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Successful Strategies for Aviation Wildlife Mitigation

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Abstract: Between October, 2007 and January, 2009 there were four catastrophic aircraft accidents in the United States caused by collisions between birds and aircraft. Four aircraft were destroyed and 15 people killed in these accidents. In North America we place great importance on airport wildlife control, however none of these accidents would have been prevented by improved airport wildlife control. This reveals a gap in our safety management plan for preventing/reducing wildlife hazards to aircraft. This paper explains, using case studies, successful aviation mitigation methodologies used in the past to mitigate other aviation hazards such as wind shear, volcanic ash, winter operations including deicing and reduced runway friction. There is no reason that aviation wildlife mitigation should not adopt and use these successful strategies to close the existing gap and improve safety. Unfortunately too many working in this field have little knowledge of aviation safety strategies and therefore are groping in the dark for solutions. The understanding and application of successful methodologies is integral to any solution for this hazard.

Introduction

Every day in aviation we cope with a variety of hazards, many of them natural phenomenon such as wind shear, volcanic ash, or icing. By themselves these natural phenomenon are extremely hazardous to aircraft, witnessed by the significant number of catastrophic aircraft accidents caused by improper operations around these hazards.

Unfortunately, for a number of reasons better discussed elsewhere, the conflict between increasing bird populations and increasing aviation activity has indicated that we no longer have our desired safety level.

During the 16 month period from October 2007 until January 2009, in the United States, we suffered four catastrophic aircraft accidents caused by collisions with birds. A review of these accident details is in order:

October 2007: a Piper Seneca, a twin engine propeller plane owned by the University of North Dakota, was enroute from a fueling stop in St. Paul, Minnesota to its home base in North Dakota. Enroute the flight, operating at night, collided with a flock of migrating Canada geese. The collision caused significant damage to the aircraft, loss of control and crash, killing both crew members.

March, 2008: a Cessna Citation twin engine business jet departed Wiley Post Airport in the Oklahoma City area. During climb out, passing around 3,000', the aircraft collided with a flock of migrating white pelicans. One engine failed and the right wing was significantly damaged, causing loss of control and crash killing all five people on board.

January, 2009: a Petroleum Helicopters S-76 aircraft, enroute at low level in southern Louisiana had its front canopy penetrated by some type of large bird. Either the crew or the engine controls were disabled by the collision and the aircraft crashed, killing 8 of 9 occupants.

January, 2009: a USAirways A320 departing New York's LaGuardia Airport collided with a flock of migrating Canada geese at around 3,000'. Both of the aircraft's engines failed due to bird ingestion. Fortunately the aircraft was successfully ditched in the Hudson River. Although the aircraft was destroyed no occupants were killed.

Discussion

It should be noted that the above four accidents involve virtually all categories of civil aviation in North America today: general aviation, corporate jet, transport helicopter, airline transport aircraft. Clearly the facts indicate that bird collisions are a hazard for all types of aircraft. Further, all of the accidents happened away from the airport: the UND Seneca accident and the PI helicopter accident both occurred in the enroute phase of flight. Both the Citation and A320 accidents happened on climb, while passing about 3,000', several miles from the airport. Three of the four accident aircraft appear to have encountered migrating waterfowl, not local birds attracted to an airport area. Currently there are no policies, procedures or mitigation designed to avoid this hazard or escape from it if encountered. Nor is there training for flight crews on the bird strike hazard, unlike other hazard such as wind shear, volcanic ash or winter operations.

ICAO (International Civil Aviation Organization), which sets worldwide standards for aviation, mandated, in 2004, wildlife control on airports as a standard. Many state regulatory agencies, such as the FAA, Transport Canada, etc., amended their rules to require airport wildlife control.

However we have effective mitigation in place for previous aviation killers such as wind shear; winter operations such as deicing, reduced runway friction and volcanic ash. A discussion of these mitigation techniques will reveal successful techniques which can be applied to successfully mitigate the aviation wildlife hazard.

Fundamentals and Definitions

In aviation we rarely have the opportunity to 'solve' hazards, particularly natural phenomenon. "Solve" means to fix a problem so that the problem no longer exists. We rarely are able to do that in aviation. Instead we "mitigate" the problem, or reduce its severity by certain acts to reduce its risk to an acceptable level.

Likewise "risk" in aviation is the exposure, probability and severity of a hazard, quantified to describe the likelihood of an event resulting in a catastrophe. We measure risk in various ways, but the measurement is always the likelihood of that event resulting in a catastrophe.

"Catastrophe" in aviation is defined by the International Civil Aviation Organization (ICAO), which sets worldwide standards and recommended practices for aviation. Under the ICAO guidelines "catastrophe" occurs when an event results in an aircraft destroyed or a fatality.

In aviation we have established a standard of safety. That standard is one catastrophe in every billion events, or $1 \times 10^{(-9)}$. That standard represents freedom from catastrophe, i.e., one crash every billion events. This standard does not consider damage, only freedom from catastrophe. This is the standard to which modern jet transport aircraft, engines and operations are designed.

"Policy" means those procedures which air carrier employees will follow when confronted by a given situation. "Flight operations manual (FOM)" is a book of policies which an airline corporation has developed to control its daily flight operations. This flight operations manual, in the U.S., is then submitted to the government regulatory agency, FAA Flight Standards and its representatives for that airline, to approve or amend. Once accepted by the FAA and the airline corporation this FOM then carries the force of law and is the controlling document for that airline's flight operations.

Successful mitigation of other aviation hazards

Windshear: windshear can be described as a rapid change in wind speed and/or direction over a short distance; it can be accompanied by strong turbulence. Most significant wind shears are associated with thunderstorm activity. A microburst is a type of wind shear characterized by a downdraft of air, limited in areal extent, which can exceed 3,000 feet per minute and create airspeed losses of between 40 and 90 knots. Wind shears encountered at low altitude are extremely dangerous and have resulted in significant catastrophes worldwide.

Not too many years ago the words 'wind shear' were not in our aviation lexicon because we did not understand what was happening. After significant catastrophes at New Orleans, Dallas/Ft. Worth and Denver industry and government working groups formed to address the hazard. Meteorologists were consulted to learn of the mechanics of wind shear. Mitigation was developed. Policy was created based upon the mitigation. The policy was trained and then the policy was implemented. On airports a wind shear detection system was installed to measure winds and give warning of wind shears. Air traffic controllers relayed these standardized warnings to flight crews, who then implemented policy steps to avoid the wind shears. Later other technology, like Doppler radar and predictive cockpit windshear devices were developed and deployed. However, we took the first step in defining the problem and then deploying the airport wind shear detection system prior to having full technology available.

Policy guidance, based upon our definition of the hazard, is provided to front line operational employees such as flight crews. They are taught how to recognize wind shear, how to avoid wind shear and how to escape from wind shear if encountering it. Further, policy guidance is established to provide clarification as to authorized operations in the vicinity of wind shear. A major airline's policy may recite: "Takeoffs, approaches and landing are not authorized when runway-specific wind shear or microburst alerts are in effect for your flight's intended runway". This policy leaves no doubt as to approved operations in conjunction with this hazard. *Delay is sometimes one of our most successful mitigation strategies for a variety of natural phenomenon.*

Winter operations

Deicing: Snow and ice accumulation on aircraft wings and tail surfaces can reduce or destroy lift over those surfaces, making it impossible for aircraft so contaminated to fly. In previous years a certain amount of snow or ice was tolerated on aircraft surfaces under the misguided principal that the aircraft could 'carry some ice'. This may have been so in the early days of propeller aircraft but modern swept wing jet aircraft are much more intolerant of contaminants. As a result we had several takeoff catastrophes caused by the attempted operation of aircraft which had not been properly deiced. Industry and government working groups were then formed to address the deicing issue. New deicing fluids, such as Type I and, later, Types II and IV, were developed and deployed. New policy guidelines governing proper deicing procedures were also developed.

Among these new policy guidelines was a revision of the Federal Aviation Rule governing deicing. Currently FAR Part 121.629 prohibits "…attempting a takeoff when frost, snow, or ice is adhering to the wings or control surfaces of the aircraft". Further policy guidance may be issued by individual air carriers for the operation of their fleet. One such carrier issued the following policy guidance:
"Takeoff is *prohibited* in:
Moderate freezing rain
Heavy freezing rain
Heavy freezing drizzle
Heavy ice pellets".
Once again we see delay utilized as an effective mitigation strategy to improve safety.

Reduced runway friction: Snow and ice may also accumulate on runways or taxiways. Such accumulation will reduce the braking effectiveness of stopping techniques such as wheel brakes or engine reverse thrust. This runway contamination can also affect lateral control of the aircraft by either the rudder or nose wheel steering, particularly in cross winds. Since aircraft cross winds limitations were developed by the manufacturer during certification using test pilots landing on dry runways, cross wind operations on contaminated runways have resulted in aircraft sliding off the side of the runway due to lack of runway friction. As a result some carriers developed policy to mitigate this risk. For example, on the A-330 the maximum crosswind limitation is 32 knots. One carrier developed the policy of issuing guidelines to flight crews reducing the maximum allowed crosswind depending upon runway friction, i.e., with braking action reported as only 'medium' (MU.39-.30), the recommended maximum crosswind should be only 20 knots. With runway friction reported as 'poor' (MU .20 and less) "no operations are authorized". In this case we are willing to trade some operational flexibility for improved operational safety.

Volcanic ash: eruption of volcanoes around the world was a new phenomenon to the world's jet fleets. The ash ejected by an erupting volcano contains a variety of material, all of it bad for ingestion into jet engines. Volcanic ash can be ejected as high as 60,000' and lighter portions of the ash cloud can travel down wind over 1,000 miles. Volcanic ash can not only adhere to fan blades but choke off airflow through the engine entirely, causing severe engine damage. On at least two occasions B-747 aircraft, flying at night, encountered volcanic ash and lost power on all four engines. On descent for night ocean ditchings the aircraft exited the ash cloud and were able to recover enough power to safely divert to nearby airports.

ICAO convened a worldwide project on volcanic ash. The hazard was defined, mitigation was developed, as was policy for the recognition of volcanic ash, avoidance of the ash cloud and mitigation steps to reduce its severity should an ash cloud be encountered. Currently, worldwide, a system of volcano watch stations has been implemented. When a volcano is detected erupting the news is quickly flashed around the world to various aviation interests. Since the ability to effectively track the volcanic ash cloud is somewhat limited in technology, the generally accepted mitigation is to reroute aircraft well away from the area of the eruption or cease operations entirely. The policy of one air carrier regarding volcanic ash is stated as: "A volcanic ash cloud will be avoided for the first 24 hours following the end of a volcanic eruption".

Results of lack of successful mitigation

Recently the Belgium AAIB released the results of its investigation into the Kalitta Airlines B747-200 accident in Brussels in 2008. During the takeoff the #3 engine ingested a small raptor causing the engine to make loud banging noises. The captain aborted the takeoff at high speed and the aircraft overran the end of the runway and broke up. Although nobody was killed, the aircraft was damaged beyond repair. While the investigation revealed a number of interesting points, of interest to the birdstrike community was the discovery that the Brussels airport's wildlife control manager was a part time job. Additionally the only qualification to be part of the airport's bird control team was to posses a Belgium hunting license.

A separate investigation by the Italian ANSV into a Delta Airlines serious incident in Rome in 2007 lead to the flight crew's actions being questioned. As the Delta B-767-400 taxied out in Rome the flight crew observed large numbers of gulls on the airport. The crew discussed the birds, as revealed by the cockpit voice recorder, but never reported the presence of the birds to ATC, the airport or Delta operations in Rome. Neither did the crew request a bird scare to disperse the birds from the intended flight path prior to takeoff. Instead the crew took off anyway, ingesting large numbers of yellow-legged gulls (similar to Herring gulls) into both engines. The engines lost power and vibrated severely, a very bad situation considering that the aircraft was at its maximum gross weight for takeoff. The crew later stated they were afraid that they would not make it back to the airport. The aircraft returned for a safe landing but post flight inspection revealed that both engines were severely damaged and had to be replaced, not repaired. This crew violated no policy or regulation in their actions because there are no policies, regulations or training for flight crews on this hazard.

In another investigation, that of USAirways 1549, US Department of Agriculture Wildlife Services personnel submitted proposed solutions to the wildlife problem to the US NTSB. One of these solutions was to:"…focus wildlife hazard mitigation efforts on the airport." This proposed solution was based upon examination of 30 'hull losses' by turbine powered transport jet aircraft. This metric, transport jet aircraft, completely ignores 3 of the 4 catastrophic accidents in the US between October 2007 and January 2009 as those accident aircraft did not fit into this category. Further, once the data behind these hull losses is examined it indicates these hull losses date back a number of decades, as far as 1968. In 2004 ICAO amended the SARPS to mandate wildlife control on airports as a standard. Worldwide state governments amended their rules and procedures to comply. In the US the FAA amended Part 139 to require wildlife control on airports and training for airports personnel in the hazard. Therefore this 'hull loss' data has been addressed and airports have received focus and mitigation. Proof of the effectiveness of this mitigation is the fact that since the 2004 change there have been no catastrophic accidents on US airports. However there have been four catastrophic accidents in the US between October 2007 and January 2009. No proposed solutions to these four accidents were forthcoming from the USDA personnel. One reason for this shortcoming may be that no USDA personnel have received any formal training in safety management. The argument here is not that USDA personnel do not care about these fatal accidents, rather that Agriculture Department personnel do not have proper education and experience in safety management to effectively make recommendations regarding aviation programs. Indeed, the USDA proposal diverts attention and mitigation efforts away from solving the catastrophic accidents to an area, the airport, where our mitigation is working properly. It could be said that these types of suggestions actually decrease safety.

No comprehensive plan

While we have work ongoing in a number of areas of the aviation wildlife hazard, we have no plan and no guidelines on how this work should properly integrate and where the actual gaps in our safety plan reside. There is no relationship between airport work and aircraft/engine certification, no training for front line employees in many areas and no focal point for coordination of the efforts. ICAO, in development of Safety Management Systems (SMS), defines the three basic defenses against risk as: technology, training and regulation. Yet there is no integration of these factors addressing this hazard, nor is any party in industry or government calling for such a comprehensive, integrated plan such as we currently deploy in mitigating wind shear, volcanic ash or winter operations. Additionally there is no current 'coach' for this team. Airports can't be held responsible for accidents occurring miles from their location, regulators such as FAA Airports can't exercise authority of areas outside of their jurisdiction and organizations such as Birdstrike Committee USA could lead but only if it becomes more diverse. Currently BSCUSA is limited by the fact that 76% of the members of the steering committee of BSCUSA are biologists; zero percent come from the flying community.

Conclusion - Solution for effective mitigation

Based upon the above case studies of successful mitigation of hazardous natural phenomenon in aviation, a successful wildlife mitigation plan can be devised. Development of such a plan will require the participation of both government and industry groups. It will also require a sponsor or focal point. Working groups should be formed for the following areas:

Working Group on Training

This Group's task would be to develop training for all personnel involved in all facets of mitigation: airport operations, flight crews, ground crews, government workers, etc. Additionally this Group should recommend training programs for such entities as flight schools, airline operators and other organizations responsible for airport and aviation operations.

Working Group on Regulations

This Group's task would be to develop policy and regulation equivalent to that in place with other aviation hazards. Regulations and policy could address the need for training plans by air operators; speed limits such as 250 knots below 10,000'; flight profiles which reduce risk in high bird concentration area, etc. Policy should be comprehensive and examine all facets of the hazard. Such policy would serve as the 'standard' for aviation operations in the presence of wildlife hazards.

Working Group on Technology

This Group's task would be to review and recommend technologies, such as data collection methodologies, integrated warning systems, comprehensive planning tools such as a civil version of the USAF BAM, for further funding for research and deployment. It must develop a cost analysis and protocols for use of technologies.

Finally, Working Groups should establish and adhere to a timeline for delivery of their finished products. The products should receive the widest distribution to industry and government and have the full backing and confidence of both.

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References

1. NTSB ACCIDENT ID: CHI08FA27

2. NTSB ACCIDENT ID: DFW08MA076

3. NTSB ACCIDENT ID: CEN09MA117

4. NTSB ACCIDENT ID: DCA09MA026

5. AAIU-2008-13 Federal Public Service Mobility and Transport, Air Accident Investigation Unit, Brussels, Belgium

6. ANSV Rapporto d'Inchiesta - Inconveniete Grave Boeing 767-432-ER, marche N834MH, aeroporto di Roma Fiumicino, 7 luglio 2007

7. NTSB Public Hearing, June 9-11, 2009, Landing of USAirways 1549 in Hudson River January 15, 2009

8. International Civil Aviation Organization (ICAO) Doc 9859, Safety Management Manual