

WILDLIFE HAZARDS TO AVIATION
ICAO/ACI AIRPORTS CONFERENCE
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STATEMENT OF THE PROBLEM

Collisions between wildlife and aircraft worldwide are increasing in number and severity. The United Kingdom's Central Science Laboratory estimates that wildlife strikes to aircraft cost the aviation industry worldwide over *one billion dollars each year*. In the United States the FAA Administrator has stated that wildlife strikes cost the aviation industry "...\$300-400 million a year". National Transportation Safety Board Chairman Jim Hall has stated that birdstrikes were on his list of most wanted concerns. Assistant Secretary of Agriculture Jim Dunn states that "...there has never been a greater potential for catastrophe than in the current conflict between wildlife and aviation".

Since 1995 over 90 people have been killed as a result of collisions between their aircraft and wildlife. The most recent fatal accident was April 20, 2000, at Pepa, Congo, in which an AN-8 twin turboprop crashed, killing 21 people.

During a four-month period in late 1999, at Detroit Metropolitan Airport alone, Northwest Airlines suffered over \$24 million in damage due to bird ingestion.

While aviation activity worldwide continues to expand, wildlife populations have exploded. The resident Canada goose population in the USA has quadrupled (4X) since 1987. Pratt & Whitney estimates it will double again in 5 years, to over 6 million resident birds. The snow goose population has become so extreme it is denuding its summer range in Canada. The gull population in the Great Lakes area cannot find nesting space and has begun nesting on building rooftops. The cormorant, a fish eating bird just slightly smaller than a goose, has returned from the dead. In 1972 there were only 6 nesting pairs of cormorants in the Great Lakes region. Currently there are over 100,000 nesting pairs. There are more deer in the US now than when the Pilgrims landed in the 17th century.

SIGNIFICANT INCIDENTS

- At Daytona Beach, Florida, a USAirways B737 encountered a flock of gulls during its takeoff on a foggy morning. Bird ingestion caused the immediate failure of one engine and damage to the other. Attempting to return to the airport the crew was required to attempt a single-engine localizer back-course approach which resulted in a single engine go-around, landing safely out of a front course ILS. Over 200 dead gulls were found on the runway.
- At Edmonton, Alberta, a Westair B737 encountered gulls during a morning takeoff in the fog, with an immediate engine failure due to bird ingestion. The flight attempted a single engine ILS to return to Edmonton, which resulted in a single engine go around and flew single engine to Calgary for a safe landing.
- At Milwaukee, Wisconsin, a B-1900 collided with a goose, which penetrated the left wing, the wing fuel tank, passed by the main wing spar and lodged against the left aileron. All the fuel drained from the tank, the engine was shut down and the aircraft landed, single engine, maximum lateral imbalance between fuel tanks and bird remains jammed against the aileron.
- At Istanbul, a Turkish A340 operating Istanbul-South Africa encountered gulls on takeoff resulting in the failure of 2 of its 4 engines. The flight returned safely to Istanbul.
- At Tel Aviv, a TWA B767 encountered birds on takeoff resulting in a violent uncontained engine failure. The flight returned safely but blew 4 tires.
- At Seoul, 5 wide body aircraft suffered engine damage in 10 days due to bird ingestion.
- Boeing reports that in ETOPS operations there have been 13 turnbacks by B767 aircraft due to wildlife strikes.

DATA COLLECTION

Although some European states require mandatory reporting of wildlife strikes, reporting is not mandatory in North America or in the rest of the world. As a result of poor data collection the scope of the problem cannot be accurately defined. Only two airlines in the USA, United and Northwest, routinely report wildlife strikes to the FAA/USDA strike database. Normal reporting methods at these carriers indicate they suffer 200-300 strikes per year.

Alex Orosz, FOD Manager at United Air Lines, developed a software program to conduct a key word search of the United Air Lines Technical Operations database. For the year 1999 he discovered an additional 1,100 strikes which United knew nothing about. For the year 1999 United Air Lines had 1,326 wildlife strikes, over 100 a month. Mr. Orosz estimates that **40%** of engine FOD (foreign object damage) at United is due to bird ingestion.

ENGINE CERTIFICATION STANDARDS

While modern jet engines are designed to be very hardy in some respects, they no longer meet the safety level contemplated by regulators for bird ingestion due to the increased number of large flocking birds. The FAA/JAA joint Engine Harmonization Working Group is currently working with a new TOR to develop increased standards for bird ingestion. Currently the largest bird an engine has to be designed and demonstrated to ingest is a 4-pound bird – about the size of a fat gull or skinny duck. The engine must ingest only **one** of these flocking birds and demonstrate **no runon time, only safe shutdown**. None of the engines currently flying are designed or built to survive an ingestion of an 8-15 pound goose, pelican, stork, vulture or 25 pound swan.

AIRPLANE CERTIFICATION STANDARDS

Currently under US CFR Part 25 aircraft windshields are certified to withstand the impact of a 4-pound bird at the design cruising speed (V_c) of the aircraft. The windshields must not fail or spall (allow flying glass shards). Unfortunately, in 1997 in three incidents with B-737 and DC-9 aircraft, three crew members were injured by flying glass when their aircraft struck small birds at 250 knots or less. In August 2000, a B-737 over New York at 10,000' and 310 knots collided with a goose. The captain's window spalled spraying the cockpit with flying glass and the aircraft depressurized. Under the same rule the aircraft empennage (tail) must not fail if it strikes an 8-pound bird at V_c . This rule was added after a Viscount lost its tail and crashed after encountering a flock of swans (20-25 pound bird).

IFALPA POSITION

The International Federation of Air Line Pilots believes that it is vital for each country/region to participate in a Bird Strike Committee, such as International Birdstrike Committee (www.int-birdstrike.com), BSC-USA (www.birdstrike.com). The gathering of data, sharing of scientific knowledge and opportunity to serve as a contact point for wildlife mitigation practices are vital.

Additionally, IFALPA most strongly feels that ICAO Annex 14 must be amended. The current idea that a *recommended practice* will serve well in the face of increasing wildlife populations conflicting with aviation has outlived its time. A **standard** must be developed and promulgated to address this public safety issue which will only get worse

INDUSTRY POSITIONS:

Are airport operators the only responsible parties? What actions are being taken by and what are the positions on mitigation of IATA, ACI, government regulators?

WHAT CAN PILOTS DO?

- Slow down. The force of impact (kinetic energy) is directly related to the speed of the aircraft: one-half of the mass (bird) times the speed of the object (aircraft) *squared* equals KE expressed in foot pounds per square inch. The impact on an aircraft traveling at 320 knots with an 8-pound goose would be 36,462 foot pounds per square inch, whereas if the aircraft were traveling at 200 knots the impact force of the same bird would be only 14,243 foot pounds per square inch. At slower speeds birds bounce off, at high speeds they penetrate.
- Do not participate in high-speed climbs at low altitude in known migratory or wintering areas for large animals, such as the U.S. Gulf Coast. Geese and swans will fly as high as 12,000' during migration.
- Don't takeoff. When confronted by wildlife hazards, treat the hazard as one would treat other transient aviation hazards such as thunderstorms: wait until they pass. Don't assume anything that can be done from the cockpit will affect the actions of the wildlife. Dr. Tom Kelly's work for Aer Rianta clearly indicates that birds aren't influenced by loud noises, such as the spooling up of jet engines.
- If warned of high bird activity in an area, climb using the standard ICAO noise abatement profile. As 90% of birdstrikes occur below 3,000 feet, climbing on the ICAO standard noise abatement profile accomplishes 4 things: (1) the aircraft climbs through the danger zone as quickly as possible; (2) the aircraft is flying slower; (3) the steep angle will keep the aircraft within or closer to the airport boundary, where the airport operator can and should be able to influence the threat by mitigation; (4) the aircraft is a "good neighbor", operating more quietly.
- What doesn't work: *don't turn on the radar, birds don't hear in the x-band*. Turn on aircraft lights but remember birds and airplanes takeoff and land into the wind – they won't see you if you're coming from behind them. What does work: patience, planning and avoidance. Confronted with wildlife, select another runway for operations if possible. If not possible, delay takeoff or landing. Worldwide, airlines are *not* giving their pilots this instruction.
- Make a report. Report an observed threat to either ATC or the airport operator so that the threat may be mitigated. Use the word "Pirep" to remind ATC to pass along the warning. Make a written report of a wildlife strike whether it results in damage or not. The Dutch Air Force, which requires mandatory reporting, has observed a direct relationship between strikes: for every 5 non-damaging strikes observed, there is 1 damaging strike. For every 150 damaging strikes there is an aircraft lost.

WHAT CAN AIR TRAFFIC CONTROLLERS DO?

- Comply with FAA Order 7110.65 (Air Traffic Controllers Handbook) paragraph 2-1-22, which requires controllers to issue warnings regarding wildlife hazards. These warnings are similar in nature to warnings issued by controllers regarding windshear or braking action.
- Don't assume wildlife are harmless; don't issue clearances into hazards. If a pickup truck or bucket of bolts were on the runway, would you issue a clearance to land?

WHAT CAN STATION AGENTS DO?

- Don't feed the birds! At MSP the MAC has removed 6 bird feeders from Northwest jetways placed on the jetways by NWA employees. Observe your catering trucks, are birds perching on them?
- Close Dumpster lids; do not allow Dumpsters to overflow. Do not tolerate birds loafing around the operations area. A DC-10 at SEA ingested a gull into an engine as it taxied into the gate.
- Participate in airport safety meetings; make wildlife an issue just like snow removal.
- Report observed wildlife hazards to the airport operator.

WHAT CAN DISPATCHERS/SYSTEM OPERATIONS CONTROL DO?

- Know where the birds are, know when the birds are coming: twice a year in North America a migration of over 300 million birds occurs. Wildlife leave Canada and the U.S. every fall for their wintering grounds in Central America and the Caribbean. They return along the same routes every spring. A similar migration happens in Europe-East Africa. Their movements are predictable.
- Know when the birds arrive: Nexrad radar absolutely shows the presence of large bird flocks, as do ATC ASR 8,9,11 radar. They are **absolutely** visible today with today's technology. Use the technology available in every dispatch center at every airline to issue "near real-time" warnings. This type of warning is the same alert as a poor braking action report or a warning of the presence of a large thunderstorm, which may create a delay or increase flight time.
- In the United States, access the Air Force's AHAS site at www.ahas.com to obtain the latest real-time information as to wildlife threats. Refer to it as one refers to the National Weather Service's radar depiction map. In the first year of its use the Air Force Air Combat Command found that the AHAS reduced its birdstrikes by **70%**.

WHAT CAN MANAGEMENT/OWNERS DO?

- Offer training to employees as to the risk and mitigation of wildlife. Currently no training is offered nor is any required by government regulation to alert airline employees that wildlife are a risk. *Only one airline in the world even mentions wildlife as a hazard in its flight operations manual.*
- Establish guidelines for operations around wildlife hazards. This industry mitigates windshear, ground de-icing, volcanic ash, wake turbulence; we can mitigate wildlife hazards also.
- Report hazards and strikes, both damaging and non-damaging, to the proper government reporting facility. Nothing can be done about wildlife hazards without data. Too many airport operators adopt the attitude “no report – no problem”. Non-damaging strikes are a countdown to a damaging strike. *In the U.S. only 2 airlines bother to report their strikes to the FAA/USDA strike database.*

NATIONAL TRANSPORTATION SAFETY BOARD

- In November 1999, the NTSB released 9 recommendations to the FAA regarding wildlife hazards. The FAA has responded to the recommendations.

TRENDS IN THE INDUSTRY

- At Phoenix, the City of Tempe constructed a 2-mile long lake at the east end of Skyharbor airport. Aircraft must pass over the lake on takeoff or landing at around 650 feet. The lake has been stocked with fish and is attracting flocks of cormorants and waterfowl. For the first time in history pelicans have appeared in the Phoenix area. The pelicans are attracted to the lake.
- At Philadelphia, between October 1998 and January 2000, five jet aircraft suffered the loss of an engine due to bird ingestion. In August 2000, an Evergreen International B-747 struck a flock of geese during takeoff, destroying the #1 engine, damaging the #2 and #4 leading edge devices and blowing 9 tires.

INDUSTRY RESPONSE

- None. There are no industry groups working on the problem. It is not discussed at CAST, not a project at Flight Safety Foundation or any other group working on safety issues. The vice president of Evergreen International was told by ATA that ATA views this hazard “...with a collective yawn”.
- When volcanic ash emerged as an aviation threat ICAO convened a worldwide task force to address the hazard. No aircraft have ever been lost to volcanic ash.

NEXT ACCIDENT IS *PREVENTABLE*

- Wildlife are on the airport for three reasons: (1) eating; (2) drinking; (3) loafing. Eliminate these three attractants and the wildlife simply go elsewhere.
- We know there are 2 migrations a year. The U.S. Air Force refers to this as “...waves of biomass.” Their coming and going are reliable and predictable.
- Wildlife will continue to come to airport areas as long as attractants are present: a strike without remedial action is simply ignoring the problem and a countdown to the next strike. Impact and fire destroyed the Dallas Cowboys football team’s Learjet in December 2000, when it struck deer on the runway at an airport in southern Alabama. One month later another Learjet was significantly damaged when it struck deer on the same runway at the same airport. Wildlife strikes are repeatable.

Appendix

CIVIL HULL LOSSES/FATAL ACCIDENTS CAUSED BY WILDLIFE

A/C-engine	date	location	birds/weight
Antonov An-8 Twenty-one fatal. After takeoff aircraft struck a flock of birds and one engine lost power. During attempted return to the airport aircraft crashed and burned.	April, 2000	Pepa, Congo	unknown
Dassault Falcon 20 Uncontained failure, fire Ten fatalities. On takeoff, just after rotation, aircraft encountered flock of lapwings, ingesting a number into the left engine. Pilot reported fire warning in cockpit and witnesses observed the rear of the aircraft engulfed in flames. Aircraft attempted return but crashed near threshold of Runway 21 and was destroyed by impact and post impact fire. The rear cowl, exit guide vane and a number of fan blades were found on the runway with the fan disc found 500 meters to the side of the runway. Fifteen dead birds were found near the rotation point. Investigation revealed that, following bird ingestion, the fan had separated and exited the engine with shrapnel penetrating the rear fuselage, puncturing the feeder tanks and fire had immediately broken out in this area.	January, 1995	Le Bourget, France	lapwing 215 grams
Antonov An-12 As the aircraft climbed through 150 feet, the #2 and #4 engines failed. Aircraft attempted return but a forced landing was made prior to reaching the runway. The aircraft slid 460 meters before it caught fire and was destroyed. At the time of departure a large flock of birds was observed in the vicinity of the runway and it is believed the engine failures were the result of bird ingestion.	October 1993	Slavgorod, RU	unknown
B-707 Two serious injuries. Takeoff was abandoned after V1 due to bird strikes. Aircraft overran the runway and was damaged beyond economic repair.	July, 1990	Addis Ababa, Ethiopia	pigeons
B-737 JT8D Thirty-five fatal. Pigeons were ingested into both engines on takeoff. Both engines surged and lost power. Aircraft attempted to return but both engines lost power and a forced landing was attempted in open country 10 km from the airport. Aircraft touched down safely but struck a riverbank and burned. Airport elevation is 5,800 feet msl.	July, 1988	Bahar Dar, Ethiopia	pigeons 320 grams

A-300	July, 1986	Madras, India	black kite 780 grams
<p>Eleven minor injuries. At 150 knots a large bird was observed on the runway centerline. The pilot flying attempted to rotate over the bird but a loud noise was heard from the right engine, followed by vibration. The takeoff was rejected and the aircraft overran the end of the runway. There was no fire but the aircraft was damaged beyond economical repair.</p>			
Lear 25 CJ610	August, 1983	Wilmington, Del.	Starlings 80 grams
<p>At 500 feet on takeoff the aircraft passed through a flock of starlings. Both engines failed. A forced landing was made in an industrial area. Aircraft struck a grove of trees and was damaged beyond economical repair.</p>			
Lear 35 TFE 731	June, 1982	Le Bourget, France	gulls 275 grams
<p>Takeoff was abandoned after V1 after striking a flock of gulls. Aircraft overran runway and struck the ILS installation, injuring the co-pilot. Engines were not damaged.</p>			
Lear 23 CJ610	April, 1981	Cincinnati, Ohio	loon 3.7 kg
<p>One fatal. At 4,000 feet a loon penetrated the windscreen, killing the co-pilot and injuring the pilot. Engine #2 ingested debris and was shut down.</p>			
Convair 580 Allison 501	July, 1978	Kalamazoo, Mich.	Sparrowhawk 105 grams
<p>Just beyond V1 a sparrowhawk was ingested into one engine, which auto-feathered. Aircraft crash-landed in a field near the airport. Three injured.</p>			
B-737 JT8D	May, 1978	Gosselies, Belgium	pigeons 465 grams
<p>During a touch-and-go landing on a training flight, a flock of pigeons was struck and ingested into one engine. The instructor pilot elected to abandon the takeoff above V1. The aircraft overran the runway and was destroyed by post-crash fire. The left engine was found with bird ingestion damage.</p>			
Falcon 20 CF700	December, 1976	Naples, Fla.	Ring billed gulls-485 gm
<p>Eleven injured. Both engines failed just after takeoff. A crash landing was made off the airport.</p>			

Lear 24	June, 1976	Bari, Italy	gulls
Both engines failed at about 450 feet after striking a flock of gulls. Aircraft crashed into a field.			
DC-10 CF-6	December 1975	JFK, New York	gulls
Uncontained failure-fire Eleven injured. At V1 the aircraft struck a flock of great black-back, ring billed and herring gulls. The #3 engine ingested gulls, exploded and caused a severe wing fire. The takeoff was abandoned and the aircraft stopped on the airport. The aircraft was destroyed by fire. All passengers were airline employees on a positioning flight.			
HS125 Viper	November, 1975	Dunsfold, UK	lapwings 215 grams
Six third party fatalities. At 75 feet on takeoff lapwings were ingested into both engines, which lost power. Aircraft crashed at the end of the runway and slid into a nearby parked car. Postcrash fire destroyed the aircraft.			
Sabreliner JT12A	June, 1975	Watertown, S.D.	gulls 260 grams
Aircraft ingested gulls into both engines on takeoff. Aircraft crash-landed off the airport, tearing off both wings. Aircraft was destroyed by postcrash fire.			
Falcon 20 CF700	December, 1973	Norwich, UK	gulls
Just after takeoff the aircraft ingested gulls into both engines. Aircraft crash landed in a nearby field.			
Lear 24 CJ610	March, 1973	Atlanta, GA	cowbirds 44 grams
Seven fatal. Just after takeoff both engines suffered power loss due to bird ingestion. Aircraft crashed into buildings in nearby industrial park. Left engine had 14 strikes and right engine at least 5 strikes.			
Falcon 20	July, 1966	Lake Erie, OH	gulls
Gulls ingested in both engines after takeoff. Aircraft ditched in the lake; 315 dead birds found on runway.			
Vickers Viscount Dart	November, 1966	Maryland, USA	whistling swan- 6kg
Seventeen fatal. At night at 6,000 feet, aircraft struck a flock of Whistling swans. One penetrated the tailplane leading edge, causing the tail to detach. Aircraft crashed.			

Lockheed Electra Allison 501	April, 1960	Boston, Mass	starlings 80 grams
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Sixty-two fatal. Immediately after takeoff aircraft ingested birds into at least 3 engines. Engine #1 was shut down, engines #2 & #4 lost power. Aircraft stalled and spun into the harbor. Worst birdstrike accident.

LARGE MILITARY TRANSPORT AIRCRAFT

C-130 Allison 501	July, 1996	Eindhoven, Neth.	Starlings
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Thirty-four fatal. On approach to the airport aircraft struck huge flock of blackbirds, ingesting birds into multiple engines. Aircraft crashed on airport. Postcrash fire was responsible for most fatalities.

E-3 (B-707)	July, 1996	Aktion, Greece	unknown
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On takeoff the aircraft struck multiple flocks of birds. Takeoff was aborted at high speed and aircraft overran the end of the runway into the Aegean Sea. Aircraft was damaged beyond economical repair

E-3 (B-707)	September, 1995	Anchorage, Alaska	Canada geese
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Twenty-four fatal. On takeoff the aircraft struck a flock of about 30 Canada geese, ingesting birds into two engines. Aircraft was uncontrollable below Vmcair and crashed into high terrain near the end of the runway.

References:

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