New Zealand and Australian Societies of Air Safety Investigators

2000 Australasian Regional Air Safety Seminar

Christchurch, New Zealand

10 – 11 June, 2000

Reducing Bird Hazards

"Double or Nothing?"

Peter Reardon, M03380
Air Safety Investigator, Aviation Safety Consultant
Peter Reardon Enterprises Pty Limited
Australia

Abstract

This paper gives a broad overview of the hazards and risk to aviation safety posed by bird strikes.

Occurrence reports indicate that aircraft damage resulting from bird strikes in Australia is double the rate estimated by the International Civil Aviation Organisation (ICAO) and the Civil Aviation Administration (CAA) of the United Kingdom.

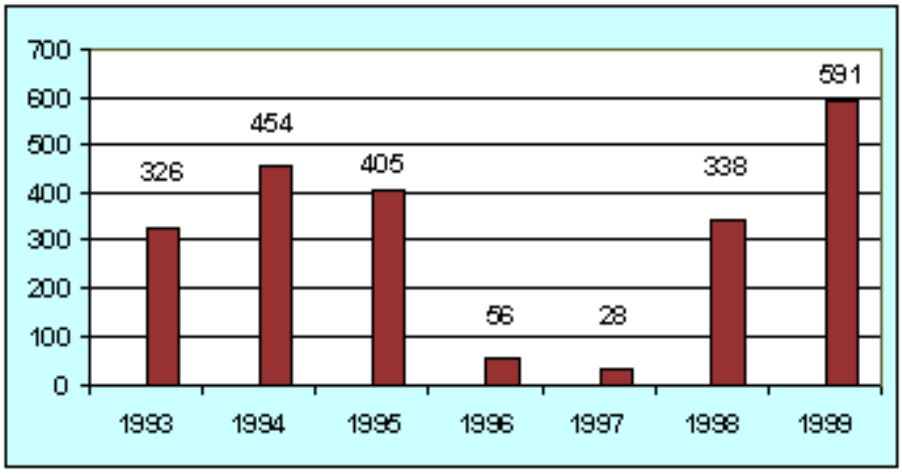
Bird strikes do not appear to be attracting the appropriate levels of attention that should be provided by aviation safety professionals. There can be little doubt that bird strikes are a safety threat and the potential for serious incidents or a hull loss accident is present.

Bird strike occurrences deserve more investigative attention combined with positive, proactive analysis, procedures, techniques and facilities focused on reducing the hazard and increasing industry awareness. Supportive responses by all aviation safety practitioners and participants with realistic goals aimed at significantly reducing the number of bird strikes is essential if the hazard is to be reduced.

It is intended that this paper should also serve to provoke discussions that ensure the investigation obligations of today can be met by responding to the safety threat posed by any deficiencies in bird hazard control.

Double or Nothing?

For the period between 1993 and 1999, there were 2,198 bird strike occurrences recorded in the public records of the Australian Transport Safety Bureau (ATSB), formerly Bureau of Air Safety Investigation (BASI). That represents an average of 314 bird strikes per year. Approximately 86% (n = 1902), 13% (n = 282) and 1% (n = 14) were assigned damage assessments of nil/unknown, minor and substantial/destroyed respectively.



As can be seen from the above chart, the number of recorded occurrences varied significantly between 1995 (n = 405), 1996 (n = 56), 1997 (n = 28), 1998 (n = 338) and 1999 (n = 591).

A subtle event occurred in Australia in 1991 associated with the move to “affordable safety.” The then Civil Aviation Authority’s (CAA) Bird Hazard Investigation Unit in Canberra was closed. What happened to all the bird strike reports? Well that is a damn good question! It appears that the bureaucrats in power at the time decided that bird strikes were perhaps not really a safety issue if the CAA was prepared to close the Bird Hazard Unit!

This is best illustrated in the BASI report “Reported Bird Strikes in Australia” published in November 1996 that stated “…. the requirement for reporting bird strike occurrences which did not involve aircraft damage was terminated in 1991”. This ‘requirement’ was not a true statement. It has never been reflected in legislation or industry documentation.

Subsequently it appears that although the reports were still being provided, they were not entered into the primary data retrieval system unless there was damage. Although the ‘paper record’ may have been retained for all reports, they apparently did not result in regular outputs to the regulators to proactively signal the dimensions of the problem.

If the regulator was not receiving the ‘total’ information available then they were deprived of essential information to address the safety issues associated with bird strikes! Some may view this as a significant organistional failure. If it is an organisation failure, then it has also undoubtedly conveyed substantial costs to the industry associated with bird strikes. Uncontrolled bird hazard activities have most probably remained unknown to

the relevant authorities and operators and represented an increased potential to jeopardise safety of commercial operations.

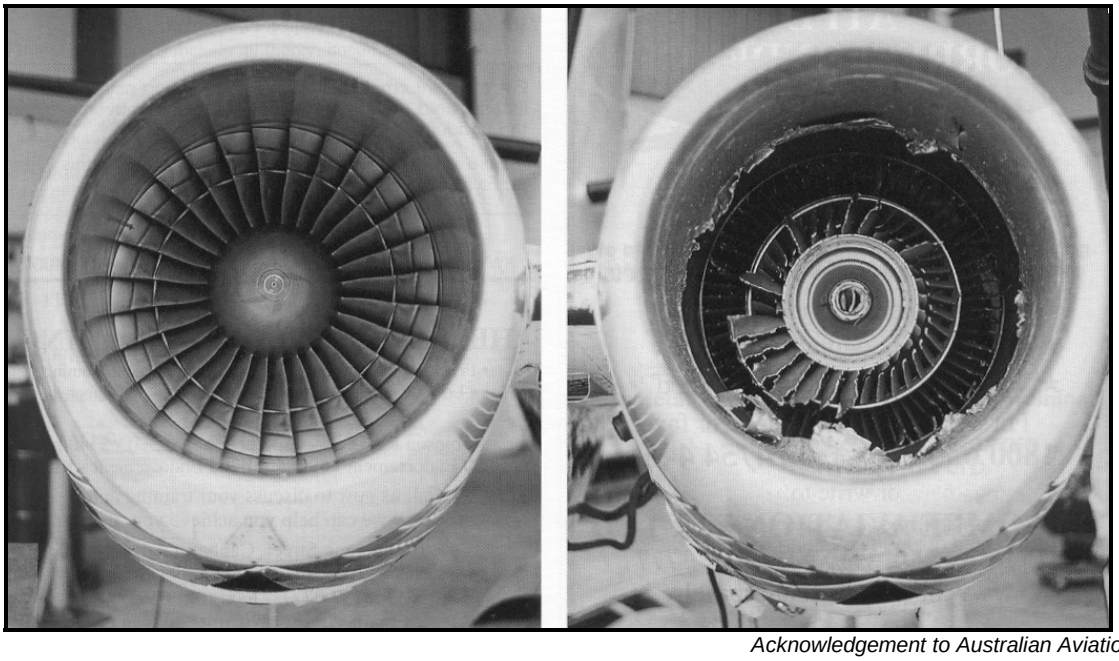
Evidence in support includes the number of bird strikes in Australia that have involved large public transport twin-engine jet aircraft where birds have been ingested into one or both engines. There have also been occurrences where aircraft have received multiple birds. Any one of these had the latent ingredients to produce a less successful outcome.

For example, the following bird strike at Cairns in 1996 was assessed as one resulting in 'Minor' damage.

2-Jan-96 5:22 hours Boeing B747 Cairns

The aircraft suffered multiple bird strikes to engines No 1 and No 2 and the left wing at about 300 feet after takeoff from Runway 15. One engine was shut down and the crew flew the aircraft to a safe landing. The birds were identified as Magpie Geese. The damage was classified by as 'Minor'.

Multiple bird strikes to engines one and two, followed by shutting down of one engine and returning to land at probably close to the maximum landing weight limits may be classified as a 'Minor' event, but the outcome could have been very different! The above bird strike would be a significant event in terms of safety risk, operational and commercial terms. It is also most certainly a myth to suppose that no damage or minor damage equals nil or minimum costs! The fact that a bird strike requires 'paperwork' in one form or another is a cost. Save money - don't do the paperwork? If that were to be the mind-set, then why do any paperwork for anything? The following photograph dramatically illustrates the extent of damage that can result from a bird strike – fortuitously in this occurrence the damage was contained.



Acknowledgement to Australian Aviation

The International Civil Aviation Organisation (ICAO) and the Civil Aviation Administration (CAA) of the United Kingdom estimate that about 6% to 7% of all bird strikes result in

aircraft damage. In Australia, the above data indicates that approximately 14% (n = 296) of all reported bird strikes result in aircraft damage if the assessments are correct, i.e. double the ICAO average. My experience in Australia is that the figure is conservative depending upon how the degree of 'damage' is classified. Are we prepared to continue with 'double' the odds for aircraft damage from bird strikes and do 'nothing', or should we be aiming for zero tolerance for bird strikes?

Bird hazard management is an important issue not only to flight crewmembers, their passengers and the aircraft operation itself, but also to airport operators and the safety regulators. If the ICAO and CAA UK data is correct, then the ATSB data represents an average of at least 42 bird strike events per annum being granted the opportunity to cause 'damage'.

Jet aircraft and engine manufacturers have to comply with certification procedures that require the aircraft to be capable of a safe landing after withstanding the impact by a bird of approximately 1.5 kg bird anywhere on the aircraft at normal operating speeds. The degree of damage and threat to safety is conditional upon aspects such as the size of the bird, bone structure, density and total mass. It has been estimated that a 1.0 kg bird struck by an aircraft at 130 knots generates a force equivalent to that of approximately a 100 kg weight dropped from a height of 3 metres. Bird strikes have resulted in aircraft hull losses and fatalities throughout the world and in Australia.

Consequently, the safety outcome of a bird strike into one or more engines remains a constant threat. The actual and potential safety hazard presented by a bird strike should neither be underestimated in terms of risk management nor simply relegated to a 'data base' without any investigative effort simply for the storing of data. Such data is useless and is itself a safety deficiency if it is not accurate, timely, complete, comprehensive and used for proactive safety purposes, outputs and safety education.

The public records indicate bird strikes are cause for serious concern. There have been a number of bird strikes in Australia where twin-engine jet aircraft have ingested birds into not only one but also both engines. There have also been occurrences where aircraft have impacted multiple birds and where four-engine jet aircraft have ingested birds into more than one engine. Some random examples are provided below.

03-Mar-96	**9:35 hours**	**Boeing B767**	**Brisbane**
During landing an Egret was ingested into the right engine causing damage to fan blades numbers 32, 33 and 34.			
04-Jul-98	**3:10 hours**	**Boeing B737**	**Honiara**
A ground engineer found three fan blades to be damaged and evidence of blood in the engine intake during a pre-flight inspection. The previous crew advised that they were not aware of a bird strike.			
23-Jan-99	**6:13 hours**	**Boeing B747SP**	**Sydney**
The aircraft sustained multiple bird strikes on landing. Subsequent inspection of the aircraft found turbine blade damage in the No 2 engine.			
15-Sep-99	**8:30 hours**	**Boeing B737**	**Adelaide**

The aircraft struck at least six galahs during rotation on takeoff from runway 30 at Adelaide. There were approximately 30 galahs in the flock that the aircraft encountered resulting in multiple bird strikes.

Why report a bird strike? In Australia, Part 2A (S.19AC) of the Air Navigation Act 1920 defines a bird strike as a collision between a bird, or a number of birds and an aircraft and defines such events as reportable occurrences. Nevertheless, it is almost universally accepted that only about 20% of all bird strikes are actually reported. So the actual problem may be far greater than the data reveals.

It is also a myth to assume that all bird strikes occur at airports and that the problem can be addressed simply by prescribing active bird hazard management techniques by the airport operators. Bird strikes can occur anywhere, at any time of the day, in any weather and at any altitude. Some of the following random examples demonstrate that although the greater number of bird strikes may be reported within airport environments, the problem is not totally confined to the airport boundary fence.

08-Sep-98 21:00 hours Avro 146-RJ70 93km N Perth

The pilot reported hearing a loud bang to the left side of the cockpit. Later inspection revealed evidence of a bird strike near the left pilot tube on the fuselage, the No 2 engine pylon and wing leading edge.

11-Nov-98 12:00 hours General Dynamics F-111 28km NE Rugby NDB

The pilot called on Sector 19 frequency and declared a "PAN" due to a bird strike. He requested a clearance to climb and divert to Canberra. The aircraft landed safely.

25-Aug-99 16:54 hours British Aerospace BAE 146 22 km N of Canberra

Passing 5,000 feet during the climb after takeoff, the aircraft struck a bird. The bird impacted the aircraft above the co-pilot's windscreen. There was no obvious damage to the aircraft at the time of the bird strike.

ICAO data indicates that civil medium and heavy jet aircraft were involved in over 70% of the reported bird strike events between 1988 and 1992, many of which occurred at a critical phase of flight when the aircraft was less than 100 feet above the ground.

So what is, or is not, happening in Australian skies? Firstly if a bird strike is not reported, recorded, investigated, analysed and the information published, then the authorities that have the safety and regulatory responsibilities for bird hazard management are deprived of the data essential for them to do their job and to make aviation safer. Consequently, pilots are not alerted to the magnitude of the problem.

Secondly, passenger jet aircraft approach a bird generally much faster than did propeller driven passenger aircraft. Jet engines have an enticing but static intake in lieu of the dynamic disc of a propeller – where “feather one” meant something totally different! Experience and anecdotal evidence indicates that a bird strike during the high power, accelerating departure phase generally poses a more significant safety threat than a bird strike at lower power settings whilst decelerating on approach. Statistics indicate that bird strike rates are marginally lower during the departure phase then the strikes rates reported during the approach and landing phases. For example, during 1999

approximately 35% of the 591 bird strikes occurred during the departure and climb phase with approximately 60% during the approach phase and the remainder during cruise (or unreported/undetermined) flight phases.

Additionally, there are the environmental issues – bird protection groups, seasonal migration, feeding patterns, time of day, type and length of grass on the airport, adjacent rubbish tips, wet lands – and the list goes on and on.

There are probably a few things that flight crewmembers can do to reduce the likelihood of a bird strike such as including birds in their situational awareness scan (remember, they don't just happen on airports). Pilots can also alert the airport operator or air traffic service unit as soon as possible of bird activity and request a 'bird' patrol to clear the runway wherever possible. They can also opt to take a short delay if necessary until satisfied that the airspace ahead is, and can remain, bird free for their operation. Pilots can also try to make their aircraft as conspicuous as possible so that the birds can include the aircraft in their situational awareness by extended use of aircraft lighting by day and night.

In April 1999, one Australian airline initiated a trial period of new bird strike reduction procedures for their Boeing B737 fleet. The trial was to evaluate the effectiveness of providing maximum lighting displays to guard against bird strikes. Instructions to B737 technical crew required all lights be used for takeoff. Above 2,000 feet, the outboard landing lights were to be selected off to reduce drag by retraction of the fittings. Inboard landing and runway turn-off lights were to remain on until passing transition altitude (approximately 11,000 feet in Australian airspace).

On descent the inboard landing and runway turn-off lights were required to be selected on approaching the transition level. When the landing gear was selected down the outboard landing and taxi lights were to be selected on. This would normally be between 1,500 feet and 2,000 feet. A review of the effectiveness of this procedure was scheduled to be complete after 12 months, i.e. April 2000.

An additional safety system is available to improve aircraft conspicuity. It is a self-contained, aircraft mounted system that makes the aircraft more conspicuous by creating an illusion of exaggerated sideways motion. The system pulses the existing landing, taxi, and recognition lights 45 times per minute in a variety of patterns,

dramatically increasing the visibility of the aircraft by creating an illusion of exaggerated motion. The aircraft becomes highly visible a can be more easily sighted.

The illusion of exaggerated motion distinguishes the aircraft from surrounding ground lights. In an instant, other pilots can see and avoid potential conflicts and anecdotal evidence to date indicates that the system is effective in reducing bird strikes.

Bird strikes do not appear to be attracting the appropriate attention that should be demanded of safety professionals. There can be little doubt that bird strikes are a significant safety threat, the number of occurrences is increasing, and the potential for serious incidents or a hull loss is also very real. Downstream effects of bird strikes have had little recognition. For example, even the smallest particle of a bird may go undetected for several hundred hours or longer in the cooling vents of a turbine blade. But eventually the operating temperatures will be exceeded and engine performance will degrade and the possibility of turbine blade failure remains a latent hazard preceding a potential engine failure.

Bird strikes deserve more investigative attention combined with positive, proactive analysis, procedures, techniques and facilities focused on reducing the hazard and increasing industry awareness with supportive responses and realistic goals aimed at significantly reducing the number of bird strikes.

This paper has provided a broad overview of the hazards and risk to aviation safety posed by bird strikes. It should also serve to provoke discussions that ensure the investigation obligations of today can be met. But, most importantly, this paper should signal that not one step of progress can be made unless ALL bird strikes are reported and actioned. Is it not time for an Asia Pacific Bird Strike Committee to be formed similar to the US Bird Strike Committee or should we continue to accept the present situation of “Double or Nothing?”

Peter Reardon has served 40 years in the aviation industry as an air safety investigator, air traffic service officer and professional pilot of approximately 9,000 hours, with agricultural and multi-engine instrument ratings. Pioneered ATS investigations in Australia in 1989 and compiled the proposed International Civil Aviation Organisation's Manual of Aircraft Accident Investigation addressing ATS investigations. Member of the International Society of Air Safety Investigators since 1990 and foundation member of the ISAS1 ATS Working Group. He was formerly the flight safety investigator with Ansett Australia and now operates his own air safety investigation and aviation safety consultancy.