlife control?

Indeed, the operating costs of new wildlife-management programs—as well as initiatives upgraded to accommodate development—should be factored into the budgets of all construction projects.

The negotiation of airport agricultural leases should also respect the safety concerns of wildlife-management programs. All agreements should not only ban crops known to attract birds, but also they should allow for the immediate removal of crops that are found to draw new problem species to airports.

Budgetary considerations

Airport wildlife-management programs are not luxury items—they are critical expenditures that, in the long run, save money. Wildlife dispersal activities, for instance, ensure that taxiways and runways remain clear, ensuring airline schedules—and revenues—are unaffected. Habitat-management efforts reduce the numbers of hazardous birds—and the number of wildlife strikes. Fewer aircraft airframes and engines are damaged, saving literally millions of dollars in expensive maintenance. Finally—and in addition to the direct financial savings enjoyed through effective wildlife management—safer skies mean a confident fare-paying public, and demonstrate that wildlife control is, in fact, an investment.

Airlines should be considered active partners in the development and day-to-day implementation of wildlife-management programs. Airlines possess unique expertise and may be helpful in advising airport field personnel in effective control methods.

Reporting procedures

According to estimates, only 14 to 30 percent of all bird strikes are reported. As successful wildlife-management programs are derived in part from the critical information acquired through strike reports, it is imperative that the aviation industry ensures accurate and complete data are made available.

Airlines should be encouraged to notify airport ATS providers of all strikes, near misses and unusual bird activity. Transport Canada's *Bird/Wildlife Strike Report* can be used to note aircraft-wildlife interactions that occur in this country.

While most strikes involve commercial carriers, airports should not overlook the effects of bird strikes on general aviation, which accounts for the majority of aircraft movements at many airports.

Transport Canada Wildlife-management Resources

Transport Canada offers a wealth of resources to assist airports in developing and implementing effective wildlife-management programs. These materials—described below—may be viewed and ordered online at http://www.tc.gc.ca/AviationCivile/Aerodrome/menu.htm

Publications

Sharing the Skies (TP 13549E)

A strategic guide to airport wildlife management—the first book to deliver a comprehensive, system-safety approach to wildlife management in the aviation community. The first seven chapters of the book provide background information on problems associated with wildlife at airports; the final chapters offer a range of solutions.

Airport Wildlife Management Bulletins (TP 8240)

Published semi-annually, Transport Canada's wildlife management bulletins provide the aviation community with updated information and research on wildlife control and flight safety. The bulletins contain information concerning bird and wildlife strikes, as well as more extensive information on topics ranging from liability issues to wildlife-control technologies.

Pilot Brochure (TP 12422)

Designed for pilots, this brochure—*Bird Avoidance*—provides an overview of the bird-hazard problem, as well as best practices for preventing bird strikes.

Bird Strike Summary Report

The annual *Bird Strike Summary Report* provides brief, easy-to-read statistics and analysis on all bird- and wildlife-strike incidents reported at Canadian airports.

Bird/Wildlife Strike Report Form

These forms are used by airport personnel and pilots to report bird and mammal strikes to Transport Canada. This critical strike information is entered into the department's database, analyzed annually and compiled in the *Bird Strike Summary Report*. A copy of this form is attached in Appendix 3. Bird strikes may also be reported online at http://www.tc.gc.ca/Aviation/aerodrme/birdstke/strikes/index-f.htm

Videos

Crossed Paths

Offers a general overview of the hazards birds pose to aircraft. Also describes a number of measures that can be taken by airport operators to minimize the hazards, including habitat modifications and active bird-dispersal techniques.

There's Something Out There

Designed to compliment the wildlife-control training seminar developed by Transport Canada. This video provides specific instructions to those involved in the management of wildlife at airports and describes techniques currently being used in Canada, including habitat modification, falconry, and pyrotechnics.

Not In My Backyard

Designed for airport operators and municipal officials involved in establishing waste disposal facilities. This video examines the hazards posed by landfill sites adjacent to airports, and suggests a range of solutions.

Research papers

Evaluation of the Efficacy of Products and Techniques for Airport Bird Control (TP 13029)

This is an LGL Limited research paper that rates the effectiveness of products currently used in wildlife control at airports.

Evaluation of the Efficacy of Various Deer Exclusion Devices and Deterrent Techniques for Use at Airports

This is an LGL Limited research paper that examines the range of fencing and trapping methods available to keep deer off airfields.

Section K

Evaluating Wildlife-management Programs

Record keeping

As all wildlife-management programs should be closely monitored and evaluated on an on-going basis, maintaining complete and accurate records is critically important. Record keeping can be conducted using traditional paper records, but this approach limits the ability to effectively analyze data. Software is now available which permits not only the recording and analysis of airport wildlife-management data, but also the efficient development of risk assessments and management plans. Canadian suppliers of wildlife-management software are listed at the end of this section.

At a minimum, records should include:

- wildlife species and numbers both prior to and during the implementation of control programs; and
- details of wildlife-control methods, such as types of control and frequency of application.

Long-term record keeping assists airport authorities by:

- providing complete histories of wildlife movements and preferred habitats;
- measuring the overall effectiveness of wildlife-control initiatives;
- predicting the arrival times of major migrant species;
- determining major wildlife trends at airports; and
- estimating the costs of wildlife control programs.

Daily recording forms

Completed on-site by airport personnel directly involved in wildlife-control activities, daily recording forms contain information on:

- dates and times of animal observations,
- details of animal actions,
- species identification,
- estimated numbers of observed animals,
- locations where observations took place,
- control methods implemented, and
- immediate effects, if any.

A sample recording form—*Wildlife Control Activities*—is provided in Appendix 4. This standardized form provides entries under the following headings:

Date:
Recording the dates of wildlife observations assists in identifying seasonal trends, and allows follow-up investigations on factors such as weather patterns.

Time Start:
When used in combination with "*Time Finish*", this information accurately indicates the time devoted to particular control methods, as well as person-hours required to employ them.

Numbers and Type:
Using field guides for reference, information concerning the types and numbers of bird or mammal species should be entered as accurately as possible.

Control Method:
Recording the control methods used to counter problem species assists in the evaluation of the effectiveness of wildlife-control programs.

Result/Effects and Comments:
Allows for concise observations of the immediate effects delivered through the applied control method.

Location:
This should be habitat-specific, identifying such areas as short or long grass, ponds or runways. The accurate identification of problem locations allows airport personnel to target specific attractants.

Weather:
Weather conditions should be limited to one or two descriptive terms, such as cloudy/rain or sunny/windy.

Initials:
This section identifies the airport personnel who recorded the data.

A preliminary checklist

As critical a task as it may be, developing an effective airport wildlife-control program is also a monumental challenge. Authorities will face a number of questions throughout the process, and perhaps the following list should be among them. Far from exhaustive, this list may nonetheless provide important

preliminary indications about an airport's level of preparedness. (Appendix 5 of this manual contains a detailed civil-airport, wildlife-control program assessment system.)

If the answer to any one of these questions is *"no,"* then the work of preparing an airport to counter the many hazards posed by wildlife may be far from over:

- Has an airport-specific wildlife risk assessment been conducted?
- Has a wildlife-management plan been developed?
- If so, has the plan been implemented?
- Has an on-site wildlife-control officer been appointed and assigned responsibilities?
- Has a program been developed to train those involved in wildlife control?
- Has a wildlife-control coordinating committee been established and provided with well-defined responsibilities and terms of reference?
- Has a memorandum of understanding been signed by all concerned parties, including ATS providers, wildlife-control officers, and airport operations managers?
- Has a reporting procedure been developed to cover all aspects of the wildlife-control program?
- Has a land-use strategy been established regarding lands on and near the airport?
- Has an ecological survey been conducted?
- Has a list of all on-site attractants been completed?
- Has a list of all attractants in the surrounding area been completed?
- Have control methods been researched and implemented at the airport?

Additional information regarding the Canadian Aviation Regulations (CARS) requirements and standards for wildlife management and planning at Canadian airports is included in Appendix 1.

Sources for record-keeping software

Winfield Solutions
Phone: (613) 398-1221
Website: www.winfieldsolutions.com
E mail: winsol@reach.net

Intercept Technologies Inc.
Phone: (905) 936-5469
E mail: rennie@intercept-technologies.com

Appendices

Appendix 1

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Appendix 2

Common Bird Zoonoses

Common Bird Zoonoses

Type	Arboviral encephalitis	Histoplasmosis	Psittacosis
Description	Inflammation of the brain caused by Arboviral infection.	Infection by the pathogenic fungus *Histoplasma capsulatum.*	Infection by the bacterium *Chlamydia psittaci.*
Birds Involved	Many species such as waterfowl and wild birds.	No birds directly involved as the fungus, *H. capsulatum*, does not infect birds.	Found in both wild and domesticated birds but is more commonly found in the latter.
Source or mode of infection	Transferred to birds from blood-sucking insects (such as mosquitoes and ticks). Humans acquire it from infected mosquitoes.	Acquired through inhalation of spores from fungus in soils contaminated by bird droppings.	Transmitted to host through inhalation of aerosolised particles or by ingesting contaminated food; also acquired through direct contact with infected bird tissues, feces and secreta.
Clinical signs of infection in people	*First symptoms*: fever, chills and headache. *More serious symptoms*: drowsiness, nausea, coma, confusion, rigidity and convulsions; may cause death.	*Different indications of symptoms depending on severity*: ranging from asymptomatic to permanent pulmonary calcification and permanent lesions.	Mostly asymptomatic or mild. *Mild symptoms*: similar to flu. *Severe symptoms*: fever, chills, malaise, myalgia, loss of appetite, headache, cough and chest pain.
Precautions and preventions	Prevent mosquito bites by wearing protective clothing; use repellents, scare tactics and mosquito netting and screening; modify habitats.	Clean up bird droppings regularly; moisten droppings to prevent spores from becoming airborne; wear face masks, disposable coveralls, gloves, boots, surgical caps and goggles during clean-up.	Wear gloves to prevent bird bites and direct contact with feces; wear facemasks, protective clothing and surgical caps; moisten and spray a 1% solution of household disinfectant on the dropping to prevent the bacteria from becoming airborne.

Appendix 3

Bird/Wildlife Strike Report Form

Transport Canada Safety and Security | Transports Canada Sécurité et sûreté

Canada

Bird/Wildlife Strike Report | **Rapport d'impact d'oiseau/de mammifère**

TYPE
- ☐ Bird Strike/Impact d'oiseau
- ☐ Bird Near Miss/Quasi-impact d'oiseau
- ☐ Mammal Strike/Impact de mammifère
- ☐ Mammal Near Miss/Quasi-impact de mammifère

DATE | LOCAL TIME / HEURE LOCALE

REPORTING SOURCE / SOURCE DU RAPPORT
- ☐ Pilot/Pilote
- ☐ Site
- ☐ Other/Autre
- ☐ Airline/Compagnie aérienne
- ☐ Municipality/Municipalité

OPERATOR / EXPLOITANT | HEIGHT (AGL, feet) / HAUTEUR (AGL, pieds) | SPEED (IAS, knots) / VITESSE (vi-tesse, nœuds)

AIRCRAFT INFORMATION / INFORMATION SUR L'AÉRONEF

Model/Modèle	Registration/Immatriculation	Engine Type/Type de moteur
Make/Marque	Flight No./N° de vol	Engine Make/Marque du moteur

AIRPORT / AÉROPORT | Name/Nom | Code | Province | Region/Région | Runway/Piste

PHASE OF OPERATION / PHASE DE L'EXPLOITATION
- ☐ Take-off Run/Roulement au décollage
- ☐ Climb/Montée
- ☐ En route/Croisière (Distance from Airport/Distance de l'aéroport _____)
- ☐ Approach/Approche
- ☐ Descent/Descente
- ☐ Landing Roll/Roulement à l'atterrissage
- ☐ Taxi/Circulation au sol
- ☐ Parked/Stationnement

PARTS STRUCK/AVARIÉES

PARTIES TOUCHÉES/ DOMMAGÉES	Struck / Touchée	Damaged / Endommagée
Radome/Radôme		
Windshield/Pare-brise		
Nose/Partie avant de l'appareil		
Engine/Réacteur 1		
Engine/Réacteur 2		
Engine/Réacteur 3		
Engine/Réacteur 4		
Propeller/Hélice		
Wings/Ailes		
Rotor/Rotor		
Fuselage		
Landing Gear/Train d'atterrissage		
Tail/Queue		
Lights/Feux		
Pitot Static/Antenne Pitot		
Tail Rotor/Rotor anticouple		
Other/Autre _____		

EFFECT ON ABORTED FLIGHT / EFFET(S) SUR L'ABANDON DU VOL

None / Aucun	
Aborted Takeoff / Décollage interrompu	
Precautionary Landing / Atterrissage de précaution	
Engine(s) Shut Down / Arrêt de(s) moteur(s)	
Forced Landing / Atterrissage forcé	
Fire / Feu	
Penetration of Airframe / Pénétration de la cellule	
Vision Obscured / Visibilité réduite	
Engine Ingestion / Ingestion dans le moteur	
Engine Uncontained Failure / Panne de moteur sans perforation	
Other / Autre _____	

LIGHT CONDITIONS / CONDITIONS D'ÉCLAIRAGE

Dawn / Aube	
Day / Jour	
Dusk / Crépuscule	
Night / Nuit	

SKY CONDITION / ÉTAT DU CIEL

No Cloud / Pas de nuage	
Some Cloud / Quelques nuages	
Overcast / Couvert	

PRECIPITATION / PRÉCIPITATIONS

Rain / Pluie	
Fog / Brouillard	
Snow / Neige	
Other / Autre _____	

BIRD / MAMMAL INFORMATION / INFORMATION CONCERNANT L'OISEAU OU LE MAMMIFÈRE

SPECIES – COMMON NAME / ESPÈCE – NOM COMMUN

SCIENTIFIC NAME / NOM SCIENTIFIQUE

SIZE OF BIRD / TAILLE DE L'OISEAU
- ☐ Small/Petit
- ☐ Medium/Moyen
- ☐ Large/Grand

NUMBER OF BIRDS / NOMBRE D'OISEAUX	Seen / Aperçu	Struck / Touché
1		
2-10		
11-100		
Mass/Plus		

BIRD REMAINS SUBMITTED FOR IDENTIFICATION? / LES RESTES DE L'OISEAU ONT-ILS ÉTÉ CONFIÉS POUR IDENTIFICATION? ☐ Yes/Oui ☐ No/Non

PILOT WARNED OF BIRDS? / PILOTE AVISÉ DE LA PRÉSENCE DES OISEAUX? ☐ Yes/Oui ☐ No/Non

Transport Canada Bird/Wildlife Strike Report Form.

Bird/Wildlife Strike Report **Rapport d'impact d'oiseau/de mammifère**

Reason for Failure/Shutdown Raison de la panne/de l'arrêt du moteur	Engine Motor No. – N° du moteur: 1	2	3	4	Comments – Commentaires
Engine Uncontained Failure Panne de moteur avec perforation des parois					
Fire Feu					
Shutdown - Vibration Arrêt-moteur - Vibrations					
Shutdown - Temperature Arrêt-moteur - Température					
Shutdown - Fire Warning Arrêt-moteur - Alarme incendie					
Shutdown - Arrêt-moteur Other (specify)/Autre (préciser)					
Shutdown Unknown Arrêt-moteur inconnu					
Estimated % of Thrust Lost Estimation en % de la perte de puissance					
Estimated Number of Birds Ingested Estimation du nombre d'oiseaux impliqués					

Additional Information
Information supplémentaire

Cost Information
Information sur les Coûts

DAMAGE CATEGORY (DNE)
CATÉGORIE ENDOMMAGÉE (MDN)

Aircraft Time Out of Service/
Durée de la mise hors service de l'aéronef

Hours
Heures

Estimated Cost of Repairs or Replacement/
Estimation des coûts de réparation ou de remplacement

$CDN

(In Thousands/En milliers)

Estimated Other Costs (e.g., Loss of Revenue, Hotels)
Estimation des autres coûts (ex., perte de revenus, hôtels)

$CDN

(In Thousands/En milliers)

Remarks – Remarques

Report By / Déclaré par: Date:

Organization / Organisation: Telephone (optional) / Téléphone (facultatif): ( )

Transport Canada Bird/Wildlife Strike Report Form. (back)

Form Approved OMB NO. 2120-0045

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 — ☐ AM ☐ PM
☐ Day ☐ Night — ☐ AM ☐ PM

7. Airport Name

8. Runway Used

9. Location If En Route

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

12. 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 of 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. $)
$

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 this 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, ASP-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 (6/91) Supersedes Previous Edition

U.S. GPO: 1997-418-086/54003

NSN 0052-00-021-9005

U.S. Department of Transportation Bird/Wildlife Strike Report Form.

Appendix 4

Wildlife Control Activities

Wildlife Control Activities

____

Daily Log

Date: ____________________________ W.C.O.: _____________________________

Time Start/Finish: Type (Species): Control Method: Weather:

Location: Number: Result/Effects and Comments: Initials:

Time Start/Finish: Type (Species): Control Method: Weather:

Location: Number: Result/Effects and Comments: Initials:

Time Start/Finish: Type (Species): Control Method: Weather:

Location: Number: Result/Effects and Comments: Initials:

Time Start/Finish: Type (Species): Control Method: Weather:

Location: Number: Result/Effects and Comments: Initials:

Time Start/Finish: Type (Species): Control Method: Weather:

Location: Number: Result/Effects and Comments: Initials:

Time Start/Finish: Type (Species): Control Method: Weather:

Location: Number: Result/Effects and Comments: Initials:

Time Start/Finish: Type (Species): Control Method: Weather:

Location: Number: Result/Effects and Comments: Initials:

Time Start/Finish: Type (Species): Control Method: Weather:

Location: Number: Result/Effects and Comments: Initials:

Sightings: (A - Airfield, V - Vicinity)

Birds: Mammals:

Appendix 5

Wildlife Hazard Management Assessment

Bird Strike Committee Europe
BSCE22/WP
Vienna, 29 August to 2 September 1994

Assessing The Implementation Of Wildlife Hazard Management Programs At Civil Airports

John L. Seubert

Abstract

This paper describes a proposed system for assessing the implementation of wildlife hazard management programs at civil airports. Important management functions and control techniques for controlling wildlife hazards are listed; and habitats, land uses, and food sources are identified that are attractive to wildlife on or in the vicinity of airports.

(Keywords: Wildlife Hazards, Civil Airports)

Wildlife often cause hazards to aviation and many airports have developed wildlife management programs to alleviate these hazards. For example, in recognition of this problem at certified civil airports in the United States, Federal Aviation Administration regulations require the development of wildlife hazard management plans if ecological studies show that wildlife cause safety problems (FAA 1987). The purpose of this paper is to propose a system for assessing the implementation of existing wildlife hazard management programs at either certified or uncertified civil airports. The only papers found describe various methods for evaluating bird management on military aerodromes (Lucid and Slack 1980, Rosseleer 1981, Kull 1984). This paper concerns civil airports and employs different methods.

As the result of a review of pertinent literature, personal knowledge, and discussions with individuals directly involved in controlling wildlife hazards to aviation, I have identified key elements of wildlife hazard management programs. (For the purpose of this paper, domestic animals are included under wildlife.) Management functions and control techniques for mitigating wildlife hazards are listed; and habitats, land uses, and food sources are identified that are attractive to wildlife on or in the vicinity of airports. In this system, the elements described in Tables 1-4 are assessed as to the degree that management programs are being implemented. Assessments should be periodic, at least twice a year, so that shortcomings and improvements can be detected (Exhibit A). The table listings are not intended to cover every possibility – the lists can be changed to meet differing situations.

The proposed system would provide a rapid means of assessing civil airport programs to control wildlife hazards. This would provide benefits to airport administration/management, government agencies responsible for aviation safety, or other organizations that assist in programs to enhance safety, such as aviation insurance underwriters, or consultants.

Four assessment categories are used to indicate how well airport wildlife hazard management plans are being implemented. If an assessor finds that an airport has initiated action to reduce a wildlife hazards according to plan and is on schedule, the action would be considered satisfactory, and the assessment symbol (AS) checked (✓) would be “S”. If no measures have been taken, the assessment would be unsatisfactory – “U”. If implementation of a control measure was behind schedule or only partially accomplished, the assessment could be either needs improvement “NI”, or unsatisfactory “U”, depending on the seriousness of the hazard. If it is apparent that certain listed techniques or items are not applicable, the assessment would be “NA”. If an assessment

is either "NI" or "U", a comment by an assessor is required (Exhibit A). Examples of assessments requiring comments are as follows:

A. Management functions related to wildlife hazards on or in the vicinity of airports (Table 1).

- If permits have not been obtained (Code 1.1) for shooting or trapping birds and/or mammals the AS would be "U".
- If animal remains found on runways are being counted to document bird strikes, but are not being identified by species (Code 1.9) the AS would be "NI".

B. Bird control on or in the vicinity of airports (Table 2).

- If bioacoustics were not being used (Code 2.4) the AS would be "U".
- If the installation of plastic or steel wires (Code 2.11) over two airport ponds was behind schedule the AS could be "NI" or "U", depending on the degree of potential hazard.
- If the raptors were not being trapped and relocated (Code 2.24), the AS would be "U".

C. Mammal control on or in the vicinity of airports (Table 3).

- If fencing (Code 3.3) was in need of repair the AS would be "NI".
- If rodenticides (Code 3.12) were not being used to control a rodent population attracting raptors, the AS would be "U".

D. Airport habitat and food sources related to wildlife hazards (Table 4).

- If airport litter control was inadequate (Code 4.17), the AS would be "NI".
- If vegetation used as a roost site (Code 4.29) was not being eliminated or made unattractive, the AS would be "U".

Examples of off-airport land uses and food sources are listed in Table 5. Wildlife hazards to airports frequently are attributable to these attractants, but airport managers have no authority over the use of private property. On rare occasions, relief might be obtained if a business or a landowner has not complied with zoning, health, or safety regulations (e.g. garbage dumps). Airport managers should initiate programs to reduce/eliminate the hazards of off-airport wildlife attractants (e.g., garbage dumps, certain agricultural activities), by informing local jurisdictions and landowners of the hazards, and suggesting ways of alleviating them (Code 1.8).

Table 1. Management Functions Related To Wildlife Hazards On Or In The Vicinity Of Airports

CODE	ITEMS	ASSESSMENT S	NI	U
1.1	Acquiring wildlife control permits from federal, state, and local agencies.			
1.2	Arranging for ecological assessments, studies, and monitoring, as needed, to evaluate the hazard potential of wildlife attracted by habitats, land uses, and food sources located on or in the vicinity of airports.			
1.3	Delegating authority and responsibility.			
1.4	Ensuring that airport habitats are managed to reduce or eliminate wildlife attractions.			
1.5	Ensuring that airport policy prohibits the feeding of wildlife and the exposure of food wastes.			
1.6	Establishing a communication capability between wildlife control and ATC personnel.			
1.7	Evaluating wildlife hazard management programs – at least twice a year.			
1.8	Interacting with local jurisdictions and land owners about zoning, land use, and the resolution of wildlife hazard problems in the vicinity of airports.			
1.9	Maintaining wildlife control log books that would be a daily record of wildlife control activities, environmental changes, wildlife interactions, and animal remains identified by species.			
1.10	Maintaining a system for warning pilots about wildlife hazards (NOTAMs, ATC, BIRDTAMs, RADAR observations, etc.).			
1.11	Monitoring bird concentrations (e.g. local movements).			
1.12	Operating a wildlife patrol system with a trained field staff (wildlife specialists, control officers, etc.), conducting surveillance/inspections of critical airport areas (runways, etc.), and effecting wildlife control when needed or requested.			
1.13	Reporting all aircraft wildlife interactions to aviation authorities (e.g. bird strikes).			
1.14	Supervising, implementing, and coordinating airport wildlife hazard management programs.			
1.15	Training personnel responsible for implementing airport wildlife hazard management programs, especially the field personnel.			

Table 2. Bird Control On Or In The Vicinity Of Airports

CODE	ITEMS	ASSESSMENT S	NI	U	NA
	Disperse, Deter, Exclude, Repel				
2.1	Arm waving (24/min.)				
2.2	Avitrol				
2.3	Balloons suspended above ponds				
2.4	Bioacoustics				
2.5	Chemical repellents				
2.6	Electronically generated noise (e.g. Av-Alarm)				
2.7	Falconry				
2.8	Tall grass/short grass				
2.9	Netting				
2.10	Nixalite (stainless steel needles placed on ledges)				
2.11	Plastic or steel wires				
2.12	Propane cannons				
2.13	Pruning vegetation				
2.14	Pyrotechnics				
2.15	Radio-controlled small aircraft				
2.16	Scarecrows				
2.17	Shooting to scare				
2.18	Stuffed birds, gull models, raptor decoys				
	Remove				
2.19	Drugging				
2.20	Nest and egg destruction, oiling eggs				
2.21	Poisoning				
2.22	Predators (dogs, foxes, coyotes, pigs, etc.)				
2.23	Shooting				
2.24	Trapping and relocation (e.g. raptors, geese)				

Table 3. Mammal Control On Or In The Vicinity Of Airports

CODE	ITEMS	ASSESSMENT S	NI	U	NA
	Disperse, Deter, Exclude, Repel				
3.1	Cattle guards				
3.2	Chemical repellants sprayed on vegetation				
3.3	Fencing				
3.4	Herding				
3.5	Pyrotechnics				
3.6	Rodent resistant sheathing on electrical and communication cables				
	Remove				
3.7	Controlled hunting (e.g. deer, canines)				
3.8	Den destruction (e.g. foxes, coyotes)				
3.9	Fumigants/gas cartridges (woodchucks, etc.)				
3.10	Kill trapping (e.g. beavers, muskrats)				
3.11	Live trapping and relocation or euthanasia (dogs, etc.)				
3.12	Rodenticides (mice, ground squirrels, etc.)				
3.13	Shooting (woodchucks, badgers, rabbits, hares)				
3.14	Tranquilizing and relocation (e.g. deer)				

Table 4. Airport Habitat And Food Sources Related To Wildlife Hazards

CODE	ITEMS	ASSESSMENT S	NI	U	NA
4.1	Agricultural crops (grains, forage, legumes, etc.)				
4.2	Animal remains				
4.3	Apiaries				
4.4	Aquatic vegetation				
4.5	Canals, creeks				
4.6	Commissaries, aircraft waste				
4.7	Culverts (open)				
4.8	Drainage ditches				
4.9	Earthworms				
4.10	Feeding birds and mammals (by people)				
4.11	Flat roofs (gull nesting sites)				

Table 4. (continued)

CODE	ITEMS	ASSESSMENT S	NI	U	NA
4.12	Fishing from shore (bait, fish)				
4.13	Garbage dumps				
4.14	Insects				
4.15	Landfills containing organic matter				
4.16	Landscaping				
4.17	Litter				
4.18	Low areas (puddles)				
4.19	Marshes, swamps				
4.20	Mud flats				
4.21	Nesting sites (gulls, egrets, raptors, etc.)				
4.22	Oxidation ponds (sewage)				
4.23	Pastures, grassland (livestock, ungulates, rodents, raptors, etc.)				
4.24	Plowing, cultivation, haying, harvesting, etc. (rodents, insects, worms)				
4.25	Reptiles, amphibians, fish				
4.26	Reservoirs, lakes, natural ponds				
4.27	Retention ponds (water, de-icing fluid)				
4.28	Rodents, beavers, muskrats, rabbits, hares, raccoons, skunks, badgers, etc.				
4.29	Roosting vegetation (starlings, crows, egrets, etc.)				
4.30	Sand and gravel quarries, borrow pits				
4.31	Seed producing vegetation				
4.32	Sewage lagoons				
4.33	Sewage outfalls				
4.34	Sewage sludge				
4.35	Shorelines				
4.36	Structures (buildings, hangers, lights, towers, signs, poles, etc.)				
4.37	Trees, brush, shrubs, woodlots (cover, browse, etc.)				
4.38	Water fountains				
4.39	Waterways				
4.40	Weeds				

Table 5. Off-Airport Land Uses And Food Sources Related To Wildlife Hazards

CODE	ITEMS
5.1	Agricultural crops (grains, forage, legumes, etc.)
5.2	Apiaries
5.3	Bird-feeding stations
5.4	Canals, creeks
5.5	Coastal commercial fish-processing plants
5.6	Drive-in theatres
5.7	Fishing from shore (bait, fish)
5.8	Flat roofs (gull nesting sites)
5.9	Garbage barges
5.10	Garbage dumps
5.11	Garbage transfer stations
5.12	Landfills containing organic waste
5.13	Livestock feedlots, piggeries
5.14	Lure/decoy sites (roosting, nesting, etc.)
5.15	Marinas
5.16	Marshes, swamps
5.17	Mud flats
5.18	Nesting sites (gulls, egrets, raptors, etc.)
5.19	Orchards, berry farms
5.20	Oxidation ponds (sewage, feedlots, etc.)
5.21	Pastures, grassland (livestock, ungulates, rodents, raptors, etc.)
5.22	Picnic areas
5.23	Ploughing, cultivation, haying, harvesting (rodents, insects, worms)
5.24	Reservoirs, lakes, natural ponds
5.25	Restaurants/cafes (outdoors)
5.26	Retention ponds (water, feedlots, etc.)
5.27	Roosting vegetation (starlings, crows, egrets, etc.)
5.28	Sand and gravel quarries, borrow pits
5.29	Seed producing vegetation
5.30	Sewage lagoons
5.31	Sewage outfalls
5.32	Sewage sludge
5.33	Shorelines
5.34	Trees, brush, shrubs, woodlots (cover, browse, etc.)
5.35	Vineyards
5.36	Waterfowl refuges, wintering areas

EXHIBIT A

The following form would be used by an assessor to record visits to airports and comments when necessary:

Airport Assessment Summary Form

Airport Date

Manager Phone Fax

Assessors Name and Affiliation Phone

Fax

Assessors Comments re implementation of applicable Coded Items

Code	Assessment Symbol	Comment

(Note: Use extra sheets for comments as needed.)

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Appendix 6

Canadian Aviation Regulation (CARS) Wildlife Management and Planning

A change in priorities related to the events of September 11 has delayed the development of the Canadian Aviation Regulation, *Wildlife Management and Planning.* The appendix containing the regulatory package will be distributed upon completion of the development process.