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Bird Strike during de Havilland Dash 8's Approach Disables Left-engine Instruments, Brakes and Nose-wheel Steering

The flight crew shut down the left engine after the aircraft struck an eagle. They continued flying near the destination airport for 31 minutes while troubleshooting a landing-gear-unsafe warning. The crew then lost directional control of the aircraft during an attempted single-engine, crosswind landing.

FSF Editorial Staff

On May 17, 1996, a de Havilland Canada Dash 8 (DHC-8) ran off the right side of Runway 10 while landing at the Broome, Australia, airport. The aircraft was damaged substantially. The final report on the accident by the Australian Bureau of Air Safety Investigation (BASI) did not say whether any of the occupants were injured.

BASI said that the following were significant factors in the accident:

- "The aircraft struck a 10-kilogram (22-pound) wedge-tailed eagle;
- "The left-engine instrumentation failed, and the master caution panel indicated multiple system failures;
- "System redundancy was compromised when the wiring was damaged, resulting in the failure of the left weight-on-wheels signal to the proximity-switch electronic unit;
- "The nose-wheel steering, antiskid and normal braking, and ground-spoiler-deployment systems were rendered inoperative; [and,]
- "The crew did not follow company procedures [for] using checklists to resolve non-normal situations."

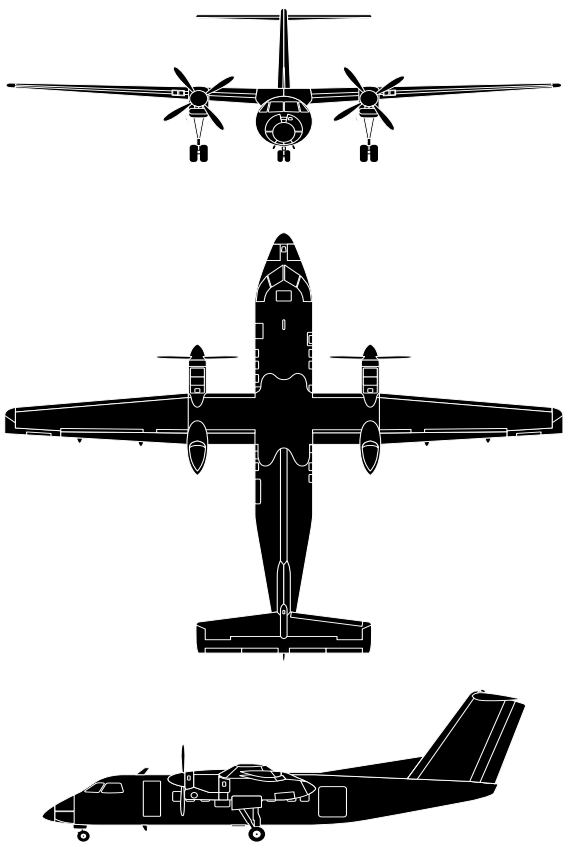
Two pilots, a flight attendant and 14 passengers were aboard the DHC-8. The flight crew was conducting a visual approach to the airport at Broome in visual meteorological conditions. The first officer was flying the aircraft.

The aircraft was northeast of the airport, descending through 4,800 feet at an indicated airspeed of 243 knots, when it struck the bird. The bird penetrated the fairing at the left wing root.

An amateur ornithologist later identified the bird as a wedge-tailed eagle weighing approximately 22 pounds (10 kilograms). "The bird had the undigested carcass of a rabbit-sized animal in its gut," said BASI.

The bird strike destroyed the fairing, bent the wing spar and cracked the forward flange of the lower spar cap. All of the wires routed along the front wing spar were severed or stretched. "At least 30 of the single or twisted-pair wires from this area, as well as one of the two main electrical power cables, [were] severed during the impact," said BASI.

"Wires [were] pulled from their respective multipin connectors, and whole connectors [were] ripped from their airframe-mounted counterparts."



De Havilland Canada Dash 8

The DHC-8 is a twin-turboprop, short-range transport. Deliveries began in 1984. The DHC-8-100 series is powered by two Pratt & Whitney PW-120A engines rated at 2,000 shaft horsepower (1,491 kilowatts) and Hamilton Standard 14SF-7 four-bladed propellers. The Dowty Aerospace landing gear have two wheels on each strut. The nose gear retracts forward; the main gear retract into the engine nacelles. Standard accommodation is for two flight crewmembers, one cabin crewmember and 36 passengers seated four-abreast with a center aisle. Maximum takeoff weight is 34,500 pounds (15,650 kilograms). Maximum payload is 8,400 pounds (3,810 kilograms). Maximum cruising speed is 265 knots. Maximum certified altitude is 25,000 feet.♦

Source: *Jane's All the World's Aircraft*

Several aircraft systems failed, including the nose-wheel-steering system, antiskid-brake system and ground-spoiler-extension system. Failure of the antiskid system also rendered the normal brake system inoperative.

Normal operation of the nose-wheel-steering, antiskid-brake and ground-spoiler-extension systems requires that the systems receive weight-on-wheels signals from the proximity-switch electronic unit. The wiring between the left-main-landing-gear weight-on-wheels sensors and the proximity-switch electronic unit was severed.

Two weight-on-wheels sensors are installed on each main landing gear for redundancy. BASI said that the quick reference handbook (QRH) for the DHC-8 does not show that illumination of the weight-on-wheels caution light could indicate failure of both weight-on-wheels sensors and the consequent failure of the nose-wheel-steering, antiskid-brake and ground-spoiler-extension systems.

The bird strike also damaged the wiring from the left engine to the left-engine instruments. The left-engine speed and torque instruments, and the propeller-speed instrument indicated zero.

The flight crew shut down the left engine two minutes and nine seconds after the bird strike. The aircraft was descending through 1,860 feet at an indicated airspeed of 220 knots when the left engine was shut down.

Both pilots later told investigators that they had conducted a power check on the left engine after they saw the left-engine instruments indicating zero and before they shut down the engine.

"However, the flight data recorder did not show evidence of a power check before the crew shut down the left engine," said BASI. "[Also,] the fuel shut-off check was not completed during the engine shut-down drills but was completed 18 minutes and 34 seconds after the engine [was] shut down."

The crew continued flying toward Broome. The left-main-landing-gear-unsafe warning light illuminated when the crew attempted to extend the landing gear.

"The crew discontinued the landing approach [while on base leg for Runway 10] and elected to hold between five nautical miles and 10 nautical miles northwest of the aerodrome while they checked the aircraft systems," said BASI.

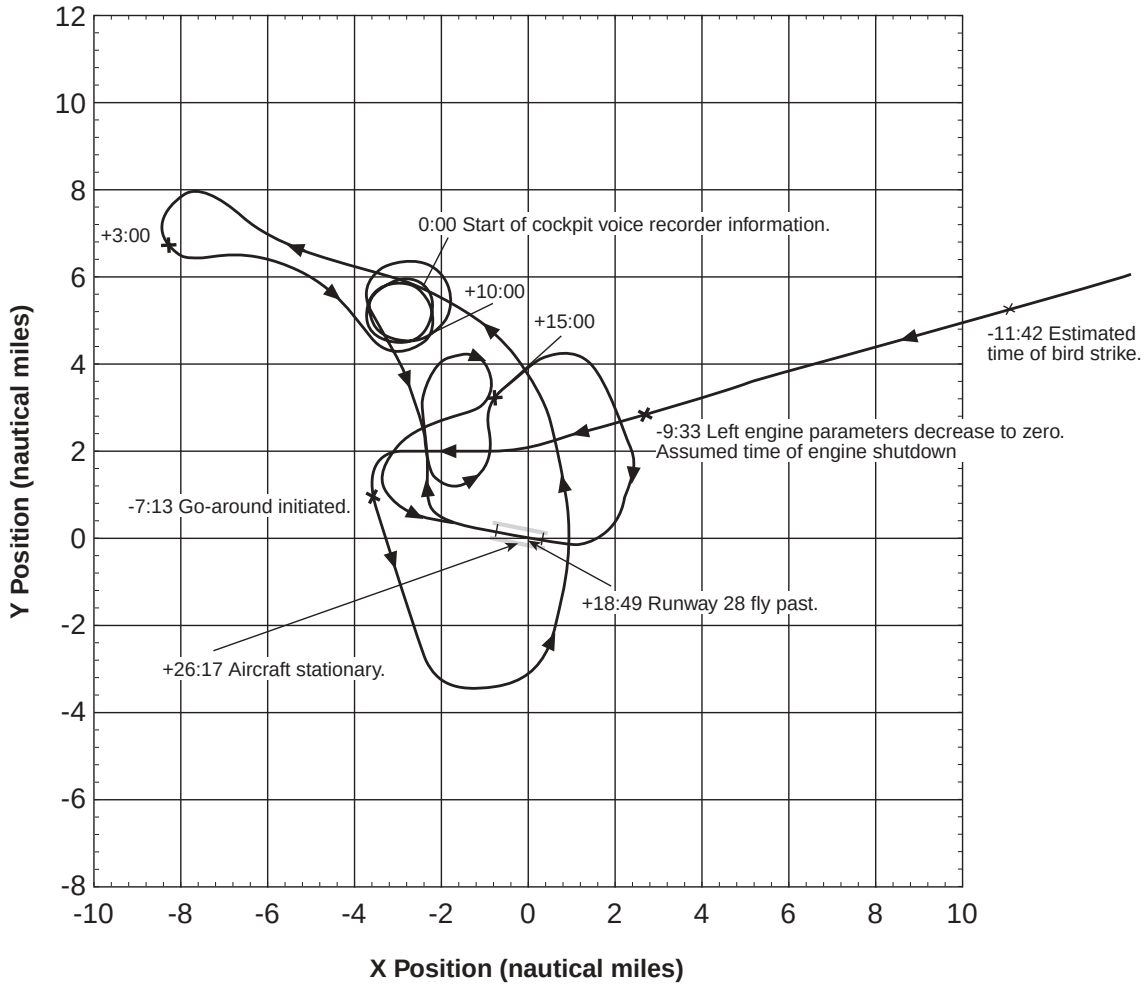
"Nine of the turns during the holding, including four orbits, were to the left, into the failed engine, and three turns were to the right. Three of the orbits during the holding were conducted at bank angles which produced a rate of turn greater than rate one [three degrees per second]." Figure 1 (page 3) shows the aircraft's flight path.

BASI said that the flight crew held for 31 minutes while attempting to analyze the landing-gear-unsafe indication.

"The crew informed the Perth Flight Service officer that they were having trouble with the landing gear," said BASI. "However, they did not declare an emergency or inform the flight service officer that they had shut down the left engine, as required [by] the company operations manual."

BASI said that the crew did not refer to the abnormal-conditions checklist but acted from memory during their attempts to resolve the left-main-landing-gear-unsafe indication.

Flight Path of de Havilland Dash 8; Broome, Australia; May 17, 1996



Note: Times are relative to the start of the cockpit voice recorder (CVR) information (minutes:seconds). Times with minus signs are for events that could not be correlated with CVR information. Times with plus signs are for events that could be correlated with CVR information.

Source: Australian Bureau of Air Safety Investigation

Figure 1

The crew used the radio to contact airline engineers at the Broome airport and a de Havilland Canada representative in Perth.

"The company engineers … asked the crew to check the landing-gear alternate-system indication," said BASI. "The crew noted that three green lights illuminated." The three green lights indicated that the landing gear was down and locked.

The crew then accepted a suggestion by one of the company engineers that they conduct a low pass over the runway at the Broome airport to obtain confirmation of the landing-gear position by ground personnel.

The captain took control of the aircraft. The first officer told the captain that he had experienced difficulty in maintaining altitude during turns while using less than maximum continuous power (97.5 percent) from the right engine.

"The fly-past was conducted along the runway at 96 feet pressure altitude with the indicated airspeed reducing to a minimum of 114 knots at a power setting of 94.7 percent [of maximum rated] engine rpm [revolutions per minute] and 61.8 percent torque," said BASI. "The landing gear was extended, and the flaps were extended to 15 degrees.

"During the subsequent climb-out, the maximum torque and engine-rpm values recorded were 107.5 percent and 101.2

percent, respectively. The minimum airspeed recorded during the climb-out was 103 knots.

"On completion of the fly-past, the manufacturer's representative confirmed that if the alternate gear system showed an indication of three green [lights], the crew could consider it safe to land the aircraft."

The crew then flew the landing pattern for Runway 10. BASI said that the crew did not use the QRH emergency-landing checklist. BASI said, "The procedures for an emergency landing … require that the crew:

- "Ensure that no passengers are seated in the vicinity of the propeller arcs;
- "Review proposed landing and evacuation procedures with the copilot; [and,]
- "Warn crew and passengers to brace before touchdown."

The crew later told investigators that they informed the flight attendant to secure the cabin and to sit for landing after the bird strike occurred. The crew said that they had expected the cabin occupants to remain seated throughout the remainder of the flight.

BASI said that this action was not in compliance with company procedures.

"Even though the crew had expressed concern about the status of the landing gear, they did not follow the emergency checklist procedures to ensure that the passengers were prepared for a possible non-normal touchdown, nor did they conduct a prelanding review of evacuation procedures."

"The manufacturer's representative confirmed that if the alternate gear system showed an indication of three green [lights], the crew could consider it safe to land the aircraft."

The surface winds were from 170 degrees at six knots when the aircraft touched down on Runway 10. The captain was unable to maintain directional control on the runway. He applied reverse thrust on the right engine and attempted to use the brakes to slow the aircraft.

"The combined effect of no nose-wheel steering, reverse thrust on the right engine and weather-cocking from the crosswind caused the aircraft to turn right through approximately 44 degrees," said BASI. The aircraft ran off the right side of the runway. The captain used the emergency brake system to bring the aircraft to a stop.

BASI's final report on the accident included the following findings:

- "System redundancy was compromised when the wiring was damaged, resulting in the failure of the left weight-on-wheels signal to the proximity-switch electronic unit;
- "The nose-wheel steering, antiskid and normal braking, and ground-spoiler-deployment systems were rendered inoperative;
- "The aircraft was manufactured to comply with U.S. Federal Aviation Regulations [Part] 25 design criteria covering transport-category aircraft. Consequently, the wing-to-fuselage fairing was not designed, nor was it required to be designed, to protect the structure beneath it from [the force of] impact with a bird weighing 10 kilograms [22 pounds];
- "The [aircraft] manufacturer's [QRH] checklist does not contain information to alert the crew that the illumination of the weight-on-wheels caution light may be warning of a failure or loss of systems such as nose-wheel steering, antiskid braking, normal brakes and ground spoilers;
- "The one-engine-inoperative checklist also does not cover procedures to be adopted and briefings to be given when one engine is not operating and there is uncertainty about the status of the landing gear;
- "The crew did not declare an emergency or inform the flight service officer that they had shut down the left engine;
- "Although the landing-gear standby system indicated that the gear was down with three green lights illuminated, the crew carried out a low single-engine fly-past in an attempt to have ground staff confirm the landing-gear position;
- "Both pilots were appropriately licensed and qualified to undertake their respective duties as pilot in command and copilot on this flight;
- "The flight attendant was qualified to perform her assigned duties on the flight;
- "Both pilots had completed a crew resource management [CRM] training course which involved pilots and flight attendants;
- "The flight attendant had not completed a [CRM] training course and was not required by company policy to complete such training;
- "The company's policy on resource-management training reflected a bias towards cockpit, rather than crew, resource management; [and,]

- "The crew did not follow company procedures when they acted from memory to resolve non-normal situations and indications."

Based on the findings, BASI made the following recommendations to the Australian Civil Aviation Safety Authority:

- "Alert all Australian operators of DHC-8 aircraft that if the weight-on-wheels caution light is illuminated, systems other than the landing gear could be affected;

- "Alert Transport Canada about a suggested revision to the manufacturer's [QRH] for the DHC-8 aircraft. The revision should include a note to aircrew that if a weight-on-wheels caution light is illuminated, systems other than the landing gear may not be operating normally. In particular, reference to the nose-wheel steering and normal braking systems should be made as a crew-awareness item under the weight-on-wheels caution-light-illuminated checklist;

- "Ask Transport Canada to consider moving the one-engine-inoperative landing checklist to the emergency-landing section of the manufacturer's [QRH]; [and,]

- "Should a revision to the checklist be made, … alert all Australian operators of DHC-8 aircraft to revise their checklists where these are at variance with the manufacturer's checklist."♦

Editorial note: This article was based on Australian Bureau of Air Safety Investigation, Investigation Report 9601590, *De Havilland Canada Dash 8, VH-JSI, Broome, Western Australia, 17 May 1996.* The 12-page report contains photographs and a diagram.

Further Reading from FSF Publications

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Huang, Shung C. "Trends of Worldwide Bird Strikes, Calendar Years 1984-1989." *Flight Safety Digest* Volume 10 (November 1991): 11–13.

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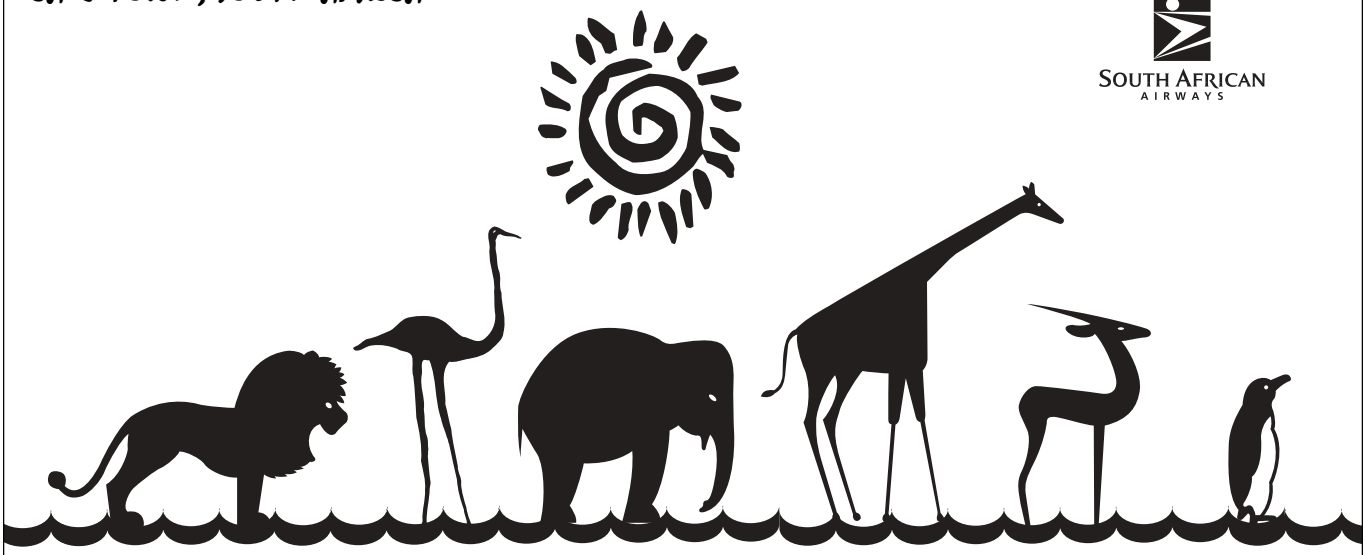

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