ALPA WHITE PAPER
AIR LINE PILOTS ASSOCIATION, INTERNATIONAL
1625 Massachusetts Avenue, N.W., Washington, D.C. 20036
703-481-4440 ▪ MEDIA@ALPA.ORG ▪ WWW.ALPA.ORG

Wildlife Hazard Mitigation Strategies for Pilots

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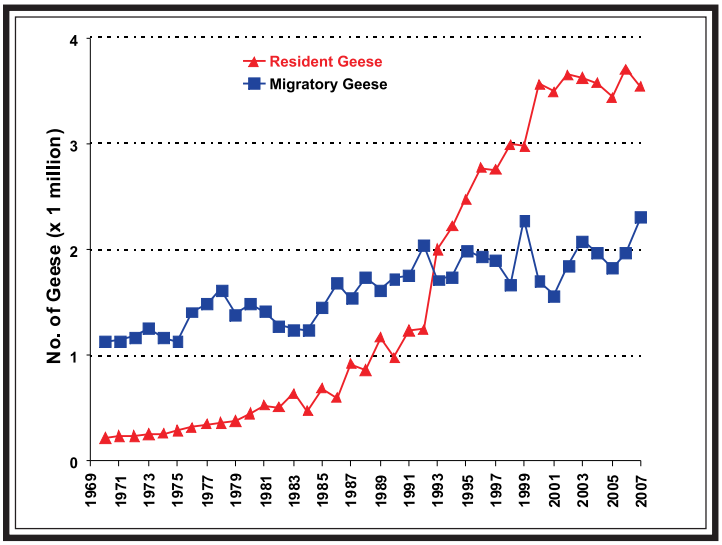
Executive Summary

From the very beginning of powered flight, pilots have competed with birds for airspace, sometimes with disastrous results.

Over the years, there have been many efforts to create a better way to "see and avoid" birds and wildlife on the ground and in flight. Several aspects of modern transport aircraft have been designed to reduce the risk associated with the hazard of bird and other wildlife strikes. However, certain attributes of these aircraft make them more vulnerable to damage, including high-speed operations, large engine inlets, and large airframe sizes.

To complicate the issue, the number of birds and their size are both increasing. Conservation efforts have resulted in the resurgence of a variety of species. While this offers an ecological benefit, it also creates a major issue for aircraft. Large flocking birds such as geese and other waterfowl are of particular concern, as each individual bird is capable of destroying an aircraft engine. When the hazard is multiplied by several hundred birds in a flock, the problem is greatly exacerbated.



Canada goose population and strike trends—Dolbeer and Seubert, 2007

This paper is intended to inform airline pilots of the risk posed by bird and wildlife strikes, the kinds of actions that airport authorities may take to limit this risk, and, finally, what specific actions they and their companies can take to further reduce the risk.

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Bird Strikes—Dangerous and Expensive

The first recorded bird strike was reported by the Wright brothers in 1905. According to their diaries, "Orville … flew 4,751 meters in 4 minutes 45 seconds, four complete circles. Twice passed over fence into Beard's cornfield. Chased flock of birds for two rounds and killed one which fell on top of the upper surface and after a time fell off when swinging a sharp curve." The first recorded bird strike fatality was reported in 1912 at Long Beach, California, when aero-pioneer Cal Rodgers collided with a gull that became jammed in his aircraft controls, causing him to crash.

Although few, if any, pilots desire to intentionally chase birds today, not much progress has been made in helping pilots avoid bird strikes either. Annually, bird and other wildlife strikes cause in excess of 1.2 billion USD damage to civilian aircraft around the world. In the United States alone, the FAA estimates some $600 million annually in damage and associated costs. Although bird strikes that result in commercial aviation fatalities are rare, this risk has brought down several aircraft and has seriously damaged many more.

Most reported bird strikes to civil aircraft in the U.S. occur in the airport environment at low altitudes[1]:

- 92% of all strikes occur below 3,000 feet AGL.
- 42% of reported strikes to civil aircraft in the United States occur on the ground during takeoff or landing.
- 73% of strikes occur at less than 500 feet above ground level (AGL).
- 2,014 strikes occurred above 5,000 feet AGL between 1990 and 2007.
- The U.S. record height for a civil aircraft strike is 32,500 feet.

Both the probability and severity of bird strikes is increased for transport aircraft compared to smaller, slower aircraft, due to a number of factors[2]:

- Operating speeds are higher, reducing the time available to observe wildlife activity and increasing potential impact force and damage should a bird strike occur.
- The physical size of these aircraft means more airframe is exposed; an encounter with a flock of birds might lead to damage at numerous locations on the aircraft.

[1] Source: *Wildlife Strikes to Civil Aircraft in the United States, 1990–2007* (Federal Aviation Administration and Department of Agriculture, June 2008).

[2] Source: *Sharing the Skies: An Aviation Industry Guide to the Management of Wildlife Hazards* (Transport Canada, 2nd edition, March 2004).

- The aircraft are larger and less maneuverable, making evasive action difficult.
- Large aircraft provide a greater opportunity for multiple bird strikes while flying through a flock of birds. Cockpit location can restrict visibility, limiting the ability to see birds and mammals.
- The extreme workload during critical flight phases means the flight crew has limited time in which to observe wildlife activity.
- Use of alternate runways to avoid bird concentrations at busy airports can lead to significant delays. Commercial aircraft operating from busy airports are subject to tight schedule constraints; arrival and departure flexibility is limited when attempting to avoid wildlife activity.
- In the takeoff phase, commercial aircraft are frequently governed by published departure procedures and noise and traffic-management requirements, limiting the ability to adopt alternate flight paths to avoid areas of bird activity.
- In the approach and landing phase, constraints are similar to those for takeoff and climb. Flight profiles are governed by published approach procedures. At large airports, sequencing high volumes of traffic further restricts flight path flexibility.

Airports in the United States and Canada are required to take proactive measures to reduce the potential for bird and wildlife strikes on or near their facilities. The Federal Aviation Administration (FAA) requires commercial service airports to conduct wildlife hazard assessments and implement a wildlife hazard management plan, if warranted. Airport operators scare birds and wildlife away from aircraft operating areas using such measures as air guns, lasers, and wildlife patrols, and they use fencing and extermination to reduce the threat posed by large mammals such as deer. While these measures can be useful for reducing the number of strikes on the airport surface or near the airport, they may do little or nothing to prevent bird strikes encountered by aircraft on an approach to, or climbing out from, an airport.

FAA began conducting research on the use of radar for bird avoidance in 2000. The goal is to determine if low-cost radars can reliably detect birds at airports, or within 3–5 miles of an airport, and develop an airport bird strike advisory system. The information might be transmitted directly to the cockpit to help pilots avoid large flocks of birds, and/or be provided to the airport operations center. The FAA is currently evaluating the use of radar for such purposes at several airports around the country, and it is planned for several more, including Chicago O'Hare, Dallas–Fort Worth, and John F. Kennedy International airports.

Pilot Procedures and Vigilance

While the airport operator is responsible for taking action to reduce the potential for bird and wildlife strikes on its facilities, the pilot in command is ultimately responsible for taking every reasonable precaution to operate safely. For that reason, wildlife avoidance techniques and guidance, such as that in the Aeronautical Information Manual (AIM), should be included in flight operations manuals, training materials, and other company guidance for flight crew. However, anecdotal evidence suggests that some companies may not provide any such guidance at all. In a nonscientific survey conducted at an international bird strike conference in 2007, all flight crew attendees participating in a discussion of operational avoidance methods were asked if any guidance had been provided to them by their respective flight operations departments. Without exception, the answer was an emphatic "NO."

Mitigation strategies that may be employed by flight crews range from simple tactics to more complex, and possibly more costly, solutions. For example, if birds are observed near the departure runway, takeoff can be delayed until the pilot notifies ATC and the hazard is removed. In this case, a relatively simple and low-cost procedure can easily be used by the flight crew to reduce the hazard for *their* takeoff. The same technique may need to be used by the flight crew of other departing aircraft as well.

The same process can be used for landing, but it is generally more difficult to visually identify bird and wildlife hazards while on approach. Consequently, it is imperative for all crews to report any birds or other wildlife hazards that they observe on their landing, in order to enable ground personnel to attempt to remove them and provide real-time information to following aircraft. If a serious hazard is present, the landing runway may be changed or an approach abandoned to afford ground personnel time to employ removal tactics.

Some regulators provide information on bird migration patterns and numbers, along with species types and approximate annual times of migration. While this data may offer useful information to ornithologists, it is not of much "real time" use to flight crew members. Likewise, repetitive, generic warnings such as ATIS broadcasts stating, "Migratory birds in the vicinity of the airport" provide pilots with little useful information. What is needed is timely, specific information on where the birds are *now* and how that information relates to the approach or departure being flown. If necessary, to avoid the threat, a different approach could be flown to another runway, a missed approach could be flown to allow ground personnel time to remove or reduce the hazard, or a different runway could be used for takeoff.

One example of an accident that might have been avoided had better information been available to the flight crew occurred November 5, 2000, involving a Dash-8 on approach at night to runway

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08 at Toronto's City Centre Airport. Just as the aircraft flared to land, the landing lights illuminated a flock of Canada geese resting on the threshold. The birds, startled by the landing lights, flew up, and as a result, the aircraft suffered numerous bird strikes and severe damage to both propellers and one engine. The vibration at idle power almost shook the engine from its mounts until it could be secured. Historical data from past investigations indicates that if a go-around had been attempted, it very well may have resulted in a hull loss. Regular inspections of the landing runway, particularly at night or when the runway is not visible from the tower or FSS, can alert airport authorities to the presence of wildlife at the airport. This event also demonstrates that wildlife strikes can be dangerous even at lower speeds.

There are some excellent wildlife avoidance and risk-mitigation recommendations for pilots in the Transport Canada publication *Sharing the Skies: An Aviation Industry Guide to the Management of Wildlife Hazards* (2nd edition, March 2004):

Pre-start

- Prior to engine start, review emergency procedures pertinent to your aircraft type and operation. Pay particular attention to rejected-takeoff and engine-failure procedures.

Taxiing for Takeoff

- Takeoff is a critical phase of flight; strike statistics show that 31% of bird strikes and 39% of mammal strikes occur during this phase.
- Be alert while taxiing for takeoff and note any bird and mammal activity reports by ATS providers and other operators.
- While taxiing, report wildlife activity observed on ramps, taxiways, and runways to ATS providers, UNICOM, and other aircraft.
- Be especially vigilant when operating at airports that either do not have ATS providers or have limited hours of ATS operation. Often, these airports have no formal wildlife monitoring or management. Prior to takeoff, it may be necessary to back-taxi the length of the active runway to ensure that there are no birds or mammals.

Takeoff

- Be aware of conditions that may affect your ability to either reject the takeoff or continue flying under reduced aircraft performance.

- Before commencing takeoff, check the runway once more for wildlife; many birds stand on concrete and asphalt surfaces to warm themselves and to gain a clear view of any approaching predators.
- Be aware that an aircraft taking off in front of you may frighten birds and mammals into your flight path.
- If there is bird activity on the runway, be prepared to wait for wildlife management personnel to clear the birds. If traffic and weather conditions permit, use another runway. Wildlife hazards should be treated like any other flight safety hazard—if any doubt exists concerning safety, delay your takeoff until conditions are right.
- Use landing lights during takeoff. Although there is no conclusive evidence that birds see and avoid aircraft lights, limited data and anecdotal evidence suggest landing lights—particularly pulsed landing lights—make the aircraft more visible to birds and provide more time for the animals to avoid the aircraft.
- Aircraft weather radar are not effective as a means of warning birds; they do not sense the low power emissions and frequencies of these units.
- Select engine ignition "on" for takeoff to enhance engine flameout protection when operating turbine-powered aircraft in the presence of birds.
- Should a bird or mammal strike occur during the takeoff roll, a rejected takeoff is the safest course of action when prevailing conditions are appropriate. When safe, vacate the runway and shut down aircraft engines. Before continuing the flight, have the aircraft thoroughly inspected, preferably by an aircraft maintenance engineer (AME).

Climb-Out

- Be prepared to adjust your climb route to avoid birds.
- The best way to reduce the probability of a bird strike is to maximize rate of climb on departure. [Pilots of] jet aircraft should use the ICAO Vertical Noise Abatement Profile 'A' (VNAP 'A'). [*Note*: ALPA does not endorse using any profile that differs from those approved for use by the pilot's airline employer.] The benefits are:
  - low aircraft speed (V2 + 10), which reduces impact force. The most effective way to reduce the severity of a bird strike is to reduce speed. Bird-impact force increases as the square of speed; doubling speed increases the impact force by a factor of four;
  - rapid climb rate to get above where most bird strikes occur (below 3,000 ft. AGL) as quickly as possible; and,
  - climb-out occurs as close to the airport boundary as possible, where bird activity is managed.

    [*Note*: Pilots should consider that an increased deck angle that results from a steeper climb may make it more difficult to see and avoid birds.]
- If there is an altitude band where birds are anticipated, climb through these altitudes as quickly as possible, using the manufacturer's recommended best rate of climb speed.
- The majority of bird strikes occur below 10,000 ft AGL, so continue to use landing lights during climb until above this altitude.

- Use extreme caution if accelerating above 250 knots below 10,000 feet ASL. In Canada and some other countries, aircraft may accelerate above 250 knots above 3,000 feet AGL. This increases the probability of a bird strike, since climb rate is reduced while accelerating, thereby increasing time spent in altitudes where birds are more likely to be present. The potential severity of a strike also rises, since impact force increases. Bird strikes above 3,000 feet AGL occur less frequently, but the majority of these strikes involve larger birds and incur frequent and significant damage.

En Route

- Listen to the appropriate en route radio frequencies to obtain up-to-date information on bird activity from ATS providers and other aircraft.
- Report all hazardous bird movements to ATS providers and other aircraft.

Approach and Landing

- Approach and landing is a critical phase of flight. Strike statistics show that 39% of bird strikes and 58% of mammal strikes occur during approach and landing.
- Obtain the latest bird and mammal activity information from ATS providers, ATIS, UNICOM, and other aircraft.
- Be especially vigilant when operating at airports which either do not have ATS providers or have limited hours of ATS operation. While these airports often do not feature wildlife monitoring and management, it is nonetheless prudent to request that airport personnel inspect the runway environment to ensure it is clear of hazardous wildlife. Watch for wildlife activity throughout approach and landing.
- Plan your descent and approach route to avoid areas that attract birds.
- During descent and approach in areas with high bird activity, reduce airspeed to diminish the severity of potential bird strikes.
- If bird activity is reported at particular altitudes, use a higher rate of descent—without increasing speed—to minimize exposure to potential bird strikes.
- Wildlife hazards during approach and landing should be treated like any other flight safety hazard—if any doubt exists concerning safety, delay your landing until conditions are right.
- If birds are encountered on the approach, consider a go-around and a second approach, but only if the go-around can be initiated without striking birds after power is increased. This strategy may allow the birds to disperse before your return. Please note that several bird-related incidents and fatal accidents have resulted from pilots initiating a go-around when the aircraft was in a low energy state and likely capable of a safe landing.

- Use landing lights during approach and landing to make the aircraft more visible to birds.
- If you encounter birds or mammals, be sure to report this activity to ATS providers, UNICOM, and other aircraft.

Conclusions

While the risk of aircraft striking birds and wildlife will always be a part of aviation, the risk is manageable with prior planning and vigilance by airports, airlines, and the flight crew.

Airport operators have a responsibility to ensure that all appropriate actions are taken to mitigate the potential for bird and wildlife strikes at their facilities.

Airlines should recognize the risks and costs associated with bird and wildlife strikes and include avoidance techniques in flight operations manuals, training materials, and other flight crew guidance.

Air traffic controllers should provide as much information to pilots about wildlife hazards within their area of control as workload permits so that pilots can take appropriate precautions. Generic, repetitive warnings about wildlife within an area do not suffice for this purpose.