FLIGHT SAFETY FOUNDATION
Accident Prevention
Vol. 46 No. 3 March 1989

Birds Vs. Aircraft: No Winners

The high impact forces of a bird striking an aircraft is a serious matter and one that may be underplayed by pilots, according to the author. A list of guidelines is offered to help birds and manned aircraft better share the skies.

Bird and manned aircraft first engaged in mortal combat in 1912, nine years after the Wright brothers demonstrated the feasibility of powered flight. Both lost.

Both have been losing ever since, and with an increasing regularity since the advent in numbers of civil turbojet aircraft in the late 1950s and early 1960s.

And, with spring approaching in the northern hemisphere, the prospects for aircraft bird strikes increase as a wide variety of species migrate to their summer feeding grounds. The number of recorded bird strikes rises dramatically each year between March and mid-May, drop off — but do not disappear — during the summer months and rise again between mid-September and the end of November when the birds return to their winter feeding grounds.

In the United States alone, reported aircraft bird strikes are averaging between 1,200 to 1,400 a year at an annual cost of approximately $20 million (U.S.). The actual number of strikes probably is between three and four times larger than the recorded total, with an undetermined increase in cost. Estimates of the annual worldwide costs attributable to bird strikes range upward to the $1 billion level.

Sea Gulls and Starlings Plague the Skies

Efforts to discourage birds from nesting or feeding at airports or in their immediate vicinity, where 75 percent of the strikes occur, are being matched by the growing proliferation of the major culprit species — notably sea gulls, which are involved in 40 percent of the reported U.S. strikes; starlings, which often fly in a single flock of up to 20 million birds, and the venerable blackbird. Man and his aircraft are scarcely holding their own, and the future outlook is not all that good for man unless preventive measures being taken or contemplated now are highly effective.

One startling example of bird proliferation can be found at New York's John F. Kennedy International Airport, U.S. In the late 1960s, Kennedy had an estimated gull population of between 30,000 and 50,000 birds. Recent estimates range as high as 200,000 despite accelerated efforts to discourage their presence. Kennedy's mating gulls migrate on a seasonal basis, but the immature birds stay behind, and a somewhat diminished threat remains.

Birds Equal FOD

The U.S. National Transportation Safety Board (NTSB) made a statement in a March 7, 1975, report to a subcommittee of the U.S. House of Representatives' Committee on Interstate and Foreign Commerce that, unfortunately, is even more valid today.

"The foreign object damage that constitutes the greatest threat to aviation safety," the report said, "is that resulting from bird ingestion, because the single most numerous foreign object category involves birds, because most of the more serious damage incidents involve birds and especially because of the possibility of simultaneous damage to more than one engine."

On November 12, 1975, several months after the NTSB report to the congressional subcommittee, Kennedy was the scene of an accident that vividly reaffirmed the board's conclusions.

An airline DC-10 encountered a flock of gulls during its takeoff roll at Kennedy. Almost immediately afterwards, the aircraft's right engine exploded, and fire broke out along the wing. The takeoff was successfully aborted, and all passengers and crew members were evacuated, but the DC-10 was destroyed by fire. The explosion of its CF6 engine marked the first catastrophic failure of a large turbofan powerplant that resulted in a major aircraft accident.

The accident vividly demonstrated that bypass-type jet powerplants are susceptible to severe bird ingestion damage despite their mass and potential for passing foreign objects around, rather than through, the engine.

There is concern that the bird ingestion problem may become more serious as new-generation turbofan-powered aircraft with only two engines become operational in increasingly significant numbers over the next several years.

A U.S. Federal Aviation Administration (FAA) engineer working on revised airport certification standards asked FAA bird hazard specialist Michael J. Harrison what the odds were for a near-simultaneous dual-engine ingestion by aircraft with only two engines.

Harrison had no firm data to use as a projection base but suggested that the engineer contact the world's twin operators to determine what their experience had been up to that time. He did, and, according to Harrison, the returns indicated that, "We may be facing one hell of a problem when there are lots of twin-engine wide bodies."

Manufacturers Engage in Turbofan Study

As a result of the engineer's findings, the FAA contracted Pratt & Whitney, General Electric and Rolls-Royce to identify the bird ingestion problem faced by such aircraft, the phase of flight during which strikes are most likely to occur, the damage they can be expected to inflict and possible preventive measures.

Because of the turbofan's vulnerability, recommendations were adopted to change Part 33 of the U.S. Federal Aviation Regulations to require a further strengthening of the components to make them more resistant to bird-impact forces.

Turbine-powered aircraft in general are more vulnerable to bird strikes than their piston-engine predecessors for a number of reasons. These include their greater speed and lower noise level in advance of their flight path, a combination that does not give the birds sufficient warning to take evasion action and, on takeoff, alarms them into swarming up in fright while the airplane is in their immediate vicinity.

For much the same reasons but with the added ingredient of normally low-altitude flight levels where birds are most apt to be encountered, high-speed turbine-powered helicopters also face an increasingly severe bird hazard problem.

In an accident in Canada, four persons were killed after a bird, or birds, struck and broke the canopy of a Bell JetRanger.

"Helicopters are flying so much faster than they did 10 years ago and in the 200- to 300-foot altitude range," said Harrison. "You see a lot of low-level flights from offshore oil rigs. If they [the helicopter operators] went to 2,000 feet, they might eliminate a large percentage of these strikes."

Prepare for Low-Level Danger

Statistically, 60 percent of all bird strikes are encountered at altitudes of below 1,000 feet agl, and the vast majority occur at altitudes below 2,000 feet agl. The threat becomes negligible above 12,000 feet, although the chance of a random bird strike at considerably higher altitudes always exists. In one recorded instance, a commercial jet transport aircraft collided with a condor while flying at its assigned cruise altitude of 37,000 feet.

During their migrations, ducks and similar relatively small waterfowl have a normal cruise altitude between 1,000 and 5,000 feet, geese between 2,000 and 7,000 feet, blackbirds and starlings between 100 and 1,000 feet and most other birds of between 500 and 3,000 feet.

Picking up a lead from western Europe and Canada, the FAA worked with the U.S. Air Force (USAF) to establish a radar ornithology program to track migrating flocks of birds and alert pilots of their presence. One problem, however, is that when birds reach the more moderate climates found in much of the United States and the more abundant food supplies there, the large flocks tend to break up into smaller groups, some pressing on, others content to progress at a more leisurely pace. Radar detection and tracking of the smaller bird groups can be difficult.

USAF tactical aircraft, like helicopters, often operate in the low-altitude ranges where birds are most likely to be encountered, and the Air Force led the way in the United States in developing bird-hazard prevention techniques.

Working to Reduce Pilot Complacency

Another problem, according to FAA officials working in the area, is the reluctance of pilots to take potential bird hazards seriously despite the past record of lost or severely damaged aircraft and the toll in human lives. Notices to airmen, flight service station advisories or other alerts will have little benefit unless the affected pilots take them seriously.

"Pilots," one official said, "tend to underplay the problem. They may know that there are birds on the runway and still fly right through them. It's analogous to the 1950s when pilots routinely flew through thunderstorms without giving it a second thought."

Birds, however, are a serious matter, with high impact forces. A one-pound bird with a diameter of three inches striking an aircraft flying at a speed of 100 mph has an impact force of 1,330 pounds. If the speed of the aircraft is 200 mph, the impact force is 5,320 pounds. At 300 mph, it is 12,000 pounds, at 400 mph, 21,000 pounds, at 500 mph, 33,300 pounds and at 600 mph, 48,000 pounds.

A bird with a four-inch diameter and weighing two pounds (a small sea gull) hits with a force of 2,000 pounds when the aircraft is traveling at 100 mph, 8,000 pounds at 200 mph, 18,000 pounds at 300 mph, 32,000 pounds at 400 mph, 50,000 pounds at 500 mph and 72,000 pounds at 600 mph.

The scale moves progressively upwards to the point where a 16-pound bird with an eight-inch diameter would strike an aircraft flying at 600 mph with an impact force of 288,000 pounds.

In one incident during the summer, a Cessna 152 was descending through 1,000 feet at a speed of approximately 90 knots when it struck a Fulmar Artic sea bird later found to weigh just under two pounds with sufficient force to break the windscreen and bloody the pilot's nose. In other incidents, birds have broken the canopies of corporate jet aircraft, although for newer models, the FAA strength requirements have been upgraded.

Avoiding Bird Strikes

Birds should be avoided. Following are some guidelines that should be followed, when possible, to reduce the potential for a bird strike:

• Increase the angle of descent and climbout when approaching or departing from an airport where birds are known to congregate in order to reduce the time spent at the lower altitudes where they are most likely to be encountered. Remain above 10,000 feet agl for as long as possible during an approach.

• Go around if birds are observed in the flight path during approach.

• Turn on all lights during a night or dusk approach — strobes, wing-tip running lights, rotating beacons, landing lights, etc. Strobe lights have been found to be particularly effective in frightening birds away from an aircraft's flight path.

• Ask the control tower at problem airports if the duty runway is clear of birds. The tower personnel may not know, but a significant number of requests sometimes can generate further action by airport authorities.

• Scan the skies before takeoff and while in the traffic pattern.

• Collect all available bird information, including NOTAMs and ATIS information, before takeoff on conditions at both the departure and arrival airports and act accordingly.

• Whenever possible, avoid takeoffs directly into the rising or setting sun. Under such conditions, it may be impossible to see even large flocks of birds along the takeoff and climbout paths.

• Avoid flying below flocks of birds. Climb over them if possible, because birds have a tendency to dive when frightened.

• Turn on the windshield heat while flying in areas that birds are known to traverse regularly. Research has shown that a warm windshield can better withstand bird impact forces because of its greater flexibility.

• Maintain lower safe airspeeds in areas frequented by birds to minimize the potential for a strike and reduce the impact force should one occur.

• Reduce local night flights, if possible, during periods of increased bird activity such as the spring and fall migratory seasons.

• Establish a prearranged plan to cope with a bird strike, including engine ingestion and a broken windshield.

• Advise the airport tower or air traffic control center when significant bird activity is observed so that other aircraft in the area may be alerted. ♦

Distraction: An Insidious Threat

Remember the one about the pilot who said he failed to lower the gear on landing because he was distracted by a loud horn and a red light in the cockpit? Or the flight crew that got so engrossed in tracing a gear problem on approach that they didn't notice the airplane was descending until too late?

Anyone who has to do more than one simple, dedicated task at a time is a candidate for distraction. Flight crews, with their multiple, interrelated tasks, may find their performance affected to the point where safety can be compromised unless they recognize, and deal properly with, the effects of often subtle distractions.

The Aviation Safety Reporting System (ASRS) of the U.S. National Aeronautics and Space Administration once made an analysis of the distractions that can so easily occur when a crew member is in the position of having to do many things at the same time. The premise is that distraction leads to errors, and errors lead to accidents.

The ASRS conducted a subjective analysis of the voluntarily submitted incident reports it had collected. The analysis led to a further refinement in the identification of the generic types of distraction, along with associated environmental factors and typical outcomes. The two classes of distraction identified confirmed previous studies and observations in this area. They were:

- Non-flight operations activities, such as public address announcements, communications with the airline, paperwork, passenger difficulties, and extraneous cockpit conversation.

- Flight-operations-oriented activities, such as checklists, traffic scan, ATC communications, malfunctioning equipment, and weather monitoring and avoidance.

Two operational environment factors were identified as encouraging distraction occurrences:

- "Company rules and procedures directed to maximizing passenger comfort and service."

- "The inherent complexity of the flight crew's job mandated by the technology of the modern jet airplane and the ATC system in which it functions."

Distraction was cited as leading to two types of human error in controlling, communicating and monitoring behavior:

- "Failures on the part of individuals to perform an essential task."

- "Breakdowns in crew coordination or management."

The outcomes of distraction are diverse but are typified by altitude deviations, failure to see traffic, airspace violations, landing or takeoff without clearance, and others. Any of these distractions, in combination with other factors, can produce an accident, and ASRS has cautioned that cockpit priorities should be clearly stated and constantly reinforced, both verbally and in writing. ♦

What's Your Input?

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