Australian Government
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**ATSB TRANSPORT SAFETY INVESTIGATION REPORT**
Aviation Occurrence Report – 200605807
Final

# Birdstrike - Melbourne Airport, Vic.
# 3 October 2006
# VH-OGJ
# Boeing Co 767-338

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**Abstract**

At 1837 Eastern Standard Time on 3 October 2006, a Boeing Co 767-338 aircraft, registered VH-OGJ, with a crew of 11 and 125 passengers, commenced the take-off roll on runway 27 at Melbourne Airport, Vic, on a scheduled passenger service to Sydney, NSW. The sun had set at 1826.

During rotation of the aircraft, the crew noticed a large flock of birds (estimated between 20 and 50 birds) converging with the aircraft's flight path. With no evasive manoeuvre available to the crew at this stage of flight, the aircraft encountered the flock and sustained multiple strikes on many parts of the aircraft. Immediately following the strikes, the crew checked the engine instruments and noticed that the left engine vibration indicator had risen to about 4.5 units. The crew reduced power on the left engine and that reduced the vibration levels. The crew reported that, based on the stable EGT and the vibration level on the left engine being below the limit provided by maintenance watch, they elected to continue the flight to Sydney rather than return to Melbourne.

The investigation found that the decision to continue the flight did not fully take into account the potential effect of the birdstrike on the durability of the left engine, nor did it account for the performance of the aircraft if the right engine ceased operating during the flight.

Following the occurrence, the operator implemented a policy for their twin engine fleet that if a birdstrike to an engine is known to have occurred and there is obvious sign of engine damage, then a landing at the nearest suitable airport should be made.

# THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal Bureau within the Australian Government Department of Transport and Regional Services. ATSB investigations are independent of regulatory, operator or other external bodies.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the Transport Safety Investigation Act 2003 and Regulations and, where applicable, relevant international agreements.

**Purpose of safety investigations**

The object of a safety investigation is to enhance safety. To reduce safety-related risk, ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not the object of an investigation to determine blame or liability. However, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

**Developing safety action**

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to proactively initiate safety action rather than release formal recommendations. However, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation, a recommendation may be issued either during or at the end of an investigation.

The ATSB has decided that when safety recommendations are issued, they will focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on the method of corrective action. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations. It is a matter for the body to which an ATSB recommendation is directed (for example the relevant regulator in consultation with industry) to assess the costs and benefits of any particular means of addressing a safety issue.

**About ATSB investigation reports:** How investigation reports are organised and definitions of terms used in ATSB reports, such as safety factor, contributing safety factor and safety issue, are provided on the ATSB web site www.atsb.gov.au.

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# FACTUAL INFORMATION

## History of the flight

At 1837 Eastern Standard Time[1] on 3 October 2006, a Boeing Co 767-338 aircraft, registered VH-OGJ, with a crew of 11 and 125 passengers, commenced the take-off roll on runway 27 at Melbourne Airport, Vic, on a scheduled passenger service to Sydney, NSW. The sun had set at 1826.

During rotation of the aircraft, the crew noticed a large flock of birds (estimated between 20 and 50 birds) converging with the aircraft's flight path. With no evasive manoeuvre available to the crew at this stage of flight, the aircraft encountered the flock and sustained multiple strikes on many parts of the aircraft. Immediately following the strikes, the crew checked the engine instruments and noticed that the left engine vibration indicator had risen to about 4.5 units. The crew had also noted a change in the sound of the engine and a slight vibration through the airframe. The exhaust-gas temperature (EGT)[2] indicator value had not changed from the pre-strike value. There were no changes noted to the engine parameters for the right engine.

The crew informed air traffic control that they had a multiple birdstrike and continued with the climb. The crew reported that they reduced the power on the left engine and noted that the vibration level reduced.

Neither the vibration indicator, nor the aircraft operational documentation provided the crew with any indication of the acceptable vibration limits[3], so the crew contacted the company maintenance watch[4] for further information. After consultation with their documentation, maintenance watch informed the crew that there was a maximum engine vibration limit of 2.5 units, but if they could keep it below 2.0 they were not concerned. The crew reduced the power on the left engine by about 10% and the vibration level reduced to about 1.3 units.

The crew decided to level out and cruise at an altitude of 29,000 ft (below the maximum single engine operating altitude). Upon reaching the reduced cruise level, the power on both engines was further reduced to about 85% N1 (the normal cruise power setting for the cruise altitude and weight). The vibration on the left engine further reduced to about 0.83. Also, the copilot left his seat to inspect the left engine from a window on that side. He did not observe any obvious damage to the engine or nacelle. The only visible indications of the birdstrikes were on the aircraft wing.

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1 The 24-hour clock is used in this report to describe the local time of day, Eastern Standard Time (EST), as particular events occurred. EST was Coordinated Universal Time (UTC) + 10 hours.

2 The EGT indicator provided an indication of the performance of the engine. A change in the EGT can indicate substantial damage to the engine.

3 Other engine gauges in the same display provide warning to the crew of exceedence of limits by a change in the colour of the indicator to orange or red (as appropriate) and an associated warning message is displayed. The vibration indicator does not change colour or produce a warning message.

4 Maintenance watch was an engineering service provided by the company to provide the crew with technical information during the flight.

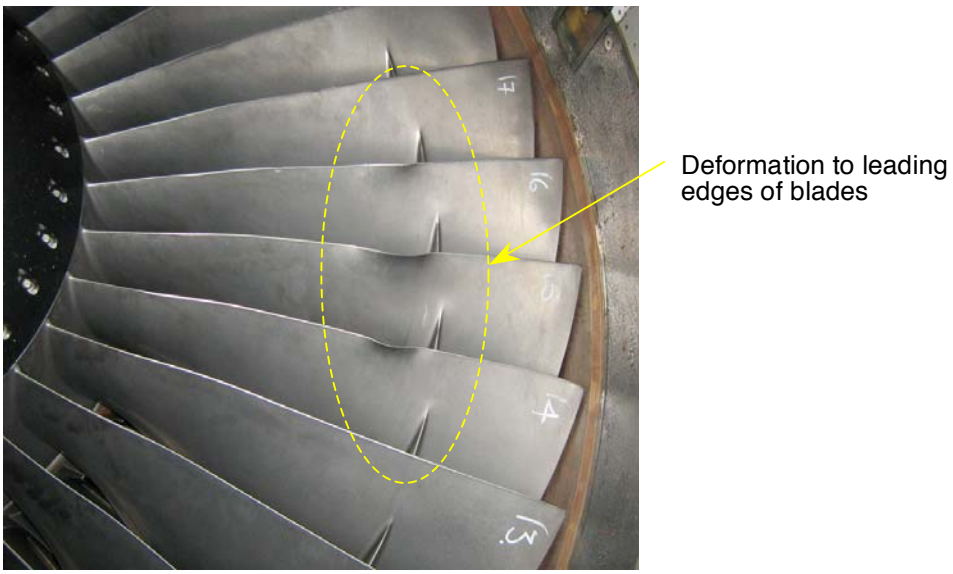
The crew reported that based on the stable EGT and the vibration level on the left engine being below the limit provided by maintenance watch, they elected to continue the flight to Sydney rather than return to Melbourne. They also considered that the flight was approximately one hour and there was at least one alternate airport available should the situation with the left engine degrade, and that the aircraft was capable of conducting a go-around on one engine should it be required. The vibration level on both engines remained below one unit for the remainder of the flight.

During the descent into Sydney, the crew reduced the left engine to flight idle as a precautionary measure and conducted an asymmetric thrust approach and landing. The aircraft landed without further incident.

## Damage to aircraft

A subsequent examination by the operator's maintenance staff revealed that the birds had struck the nose of the fuselage, the nose and right main landing gear, the wing leading edges, the engine pylons and both left and right engines. The damage to the aircraft was determined by maintenance staff to be minor, except for damage to the leading edges of 4 to 5 blades on both engines (Figure 1) and blockage of the pre-cooler on the left engine.

**Figure 1: Damage to right engine fan blades**




Note: damage to blades on both engines was similar in appearance.

The aircraft was inspected, cleaned, repaired and returned to service in accordance with the applicable sections of the aircraft maintenance documentation. No further issues relating to this birdstrike incident were reported by the operator.

## Operator's policy on birdstrikes

Other than the mandatory reporting requirements, the operator did not have any documented policies or operating procedures directly relating to birdstrike incidents. The procedures to be carried out by flight crews were based upon the

indications of any damage noted on the aircraft's instrumentation and warning systems, and good airmanship.

## Engine design requirements

The engines fitted to the aircraft were General Electric Company CF6-80C2B6 turbofan engines certified to US Federal Aviation Regulation Part 33 (FAR 33). When the engines were certified, FAR 33 included a requirement for ingestion of foreign objects,[5] which included ingestion of birds. The parts applicable to bird ingestion were:

> (a) Ingestion of a 4-pound [1.81 kg] bird, a piece of tire tread, or a broken rotor blade, under the conditions set forth in paragraph (f) of this section, may not cause the engine to--
>
> (1) Catch fire;
>
> (2) Burst (penetrate its case);
>
> (3) Generate loads greater than those specified in Sec. 33.23; or
>
> (4) Lose the capability of being shut down.
>
> (b) Ingestion of 3-ounce [0.09 kg] birds, 1 1/2-pound [0.68 kg] birds, or mixed gravel and sand, under the conditions set forth in paragraph (f)[6] of this section, may not cause more than a sustained 25 percent power or thrust loss or require the engine to be shut down.

This requirement did not specify the durability of the engine after the ingestion of birds under item (b), above, other than that the engine should not require to be shut down.

Amendments of FAR 33 subsequent to the amendment applicable to the engines on the aircraft[7] have included a 'run-on' period[8]. Amendment 33-10[9] of FAR 23 had a run-on period of 5 minutes. The Notice of Proposed Rule Making associated with this introduction of Amendment 33-10 stated that this 5-minute run-on period was 'representative of the time required for an aircraft to return for landing following bird ingestion during takeoff or climbout.'

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5 FAR Part 33 section 33.77

6 For the engines fitted to VH-OGJ, this required the ingestion of sixteen 3-ounce (0.09 kg) birds or eight 1-½ pound (0.68 kg) birds. The species of bird struck has an average weight of about 0.64 kg, fitting into the design requirement item (b), above.

7 Amendment 33-6

8 Run-on period refers to the length of time, subsequent to an ingestion, where an engine is designed to operate safely without requiring to be shut down.

9 Amendment 33-10 became effective on 26 March 1984 and was superseded on 13 December 2000. The Type Certificate for the engine was amended to include the model on VH-OGJ in September 1987, but did not include the Amendment 33-10 requirements for ingestion of foreign objects. The certification of the CF6-806C2B6 model was based on the original design standard for the basic CF6 model, which predated amendment 33-10.

## Research into birdstrike hazards

The Australian Transport Safety Bureau (ATSB) released a research report in November 2002 entitled *The Hazard Posed to Aircraft by Birds*.[10] Key points from this research report include:

- Since 1912, birdstrikes have been a factor in the loss of at least 52 civilian aircraft and about 190 lives worldwide.
- The available data suggests that there has been a significant increase in the rate of both total birdstrikes and damage birdstrikes recorded between 1991 and 2001.
- Both the Australian statistics and [International Civil Aviation Organisation] (ICAO) reports suggest that the majority of birdstrikes occur on or near the airport environment. This corresponds to several critical phases of flight – approach, landing, take off and climb, and the statistics show that birdstrikes are most common at these stages of flight.
- Birdstrike rates appear to vary according to time of day. The available data suggests that strikes are most common in Australia during dawn, early morning and dusk. This may be due to a combination of bird and aircraft activity at these times.
- Birdstrikes are capable of exerting very large forces on an aircraft. According to the ATSB data, the most commonly damaged sections of an aircraft following a birdstrike include (not unexpectedly) the wings, engine(s) and the windshield.

The research report also included a recommendation that a birdstrike working group be developed and that such a group should include industry representatives from Australia. The Australian Bird and Animal Hazard Working Group was formed in December 2003 as a result of this recommendation. Details on the working group can be found in their Statement of Purpose and Charter available on the Civil Aviation Safety Australia web site at http://www.casa.gov.au/aerodromes/bird.htm.

## Aerodrome bird hazard management

Part 139 of the Australian Civil Aviation Safety Regulations, requires that aerodrome operators must have procedures to deal with the danger to aircraft operations caused by the presence of birds on or near the aerodrome. This was to include arrangements for assessing any bird or animal hazard and the removal of any such hazard.

The operator of Melbourne Airport had a comprehensive wildlife hazard management plan that included a monthly review by an external expert. The objectives of the management plan included to:

- have timely identification of potential hazards through monitoring and data collection
- have informed, data-based decisions as to the best management actions to take

10 Refer to http://www.atsb.gov.au/publications/2003/pdf/Hazard_aircraft_by_birds.pdf.

- have effective long-term, pro-active measures to reduce bird numbers at the airport
- have effective reactive measures to disperse wildlife on the airport, which are persistent and varied
- implement species-specific management actions targeting those species identified as being of particular concern
- have ongoing training of staff and trialling of new techniques.

The management plan also included a bird watch condition report that was to be carried out on four occasions each day and reported to air traffic control. This report assessed the bird activity within the vicinity of the runway. Dispersal actions were applied when considered necessary to reduce the threat.

The airport operator advised the ATSB that they had recently joined the Australian Bird and Animal Hazard Working Group as part of their ongoing commitment to bird and animal hazard reduction.

The airport operator reported that an autopsy had been carried out on the birds recovered on the aerodrome. The autopsy confirmed that the birds were a species of corella[11] and that they had not been feeding on any plants known to exist within the aerodrome boundaries. They also reported that they had contacted the Victorian Department of Sustainability and Environment and been advised that the bird species was not a local species and probably entered the area in search of food, as a result of the drought conditions in their natural area. The airport had not included the corella in the species-specific action plan as it had been assessed as a very low likelihood due to the very small numbers observed at the airport in the preceeding eight years (1997 to 2005).

The *Aeronautical Information Publication (AIP) En Route Supplement Australia*[12] stated that a bird hazard existed at Melbourne.

11 A small species of cockatoo.

12 The En Route Supplement Australia is a publication of Airservices Australia that provides specific operational information for all approved aerodromes in Australia.

# Additional information

## Similar recent event

On 28 September 2006, during the take-off run at Adelaide Airport SA, a Boeing Company 737-476, registered VH-TJU and operated by the same company, struck 10 galahs. The crew declared a PAN and returned the aircraft for a landing with both engines at a reduced power setting. The crew of VH-OGJ were not aware of this particular occurrence.

## Recent technological advances in bird detection

Recent technology advances have resulted in several commercial bird detection radar systems being developed. These systems claim to detect individual birds and flocks of bird several nautical miles from the airfield and can be configured to concentrate on the approach and departure corridors. This information can be presented to air traffic controllers to assist in the safe coordination of aircraft traffic at the aerodrome.

# ANALYSIS

Given the limited avoidance manoeuvres available immediately after takeoff and the point at which the crew noticed the flock of birds, the collision between the aircraft and the birds was considered unavoidable. Apart from the entry in the *En Route Supplement Australia* noting a general bird hazard at Melbourne, there was no information provided to the crew that there was an immediate threat from birds in the area.

The investigation identified two issues regarding the decision to continue with the flight to Sydney. Firstly, the durability of the engine that had indications of possible damage resulting from the birdstrike (the left engine); and secondly the unknown performance of the aircraft if the right engine had failed during the remainder of the flight.

The crew indicated that they had some concern about the serviceability of the left engine while they attempted to obtain as much information on any damage as they could from the engine instruments, visual inspection and the contact with maintenance watch for advice on the vibration limits. After obtaining that information, the crew felt that the engine would remain serviceable if the vibration could be kept within the vibration parameters supplied to them.

If the effect of the birdstrike was greater than the crew understood at the time, and the condition of the left engine degraded further, the crew took into account that the aircraft had the performance to continue to the destination, or an en-route alternate if required, on one fully serviceable engine. This included consideration that the aircraft could still perform a go-around at the destination on one fully serviceable engine.

The crew's decision to continue the flight was based upon the options available should the left engine's performance degrade. However, that risk assessment does not appear to have included consideration of the possibility of a failure of the right engine (related or unrelated to the birdstrike event) at a later stage in the flight. Because of the requirement to maintain vibration levels below those parameters specified by maintenance watch, the crew did not have access to the full power of the left engine, and thus had no way of determining what the performance of the aircraft would be if only that engine was available.

As the damage occurred to the left engine before the aircraft had departed the Melbourne area, the crew were assuming that the right engine would be operational for the entire flight. As it turned out, the right engine had also sustained some damage due to the birdstrike and was thus at an increased risk of failure during the flight.

The engine certification standard for the engines fitted to VH-OGJ required that the engines did not need to be shut down following ingestion of up to eight 1½ pound (0.68 kg) birds, but did not stipulate a run-on time. However, later amendments of the certification standards stipulate run-on times following bird ingestion. This indicates that it was the intention of the design requirement that the engine need only operate safely for the time that would allow the aircraft to return to the aerodrome.

The crew made a decision on the continued safe operation of the aircraft based upon a limited amount of information and in a limited amount of time. As a result, the decision to continue the flight to Sydney was made without a full appreciation of the aircraft damage and the potential risks to the safe conduct of the flight. Had the operator provided some operational guidance, taking into account the durability of the engine following a birdstrike and the increased risk of conducting a flight with one engine at reduced performance, the crew would probably have returned the aircraft to Melbourne.

The aerodrome operator had a bird and animal hazard management plan and therefore met the requirements of the Civil Aviation Regulations. That plan managed the hazard to aircraft from birds by controlling the numbers of birds at and around the aerodrome, making it unattractive to birds and dispersing them when numbers increased or they were considered a threat to aircraft. Even though the management plan included a bird watch report to air traffic control, it was not a continuous monitoring of the immediate bird threats. By reviewing and implementing modern real-time bird detection technologies, aerodrome operators could make a potentially significant reduction in the hazard that birds present to aircraft in the vicinity of the aerodrome.

# FINDINGS

## Contributing safety factors

- The aircraft encountered a flock of birds on takeoff shortly after the aircraft left the ground.
- Both engines were struck by birds. Both engines were damaged, but only the left engine indicated a change in the vibration level.

## Other safety factors

- The crew decided to continue the flight to Sydney.
- The operator had no documented policy regarding actions to be taken when there were indications of engine damage as a result of a birdstrike.

## Other key findings

- The intent of the certification of modern turbine aircraft engines was that, following the ingestion of a bird(s) during the takeoff or climb out, the engine continues to operate safely only for a duration that was representative of a return to the aerodrome.
- Modern technologies exist, like bird detection radar systems, which can provide real-time information on birds in the airport proximity.

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# SAFETY ACTION

As a result of this incident the aircraft operator issued a Flight Standing Order on 6 October 2006 that provided a policy for flight crew in the event of a birdstrike on any of their twin engine aircraft fleet. The policy states:

> Any time a birdstrike to an engine (or engines) is known to have occurred AND there is obvious sign of engine damage, then a landing at the nearest suitable Airport should be accomplished.

It noted that obvious signs of engine damage may include: increased vibration (either indicated or felt), a change in engine parameters that is not normal for the phase of flight, or significant difference in the parameters between engines.