AVIATION INVESTIGATION REPORT
A01Q0166

LOSS OF CONTROL AND COLLISION WITH WATER

AIR SAINT-MAURICE INC.
DE HAVILLAND DHC-2 MK 1 C-GPUO
MOLLET LAKE, QUEBEC
08 OCTOBER 2001

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Summary

The float-equipped Beaver de Havilland DHC-2 Mk 1, registration C-GPUO, serial number 810, took off at 1710 eastern daylight time from Iyachisakus Lake, Quebec, with the pilot and six passengers on board, for a visual flight rules flight to an outfitter on Mollet Lake, 26 nautical miles (nm) to the east. At about 1730, a witness at the outfitter heard the seaplane flying on an easterly heading to the south of the lake. About 20 minutes later, noting that the aircraft had not arrived at the dock, the manager of the outfitter sent a boat to look for C-GPUO. The Beaver was found 1 nm east of the outfitter. It was lying partly submerged in Mollet Lake near the north shore, with the nose in the water and leaning backward. Four injured occupants who were clinging to the fuselage were rescued. The pilot and two of the passengers were fatally injured.

Ce rapport est également disponible en français.

Other Factual Information

The pilot was certified and qualified for the flight. He held a commercial pilot licence (aeroplane) since 03 May 1999 and a float endorsement since 31 May 1999. The pilot earned a Group 1 instrument flight rating on 24 March 2001. He had his most recent annual flight training on the DHC-2 on 02 June 2001. His most recent medical examination, on 07 April 2001, indicated that he had a total of 900 flying hours. Most of his flying was on the DHC-2 and Cessna 185. The pilot had been flying for the company for over two years and had a reputation as a careful flyer. In 1995, the pilot had taken a decision-making course recognized by Transport Canada (TC) while on pilot training at the *Centre québécois de formation aéronautique* at the Chicoutimi CEGEP. Neither TC records nor the operator's training records indicate that the pilot subsequently took any other training in decision making. *Canadian Aviation Regulations* (CARs), section 723.28(1), require that refresher training be taken every three years after the initial course.

The aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The aircraft had accumulated a total of 13 140 hours as of 17 September 2001, and on that date, a 400-hour inspection was performed in accordance with inspection program Q2083. About 40 hours were logged on the aircraft after the inspection. Weight and balance calculations by the TSB indicate that, at the time of the accident, the aircraft weight and payload distribution were within prescribed limits. The aircraft was not equipped with a stall warning device, nor was one required when the aircraft was certified. According to the specific operating provisions issued to the carrier by TC, C-GPUO was not authorized to fly in accordance with instrument flight rules (IFR). Under the applicable regulations, visibility in flight had to be at least two miles. However, TC had issued an operating specification for the carrier, allowing a pilot who had received decision-making training to fly with a visibility of one mile if the aircraft is equipped with an artificial horizon, a directional gyroscope, and a global positioning system (GPS) navigation receiver. The aircraft and pilot were in compliance with the operating specifications.

On the day of the accident, there was a low-pressure system in the area. The height of the cloud layer was variable, and visibility fluctuated in snow showers. The investigation did not determine with accuracy the weather conditions that prevailed at the time of the accident. According to the information received, the winds were from the southwest at 20 to 25 knots, the temperature was around 1 °C, and visibility was reduced at times to one-half mile. At 1610 eastern daylight time,[1] a Cessna 185 en route to Mollet Lake had been forced to land on Malécot Lake, 12 nautical miles (nm) west of its destination, due to adverse weather. The performance of the Cessna had been affected by ice accretion during the flight. However, at about 1720, visual flight rules (VFR) conditions prevailed when C-GPUO flew over the Cessna. At approximately 1730, the pilot of the Beaver reported to another Cessna 185 that he was 3 nm from destination and that conditions were visual. He also passed this information on to a helicopter that had just taken off from the outfitter at Mollet Lake to pick up the passengers from the two Cessnas. A few minutes later, the second Cessna, which had taken off from Iyachisakus Lake some 15 minutes after the Beaver, was forced to land on Malécot Lake due to adverse weather. Witnesses at the outfitter reported heavy snow at the time of the accident. Information received indicates that the aircraft was operated outside the clouds and that visibility was conducive to navigating by references on the ground.

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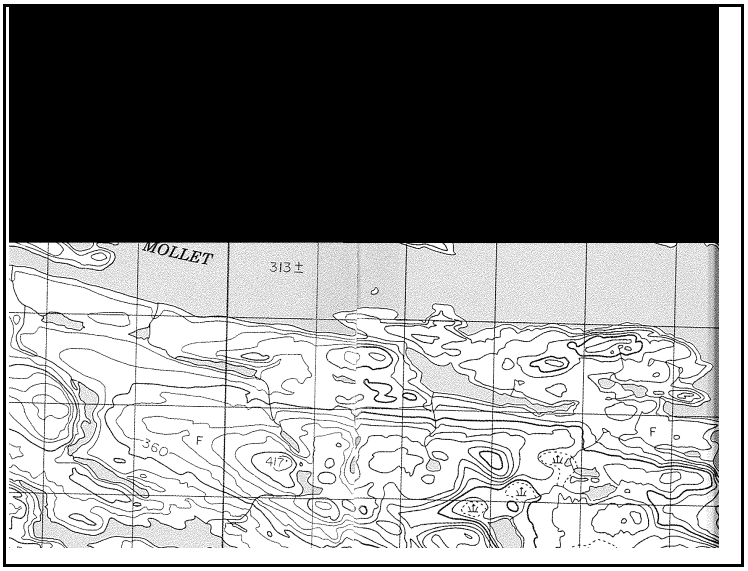
[1] All times are eastern daylight time (Coordinated Universal Time minus four hours).



The outfitter is located on the north shore of Mollet Lake. The lake is 1 nm wide and is oriented east-west. The aircraft flew the downwind leg, proceeding east along the south shore of the lake. About 1 nm east of the outfitter, at an altitude of about 500 feet above ground level, the pilot made a left turn and proceeded north on the base leg. On approaching the north shore and the rising terrain immediately north of the lake, the aircraft was shaken and then turned right, taking it farther away from the outfitter. Meanwhile, witnesses heard an increase in engine noise. In the turn, the seaplane pitched nose-down and struck the surface of the lake, right wing first. The aircraft crashed 1 nm from the outfitter at about 1735.

About 20 minutes after hearing the aircraft, the manager of the outfitter sent a boat to meet the aircraft. Four passengers had evacuated the aircraft and were clinging to the wreckage. A fifth passenger was floating face-down in the water. The on-board survival equipment met regulatory requirements. Life jackets were on board. None of the occupants wore a life jacket during the flight and none used one after the accident. Regulations do not require that life jackets be worn.

A Safety Study of Survivability in Seaplane Accidents, TSB report No. SA9401, concluded that more than two-thirds of fatalities occurred when occupants who were not incapacitated during the impact drowned. In May 1994, the TSB recommended to TC that all occupants of seaplanes be required to wear a personal flotation device during the standing, taxiing, take-off, and approach and landing phases of flight (A94-07). According to TC, wearing a life jacket while taking off and landing on water provides no tangible and quantifiable safety improvement. Consequently, TC decided to not amend the regulations.

The fixed emergency locator transmitter (ELT), a Narco model ELT10C, was found on its bracket in the "ARM" position. No distress signals were received or heard. It could not be determined whether the ELT activated at the time of impact. However, if the ELT had activated, the signal would have been cut off by a short circuit caused by contact with the water. Under Section 605.38 of CARs, it is prohibited, with some exceptions, to operate an aircraft unless it is equipped with at least one ELT. CARs do not specify which model of ELT is required, nor whether or not the ELT must be able to operate when in contact with water in the case of installation on a seaplane.

The aircraft had three rows of seats: two seats in the cockpit (0A and 0B), three seats in the middle row (1A, 1B and 1C), and a two-seat rear bench (2A and 2B). All seats were fitted with belts. However, the passenger in seat 1B had not fastened his belt; he sustained minor injuries to the head and one ankle. The passenger in seat 1C perished as a result of multiple fractures to the skull and facial bones. His belt was found fastened, but the investigation could not determine whether or not he was wearing it. Only the pilot and front passenger seats were fitted with shoulder harnesses, but the occupants of these seats were not wearing them. The pilot's and front passenger's heads struck the instrument panel. Their deaths resulted from cranial trauma and drowning. CARs sections 605.26 and 605.27 require that shoulder harnesses be worn when taking off and landing on water. Three survivors sustained severe injuries. All four survivors exhibited symptoms of hypothermia.

The damages observed were attributed to impact forces. The fuselage aft of the cockpit did not show severe deformation. The flaps were extended to the landing position. The right wing separated and has not been located. The engine showed no visible damage, and an examination established that it was developing power on impact. The engine examination also revealed that the vacuum pump shaft was broken in the engine gearing. The shaft failed before impact as a result of torque overload, possibly preceded by weakening due to metal fatigue. At the time of the accident, it had been 682 hours since the pump had been overhauled. According to the Air Saint-Maurice Inc. inspection program, the pump was to be overhauled again after 1400 hours of operation. The vacuum pump on the DHC-2 drives the attitude indicator, the directional indicator, and the turn and bank indicator. A vacuum gauge mounted on the right side of the cockpit allows the pilot to confirm that it is working. Analysis of the electric turn and bank indicator, vacuum gauge, and attitude indicator by the TSB Engineering Laboratory provided no useful information as to their positions at the time of impact. Examination of the propeller revealed that the blades were in the "FINE PITCH" position at the time of impact, which is the normal configuration for landing. Before the accident, the pilot did not mention any problems to his company, to three colleagues based at the same outfitter's, or to his customers. The aircraft logbook that was on board the aircraft has not been found.

The six passengers spoke English; none of them spoke French. A safety procedures card written only in French was affixed to the right wall. The pictograms on the safety card were clear enough to enable the occupants to understand the instructions without referring to the text. Part 703 of CARs allows unilingual safety procedures cards to be used. However, at the time of the accident, the safety procedures card on the aircraft was not in compliance with regulatory requirements; corrections ordered by TC in August 2000, concerning the illustration of the seating arrangement, had not been made.

When the aircraft gets close to the ground, its movement in relation to the ground becomes more apparent and, in high winds, illusions are created that give false impressions that could lead to dangerous situations. When the aircraft turns from the crosswind leg to the downwind leg and then turns into the wind, the pilot initially must deal with a sudden increase in ground speed. The pilot may be tempted to reduce the speed of the aircraft, which could result in a stall. This situation is aggravated when visibility is reduced and when aircraft speed is low. The hazards of these illusions created by drift have been documented.

The normal stall speed of a Beaver at maximum gross weight with the wings horizontal, and the power off and flaps at 30 degrees is 45 mph. However, stall speed increases in a turn or bank at constant altitude. Calculations show that, in a 40-degree turn, the stall speed of the aircraft increases by 13 per cent, and in a 60-degree turn, it increases by 40 per cent. When the aircraft stalls in a level or descending turn, the inside wing normally stalls first, and the aircraft rolls to the inside of the turn. Turbulence can also increase the stall speed significantly; a rising gust increases the angle of attack.

According to the manufacturer, the Beaver has gentle stall characteristics when carrying a normal payload. The stall is preceded by mild buffeting, the aircraft pitches down if there is no yaw, and if yaw is present, the aircraft will also tend to roll.

According to TSB report No. SSA93001, *A Safety Study of Piloting Skills, Abilities, and Knowledge in Seaplane Operations*, accidents attributed to a loss of control in flight on the approach "were generally characterized by a stall, or a stall followed by a spin at low altitude while turning from base leg to final. Many of the visual cues and approach aids that are available to land-based aircraft are not there for seaplanes about to land on the water. Wind direction and strength may be difficult to gauge in the absence of an appropriately located wind sock, especially where local geography may affect the winds in the landing area. Mountainous or

hilly terrain on the final approach may alter the pilot's perception of the correct approach angle. In the absence of a clearly defined and visible landing area, the turn from base to final can be easily misjudged and result in excessive angles of bank during a critical manoeuvre for landing. The illusions created by the topography and drift at low altitude can also contribute to approach accidents."

Analysis

There was no indication of an emergency situation or that the seaplane was encountering problems before impact. It was established that the weight of the seaplane was below the maximum allowable and the centre of gravity was within the prescribed limits.

The investigation revealed that the failure of the vacuum pump occurred before the crash, but the exact time of failure could not be determined. In any event, the instruments driven by the vacuum pump were not required because the aircraft was supposed to be operating under VFR only.

In view of the fact that the pilot had not had decision-making training since 1995, the regulations require that in-flight visibility be at least two miles. The Beaver did not encounter the weather that forced the two Cessnas to make precautionary water landings, since the three aircraft did not overfly the same areas at the same time. Considering the variable conditions moving through the region, the meteorological information received, and the reports from the pilot in flight, it cannot be concluded that the aircraft was operating in weather conditions below the regulatory requirements. If the flight had been operating in IFR conditions, the pilot would have been relying on instruments that were indicating incorrect information on the attitude, bank, and heading of the aircraft after the vacuum pump failed. Under those circumstances, it is unlikely that the pilot could have avoided spatial disorientation before reaching his destination.

The fact that the propeller blades were in the "FINE PITCH" position and that the flaps were extended 30 degrees suggests that the pilot had completed his landing check either on the downwind leg or base leg. At the end of the base leg, the pilot normally should have made a left turn onto the final approach over the lake. But the pilot decided, for some unknown reason, to turn right and move away from the intended landing area. Since the pilot had reported seeing the outfitter a few minutes before, it is unlikely that the weather made him turn right. It is more probable that, on the base leg, due to wind, the descending aircraft drifted faster than the pilot was expecting towards the high ground to the north of the lake and consequently overshot the intended approach track.

In this case, it is possible that a left turn would have resulted in a collision with the terrain feature or placed the aircraft over the terrain at an unsafe altitude or on a track that would preclude a stable approach. On the other hand, a 270-degree right turn would allow the pilot to keep the aircraft over the lake, avoid all obstructions, and make a stable approach. However, the right turn put the aircraft on a downwind track at low altitude in a situation conducive to illusions created by drift. It is possible that, due to the effects of wind, the pilot adopted a steep bank to counteract drift; this manoeuvre, which increases vertical speed, may have brought the aircraft close to the surface of the lake, forcing the pilot to raise the nose and increase power. Although extending the flaps increased wing lift, it also increased aircraft drag; therefore, the increase in power was not felt as quickly as with the flaps retracted. Also, it is reasonable to believe that the conditions at the time of the accident were conducive to contamination of the flight surfaces of the Beaver, because the two Cessnas reported icing after flying in snow showers. The combined effect of contamination of critical surfaces and the turn increases the stall speed. Therefore, the stall can be attributed to the combination of all these factors, which eliminated the gap between the speed of the aircraft and the stall speed in a situation conducive to illusions created by drift.

Given the slight damage to the fuselage, the accident was survivable. Indications are that the impact forces did not exceed the normal limits of human resistance. Considering the injuries sustained by the occupants in the cockpit, it is reasonable to believe that their chances of survival would have increased if they had been wearing their shoulder harnesses. None of the occupants was wearing a life jacket at the time of impact. Although life jackets were available, the occupants who evacuated the aircraft do not seem to have had time to find them, retrieve them, and don them. If the survivors, three of whom were seriously injured, had not been able to hang onto the wreckage, they would have been in the water without life jackets to keep them afloat, and their chances of survival would have severely diminished. The survivors were still alive because of the fact that the aircraft did not sink before the rescuers rapidly arrived.

The following laboratory reports were completed:

LP 106/2001 – *Engine and Propeller Examination*
LP 113/2001 – *Instrument Examination*
LP 93/2001 – *GPS Examination*
LP 94/2001 – *Flap Actuator Rod*
LP 01/2002 – *Document Restoration and Analysis*

Findings as to Causes and Contributing Factors

1. The seaplane stalled at an altitude that did not allow the pilot time to recover from the stall.

2. The stall occurred in circumstances conducive to illusions created by drift.

Findings as to Risks

1. The aircraft was not equipped with a stall warning device, which could have alerted the pilot to the onset of a stall.

2. The chances of surviving the impact would have been improved if the front seat occupants had been wearing their shoulder harnesses as prescribed by aviation regulations.

3. Life jackets were available, but the occupants who evacuated the aircraft do not seem to have had time to find, retrieve, and don them.

4. The emergency locator transmitter was not capable of emitting a distress signal because a short circuit occurred when the antenna came into contact with the water.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 04 August 2004.

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