Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A11C0100

COLLISION WITH TERRAIN
LAWRENCE BAY AIRWAYS LTD.
DE HAVILLAND DHC-2, C-GUJX
BUSS LAKES, SASKATCHEWAN, 2 NM SE
30 JUNE 2011

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

Aviation Investigation Report

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De Havilland DHC-2, C-GUJX
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Report Number A11C0100

Synopsis

The Lawrence Bay Airways Ltd. float-equipped de Havilland DHC-2 (registration C-GUJX, serial number 1132) departed from a lake adjacent to a remote fishing cabin near Buss Lakes for a day visual flight rules flight to Southend, Saskatchewan, about 37 nautical miles (nm) southeast. There were 4 passengers and 1 pilot onboard. The aircraft crashed along the shoreline of another lake located about 2 nm southeast of its point of departure. The impact was severe and the 5 occupants were killed on impact. The emergency locator transmitter activated, and the aircraft was found partially submerged in shallow water with the right wing tip resting on the shore. There was no post-crash fire. The accident occurred during daylight hours at about 1111 Central Standard Time.

Factual Information

History of Flight

The pilot had flown from Southend to a remote fishing cabin near Buss Lakes to pick up 4 passengers he had transported there 4 days earlier on 26 June 2011. This was a commercial charter operating under Canadian Aviation Regulations Part 703.

The flight had been scheduled to depart Southend at 0900 but was delayed by 1 hour due to a line of cumulonimbus (Cb)[1] clouds that passed through the area.

Weather

The closest weather reporting station to the accident site is Key Lake, Saskatchewan, approximately 80 nautical miles (nm) to the northwest of Buss Lakes. A special weather observation issued at 1111 for Key Lake indicated wind 290° true (T) at 3 knots; visibility 5 statute miles (sm) in light rain and mist; cloud scattered at 1700 feet above ground level (agl) and overcast at 2500 feet agl; temperature 14°C, dew point 13°C.

Graphical area forecasts (GFA) valid for the time period of the flight indicate a low pressure system and cold front moving eastward through the area. Adverse weather conditions were associated with this system, and a report of significant meteorological information, SIGMET H10, was issued at 0656 [2] on 30 June and was valid for the period 0855 to 1255. The SIGMET indicated that within 30 nm of a line co-incident with the route between Buss Lakes and Southend, a line of Cb had been observed by satellite and lightning detection screens. Cumulonimbus tops were estimated at 38000 feet above sea level (asl). Large hail and wind gusting to 40 knots were forecast along the line of Cb which was moving northeastward at 25 knots.

Images recovered from a camera of one of the passengers showed the line of Cb passing overhead Buss Lakes and the aircraft arriving about 2 hours later. While the images indicate that there was still some cloud in the area, the ceiling appeared sufficient for visual flight rules (VFR) flight. Images of the water surface during the landing and subsequent take-off showed no wave action other than a light ripple.

In view of the variability of weather conditions, a meteorological assessment [3] for the Buss Lakes area was requested from Meteorological Service of Canada. The following was gleaned from the report:

- From satellite imagery it was determined that a brief clearing of weather occurred at Buss Lakes at or around 1030 after the frontal system had passed through the area.

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1 Clouds associated with a thunderstorm.

2 All times Central Standard Time (coordinated Universal Time minus 6 hours).

3 Meteorological Assessment: Buss Lakes, SK, Canadian Meteorological Aviation Centre-West, Meteorological Service of Canada, August 31, 2011.

- By 1046, shortly after this clearing occurred, stratiform cloud could be seen developing in the clear skies in advance of the next band of cloud associated with this system.
- By 1100, the growing area of stratiform cloud was affecting the Buss Lakes area itself; it had expanded further by 1716.
- The combination of saturated lower levels, resulting from recent precipitation; light winds in the axis of the trough; and cold water surfaces may have resulted in local dense fog patches over the Buss Lakes area, possibly obscuring shorelines and / or higher terrain in the area.

Pilot Qualifications

The pilot was certified and qualified in accordance with existing regulations. On 30 June, the pilot's total flying time was 4023 hours with 3664 hours on float-equipped aircraft. Company records indicated that the pilot had completed the required ground training, which was in accordance with CAR 703.98, [4] before starting the summer season. The pilot had also completed the company's required flight proficiency training prior to carrying passengers.

Company

Lawrence Bay Airways Ltd. operated 2 aircraft, the accident DHC-2 and a Cessna 180, both on floats. The company was being operated under an Air Operations Certificate issued under subpart 703 – Air Taxi Operations of the *Canadian Aviation Regulations*.

Aircraft Information

Manufactured in 1958, technical records indicated that the aircraft was certified, equipped and maintained in accordance with existing regulations and approved procedures. Prior to the float season, the aircraft underwent an 800-hour inspection by an approved aviation maintenance organization (AMO) in La Ronge, Saskatchewan, on 28 May 2011, when the airframe had logged 12 746.9 hours. On 30 May 2011, the pilot picked up the aircraft and flew it back to Southend. The company had a maintenance arrangement with the AMO, under which it would supply an engineer to fly to Southend to fix any maintenance issue that arose. About a week prior to the accident, the AMO received a call that a 100-hour inspection was coming due and that, other than a few minor issues, the aircraft was operating satisfactorily.

Weight and Balance

No record of a pre-departure weight and balance calculation for the occurrence flight was found. Using actual passenger and cargo weights loaded in different seating and placement configurations, investigators made centre of gravity (C of G) estimates. All showed that the aircraft was operating within its maximum gross weight and C of G limits. The estimates did show, however, that the aircraft was near its maximum gross weight and that some load placements would put the C of G near its aft operating limit.

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[4] Canadian Aviation Regulations

Site Examination

The wreckage was located partially submerged in the water on the north shoreline of one of the Buss Lakes approximately 2 nm southeast from the departure lake where the fishing cabin was situated. A portage was required to reach the accident lake by boat from the departure lake (Figure 1).

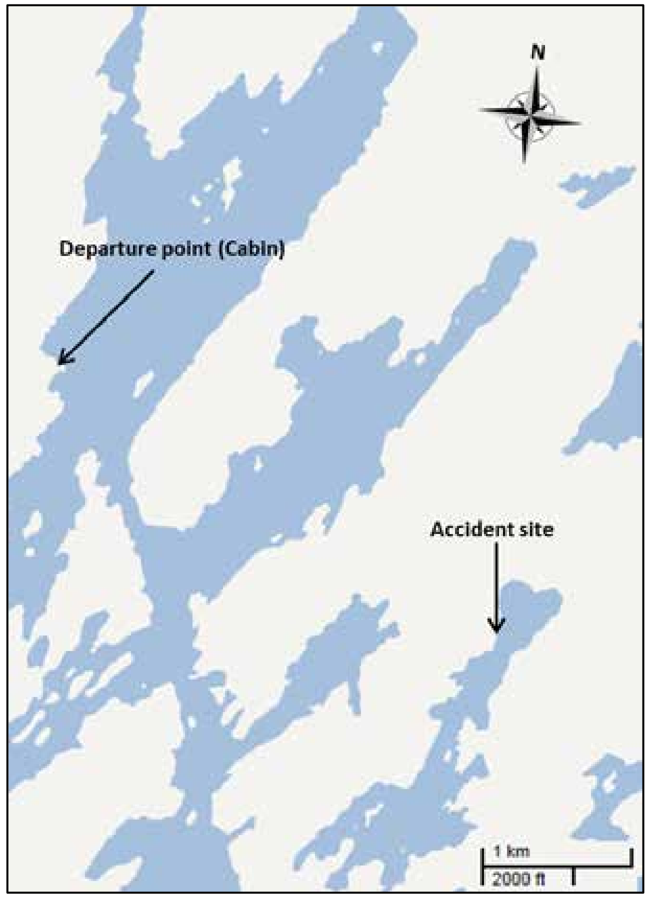

Figure 1. Buss Lakes

The nose of the aircraft was oriented to the southwest, about 245° T. The tip of the right wing was on the shore and at a right angle to the shoreline. The remainder of the aircraft was partly submerged in the water. The engine had been driven under the fuselage and the floats had been driven back behind the wings. The aft fuselage had buckled just behind the wing and was bent in towards the shoreline. Broken trees directly behind the aircraft and a ground scar left by the outer portion of the right wing indicated that the aircraft had struck the ground and water surface at an angle of about 30° nose down and right wing low. After striking some trees, the aircraft came to rest about 10 feet beyond and about 24 feet to the left of the ground scar.

Wreckage Examination

The wreckage was slung onshore by helicopter and examined. All control surfaces were present and continuity of controls was established. Several instruments and instrument panel warning lights were removed and sent for examination at the TSB Laboratory in Ottawa. The engine, propeller and flap actuator were removed and taken for examination to the TSB regional wreckage examination facility in Winnipeg.

Examination and Component Testing

Examination of the propeller revealed twisting that was characteristic of high engine power at impact. One propeller tip had broken off and the fracture face was examined at the TSB Laboratory. It was determined to be an overload failure. A mark on the propeller dome indicated that the propeller was at the low pitch stop at impact.

Impact damage to the engine precluded an engine test run. The engine was disassembled and no pre-existing internal damage was found. The engine-driven fuel pump was removed. Corrosion damage to the impeller section, the result of being in the water for some time, prevented running the pump. Other than the water corrosion, no other damage was found in the impeller section. The control section of the pump, which includes a pressure regulator and a by-pass valve, was not affected by the corrosion and tested serviceable. The investigation revealed that the fuel pressure warning light would illuminate when taxiing at low power settings.

Both engine magnetos were tested and found to function. The engine tachometer was examined and determined to be indicating 2400 revolutions per minute (rpm) at impact, approximately 50 rpm over the maximum engine rpm setting of 2350 rpm. The oil temperature was at 60 degrees C, in the middle of the green arc (normal operating range.)

Microscopic examination of the airspeed indicator (ASI) revealed a possible speed range at impact of 50–83 miles per hour (mph). A similar examination of the vertical speed indicator gave a rate of descent in the range of 500 feet per minute (fpm) to 1200 fpm. The suction gauge was at 3.6 inches of mercury, at the bottom of the green arc (normal operating range.)

Examination of the instrument panel warning light filaments found the fuel pressure warning light filament had come off its support posts and had some minor stretching. The remainder of the lights had no filament stretch. Filament stretching can occur at impact when a light is illuminated and the filament is warm. The examination could not determine whether the stretching had occurred on the accident flight.

Risk of Low Flying

Transport Canada publishes the following warning about low flying:

> Warning—Intentional low flying is hazardous. Transport Canada advises all pilots that low flying for weather avoidance or operational requirements is a high-risk activity. [5]

The Transport Canada approved company operations manual addresses this risk by specifying that:

> Except for take-off and landing, the aircraft shall not be operated in VFR flight during the day at less than 300 feet agl or at a horizontal distance of less than 300 feet from any obstacle. [6]

Aerodynamic Stalls

An aerodynamic stall occurs when the wing’s angle of attack exceeds the critical angle at which the airflow begins to separate. When a wing stalls, the airflow breaks away from the upper surface and the amount of lift will be reduced to below that needed to keep the wing flying. While stalls occur at a given angle of attack, they can happen at any speed.

Airspeed is often used to predict stall conditions. The faster an airplane flies, the less angle of attack it needs to produce lift equal to weight. As the airplane slows down, the angle of attack

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5 Transport Canada, *Aeronautical Information Manual* (TC AIM), April 5, 2012, p. 406.

6 Lawrence Bay Airways Ltd., *Operations Manual*, Section 3.3.1 Obstacle Clearance Requirements.

needs to be increased to create the lift equal to weight. If an aircraft slows further, the angle of attack will be equal to the critical (stall) angle of attack at some point. Stall speed is the speed below which the airplane cannot create enough lift to sustain its weight in flight.

The Beaver was originally certified in 1947 to British Civil Airworthiness Requirements and its stall characteristics were found to be acceptable. However, the Beaver demonstrates little or no pre-stall buffet and, if a warning system is not installed, the onset of the stall may surprise pilots. This aircraft was not equipped with a stall warning.

Stalls and low-level manoeuvring are hazardous. The Federal Aviation Administration (FAA) explains it as follows: [7]

> Maintaining control of an airplane during flight requires managing lift. Lift is produced by the dynamic effect of air acting on the airfoil, or wing. The pilot controls lift by controlling the angle of attack (AOA), which is the acute angle formed between the wing's chord line and the relative wind (that is the direction of the air striking the wing). All other things being equal, increasing the AOA increases lift until the wing reaches the maximum, or "critical," AOA. Increasing AOA beyond this point results in a large loss of lift and an increase in drag. A wing in this condition is said to be "stalled".

Because lift must equal weight, an airplane that is heavier because of physical or aerodynamic loading must generate more lift in order to maintain level flight. For any given airspeed, then, an aircraft with a greater load must be flown at a higher angle of attack in order to generate sufficient lift for level flight. Since an airfoil always stalls at the same AOA, an aircraft loaded by additional physical weight (e.g., passengers, fuel, baggage) or aerodynamic "weight" (e.g., g-force from turning flight) flies at an AOA closer to the critical AOA.

Recovery from an aerodynamic stall is accomplished by reducing the angle of attack and increasing engine power. Aerodynamic stalls at low level are hazardous because there may be insufficient altitude to accommodate the descent that would ensue during the stall recovery.

The following TSB Laboratory reports were completed:

LP090/2011 Examination of Fractured DHC-2 Propeller Blade
LP076/2011 Instrument Examination

Analysis

Both the images recovered from the wreckage and the meteorological assessment indicate that the pilot had waited until the weather was suitable to accomplish the flight to and from Buss Lakes. The meteorological assessment suggested that light winds would prevail during the flights. Therefore it is unlikely the flight encountered unusual winds or turbulence that would have led to the accident. The assessment suggested that local dense fog patches could have formed in the Buss Lakes area, possibly obscuring shorelines and/or higher terrain in the area. While it is unlikely the pilot would have flown into dense fog at low level, it is possible that

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[7] Susan Parson, "Getting in Right in Manoevering Flight", *FAA Safety Briefing*, March/April 2010.

manoeuvres had to be performed to avoid it. Fog patches near the aircraft would have been a distraction and would have contributed to the pilot's workload.

Airframe and engine problems were not considered to be factors in the accident. The indications of a relatively high power setting at impact and the condition of the fuel pump suggests it is unlikely that the fuel pressure warning light was illuminated and a factor in the accident. Since the fuel pressure warning light illuminated at low power settings when taxiing, the minor stretching of the filament could have occurred on a previous flight.

Forward movement after impact was limited to 10 feet. While this can be attributed to the steep angle at impact, it also suggests low forward speed. Consequently, the speed was likely in the lower range of the airspeed marking of 50 to 83 mph. Likewise, the severe damage to the aircraft and limited forward movement suggests the rate of descent was likely at the higher end of the range of 500 to 1200 feet per minute identified on the instrument. A low forward speed, high rate of descent and steep angle are consistent with an aerodynamic stall. Consequently, while manoeuvring the aircraft, the pilot likely exceeded the critical angle of attack for the aircraft weight. Since the propeller appeared to be in a low pitch condition, suggesting that the propeller governor did not have time to adjust rpm, and the rate of descent had developed to only 1200 fpm, the stall likely occurred at low level, from an altitude that would preclude recovery. The weight of the aircraft and possible aft C of G could have contributed to the aerodynamic stall.

The location of the accident site was close to, but not easily accessible from, the lake on which the fishing cabin was located. The aircraft's heading to the southwest at impact rather than toward Southend, and its low altitude, suggest that the pilot was manoeuvring along the shoreline, possibly to permit the passengers to observe the area.

Findings as to Causes and Contributing Factors

1. While manoeuvring at low level, the aircraft's critical angle of attack was likely exceeded and the aircraft stalled.

2. The stall occurred at an altitude from which recovery was not possible.

Other Findings

1. The separation of the propeller blade tip likely resulted from impact forces.

2. The investigation could not determine whether the fuel pressure warning light was illuminated prior to the accident.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 04 July 2012. It was officially released on 11 July 2012.

Visit the Transportation Safety Board's Web site (www.tsb.gc.ca) for information about the Transportation Safety Board and its products and services. You will also find the Watchlist, which identifies the transportation safety issues that pose the greatest risk to Canadians. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.