Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A05Q0178

CAPSIZING AT TAKE-OFF

AVIATION WHEELAIR
CESSNA 185 SEAPLANE C-FYZC
LAC OUIMET, QUEBEC
29 SEPTEMBER 2005

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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Summary

The Cessna 185, registration C-FYZC, serial number 185-1540, operated by Aviation Wheelair, was to make a scenic flight following visual flight rules with a pilot and five passengers on board. The seaplane left the company's wharf at Lac Ouimet, Quebec, then taxied on the surface of the lake for about 500 m. When it reached the take-off area, the seaplane turned left to face into the wind in preparation for take-off. At approximately 1510 eastern daylight time, as the pilot was applying the throttle, the seaplane tipped to the right, the nose of the right float dug into the water, the propeller hit the surface of the lake, and the aircraft capsized. The pilot and four passengers escaped from the cabin. A seaplane from the company and a neighbouring resident in a boat headed to the survivors right away. The survivors were rescued within seven minutes of the accident. The passenger in the right front seat was unable to escape from the submerged cabin and drowned.

Ce rapport est également disponible en français.

Other Factual Information

The pilot and five tourists boarded the seaplane. One passenger sat in the right front seat. After leaving the wharf, the aircraft taxied downwind to the left and eastward for about 500 m to take off towards the northwest. As it was taxiing, the seaplane was subjected to strong gusts of wind. When it reached its position, the aircraft turned left to face into the wind (Figure 1). Before the turn was completed, the pilot pushed the throttle in preparation for take-off. The left wing lifted right away, the right float dug into the water and the seaplane pitched nose down. In an attempt to right the aircraft, the pilot applied the full right rudder, pulled back on the control column, completely applied the left aileron, and gave full throttle. The propeller hit the surface of the water and the aircraft capsized.

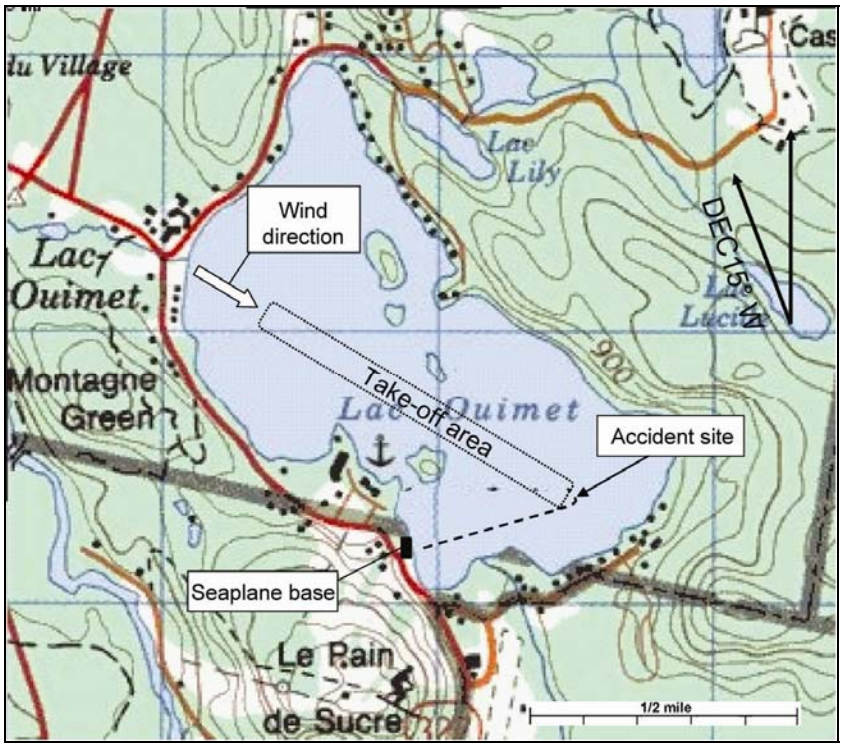

Figure 1. Location of the accident

The pilot opened his door and exited the seaplane. As soon as he was in the water, he swam to the baggage compartment door, which was open, where he helped three passengers escape from the wreck. The fourth passenger escaped through the pilot's door. The pilot had to hold two passengers in his arms because they were unable to hold on to the fuselage. The two other passengers held on to the wreck. The survivors were rescued within seven minutes of the accident by a neighbouring resident who went to the accident site in a boat, and by one of the company's aircraft that was landing at the time of the capsizing. The passenger in the front was not able to escape from the aircraft. A rescuer found the passenger floating freely in the cabin.

At the time of the accident, the weather conditions were suitable for visual flight rules. Four automated weather stations reported wind in this area. The closest station (WJT) is located seven nautical miles (nm) south of Lac Ouimet. The observation at 1500 eastern daylight time[1] recorded by WJT indicates that the wind was 285° Magnetic at 10 knots with gusts up to 17 knots. At 1510, the station recorded a peak wind speed of 23 knots for the period between 1500 and 1600. Both of the company's seaplanes, Cessna 172 aircraft, were in flight at the time of the accident. In-flight turbulence was moderate at the time and the wind was gusting. Otherwise, neither pilot reported any trouble controlling their aircraft while taxiing. The surface

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

of the water in the middle of the lake in the line of take-off was moderately rough with some whitecaps. A photo taken from the company's wharf shortly before the accident shows only small waves stirring the surface of the water.

The pilot was certified and qualified for the flight in accordance with existing regulations. He obtained his commercial licence in July 2001. He completed a seaplane endorsement in the same year. The pilot started working for Aviation Wheelair in June 2005. After being hired, he also took training to become familiar with the company's policies and procedures. The data available indicate that he had a total of almost 1160 flying hours, of which 970 hours were on a seaplane.

According to the company's operations manual, pilots must tell the operations manager how many hours they have flown. The operations manager must ensure that the pilots' hours comply with the regulations governing flight times and flight duty times as set out in Section 700.15 of the *Canadian Aviation Regulations* (CARs). Because Transport Canada had issued an operations specification to the company to exceed flight time restrictions, the company had to ensure that pilots did not exceed the times set out in Section 720.15.

At the time of the accident, the last update on the form for reporting the pilot's flight time, flight duty time, and rest period had been entered on 26 August 2005. To determine the pilot's flight time from August 27 up to the day of the accident, the journey logs for the aircraft operated by the company were used. The calculation for the flying hours completed by the pilot indicates that he had not exceeded the limitations set out in Section 720.15 of the CARs. According to the information obtained, there is nothing to indicate that fatigue was a factor in the accident.

Section 703.39 of the CARs stipulates, among other things, that the pilot-in-command shall ensure that passengers are given a safety briefing. Sometimes, the safety briefing is insufficient for a passenger because he or she has a physical, sensory or comprehension limitation, or because he or she is responsible for another person on the aircraft. In this case, the pilot-in-command must ensure that, before take-off, the passenger is given an individual safety briefing that is appropriate to the passenger's needs. An air operator must ensure that each passenger is provided, at the passenger's seat or by means of clearly visible placards, with the safety information. The pilot-in-command shall ensure that each passenger who is seated next to an emergency exit is made aware of how to operate that exit.

Normally, passengers are taken to the company's wharf where they are given a standard safety briefing. However, in this case, the passengers did not speak English or French and did not receive a safety briefing, and none of them noticed the safety briefing cards.

The safety briefing cards on board the aircraft were written in French and in English. However, the pictograms on the safety cards should have been sufficiently clear to allow passengers to understand the instructions without requiring any text. The cards did not provide any information on the evacuation procedure in case of capsizing, nor do the regulations require this.

Examination of the card showed that the instructions for using the passenger door handle were incorrect. Contrary to the instructions provided, the handle had to be turned clockwise to open the door. At the same time, the investigation determined that the safety briefing card for the

company's Cessna 172 contained the same error. It was also noted that the fire extinguisher, survival equipment, first-aid kit, and emergency locator transmitter (ELT) were identified by text rather than easily recognizable pictograms. In July 2003, Transport Canada had found that the company's safety briefing card for the Cessna 185 met the CARs requirements.

The survival equipment on board met regulatory requirements. Inflatable lifejackets were in pockets under the seats. None of the occupants were wearing them while the aircraft was taxiing and no one used them after the aircraft capsized. Neither the regulations nor the operator require that lifejackets be worn.

The aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures. No deficiencies were reported or recorded in the aircraft's logbook.

The aircraft has two rows of two seats and a rear bench with two seats. There are two doors, which are located on each side of the aircraft next to the front seats. The baggage compartment door is to the left of the bench and measures 0.99 by 0.87 metres.

The aircraft was refloated the day after the accident. Examination of the wreckage revealed that the fuselage had undergone little deformation and that the cockpit, as well as the cabin, was practically intact. No deficiencies that could have contributed to the accident were found in the flight control system or the aircraft's structure. The left front door and the baggage compartment door were open. The right door was closed and its handle was in the locked position; an examination established that it operated normally and that it was labelled with the required placard. To open the doors, the handle is turned up and then the door is pushed out. All the lap belts were unbuckled.

The elevator trim indicator showed a setting of 50 per cent NOSE DOWN. It had been set to this position because of the weight distribution on board. The rudder trim indicator showed a setting of 75 per cent NOSE RIGHT, which is the position normally used for take-off on this aircraft. The throttle was on FULL OPEN, the mixture control was on RICH and the propeller pitch control was on FINE PITCH. The flaps were set to 20 degrees, or the take-off position. The lever to raise the water rudders was in the down position.

All seats had lap belts, and the seats for the pilot and passenger in the front also had shoulder harnesses consisting of a single diagonal strap over the shoulder. All occupants were wearing their lap belts. However, the pilot and passenger in the front were not wearing the harnesses.[2] The diagonal harness straps for the pilot and front passenger were hanging from the ceiling in their respective storage brackets and were attached with an elastic band.

Aviation Wheelair operates one Cessna 185 and two Cessna 172 aircraft from its main seaplane base at Lac Ouimet. The elevation of Lac Ouimet is 771 feet above sea level (asl). The lake is rectangular, with four islands in the middle. It lies northwest/southeast and is about 1 nm long and 0.5 nm wide. The lake is surrounded by hills with elevations between 1000 and 1300 feet asl. The company offers packages for travel agencies that consist of short scenic flights over the Mont-Tremblant area.

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[2] Sections 605.26 and 605.27 of the CARs require the use of safety belts and restraints during take-off and landing.

The last two regulatory audits of flight operations at Aviation Wheelair conducted by Transport Canada (TC) were dated August 2002 and June 2005. The 2002 audit noted deficiencies in monitoring pilot flight time and flight duty time, use of the safety harness, and the briefing given to passengers regarding lifejackets. In June 2004, TC accepted all the corrective measures implemented by the company. During the audit in June 2005, none of the deficiencies mentioned above were noted by TC.

In 1994, the TSB carried out an analysis of seaplane accidents that had occurred in Canada from 1976 to 1990.[3] The study revealed that 41 per cent of the fatal accidents occurred during the take-off phase, while 37 per cent occurred during the approach and landing phases. More than two-thirds of the fatalities were occupants who survived the impact without being incapacitated, but who drowned. When an aircraft capsizes, occupants can lose their sense of orientation and panic when the water rushes into the cabin in the seconds following impact. Less than 10 per cent of the occupants of aircraft that sank in water succeeded in escaping without difficulty from the aircraft. Further to this study, the TSB issued six safety recommendations to improve the chances of survival in seaplane accidents.

In May 1994, the TSB recommended that "the Department of Transport require that all occupants of seaplanes wear a personal flotation device during the standing, taxiing, take-off, and approach and landing phases of flight." (Recommendation A94-07) TC decided not to amend the regulations because, according to TC, wearing a lifejacket while taking off and landing on water provides no tangible and quantifiable safety improvement.

On 02 March 2000, the TSB sent Aviation Safety Advisory A000003-1 (Escape from a Submerged Seaplane) to TC, reiterating its concerns regarding the apparent lack of progress among seaplane operators to address the issue of underwater escape. In its response, TC reported that it had published relevant articles in its Aviation Safety Letter and in four separate safety brochures. TC has also produced a video about seaplanes, which is available from all its regional offices, and is developing a training program that will focus on the issues raised in the Safety Advisory.

The Safety of Air Taxi Operations Task Force (SATOPS), established in 1996 by TC, issued a report containing numerous safety recommendations to deal with the problems identified during its work. One concern identified by SATOPS was that "There is a lack of information available to passengers in float-planes and helicopters about underwater egress in the event the aircraft flips over on take-off or landing or ditches and rolls over. . . ." In response to SATOPS recommendation SR 52, TC produced a brochure[4] that air operators can give to passengers. It describes the escape procedures when an aircraft is under water. Copies of that brochure were available at Aviation Wheelair's headquarters at the time of the accident. The report also recommended that "Float-plane pilots and helicopter pilots operating over water include information on underwater egress procedures in the passenger briefing."

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3 *A Safety Study of Survivability in Seaplane Accidents*, report SA9401

4 *Seaplanes:A Passenger's Guide* (TP 12365E) is available in English and French on the Transport Canada Web site.

Analysis

Normally, water rudders are raised before take-off. It is possible that, during capsizing, the lever was moved to the rudder down position by an occupant who was trying to escape from the cabin. Regardless of this, having the water rudders lowered could not have contributed to the aircraft's capsizing.

Visual flight rules (VFR) prevailed at the time of capsizing. However, the gusting wind in the region exposed the aircraft to control problems. Similarly, the shape of the lake and the surrounding topography can affect the intensity of the turbulence and cause rapid changes in wind direction. Finally, the relatively rough water conditions made it easier for the aircraft to tip. Such conditions required the pilot to be extremely cautious while taxiing.

The aircraft taxied downwind until it reached the take-off area. To face the take-off direction, the aircraft made a left turn. Because the wind was irregular, it must have been difficult to control the seaplane's rotation speed as it turned across the wind. The centrifugal force during the turn caused a rolling motion towards the outside of the turn. Also, the force of the wind on the left side of the aircraft increased the effect of the roll to the right. Finally, the water's resistance to the aircraft's lateral movement to the right, which was opposite to the wind and centrifugal forces, turned the right float into a pivot point for a roll.

The combination of these forces made it easier for the aircraft to tip to the right. Starting the take-off before the aircraft was facing into the wind increased the rolling movement and caused the right float to dig into the water even more. Moreover, opening the throttles to full power to regain control of the aircraft increased the propeller's downward pull. The propeller's contact with the surface of the water precipitated the capsizing. The combined effects of the wind, centrifugal forces, water resistance, starting the take-off run in a crosswind, applying the full right rudder, and the attempt to regain control by applying full throttle contributed to the capsizing of the seaplane.

The accident was survivable because it occurred at a slow speed just as the throttle was applied. Because of this, the cabin and doors were not deformed, which could have impeded the occupants' escape. In fact, none of them suffered serious or immobilizing injuries. Although they had not been given a safety briefing before take-off, three passengers escaped through the baggage compartment door after one of them managed to open it. Another passenger managed to escape through the door opened by the pilot.

Nevertheless, the passenger seated by the main door on the right either did not attempt to open the door or did not succeed in opening it. He may not have been able to locate the handle due to the urgency of the situation. In addition, it is probable that, after unbuckling the safety belt, the passenger was not able to find a way out while he was still conscious because he had become disoriented in the overturned, submerged seaplane.

Although the passengers spoke neither French nor English, it is reasonable to believe that a safety briefing adapted to their needs, for example by pointing, could have increased the victim's chances of survival. Nevertheless, egress from a capsized, submerged aircraft is

difficult at best and the standardized briefing given before the flight does not give passengers enough information on the procedures required to ensure escape from an aircraft that is under water.

Although lifejackets were available, none of the occupants who escaped from the aircraft were wearing one. Because the passengers had not been given a safety briefing, they did not know where the lifejackets were located. Nevertheless, even if they had known the location, the passengers had little time to find them and take them before escaping from the overturned, submerged aircraft.

Had the pilot not held two of the passengers until the rescuers arrived, they would have been in the water trying to keep afloat without lifejackets and their chances of survival would have been greatly reduced. It can also be concluded that, because the pilot was helping the passengers, he was unable to help the victim escape from the aircraft. The survival of the occupants can be attributed partly to the fact that the aircraft did not sink before the rescuers reached the scene.

During the investigation, the TSB identified three operational deficiencies that TC had noted earlier in August 2002 and reported to the company. The deficiencies concerned the monitoring of pilot schedules, the use of shoulder harnesses and the pre-flight safety briefing. The recurrence of these deficiencies two months after the last TC audit conducted on 28 June 2005 suggests that the corrective measures adopted by the company and accepted by TC were not being implemented systematically.

Finding as to Causes and Contributing Factors

1. The combined effects of the wind, centrifugal forces, water resistance, starting the take-off in a crosswind, and the attempt to regain control by applying full throttle and full rudder contributed to the capsizing of the seaplane.

Findings as to Risk

1. The passengers were not given a safety briefing before the flight. Consequently, the passengers did not know the location of the lifejackets.

2. The instructions printed on the aircraft's safety briefing card about how to open the passenger door were incorrect, which could have compromised the safe egress of occupants.

3. The form for recording the flight times, flight duty times, and rest periods for the pilot had not been updated for almost a month. This did not allow the company manager to monitor the pilot's hours.

4. Neither the pilot nor the front passenger was wearing his shoulder harness, as required by regulations. This could have increased the risk of injury.

Other Finding

1. During the investigation, the TSB identified three operational deficiencies that Transport Canada had noted earlier in August 2002 and reported to the company. The deficiencies concerned the monitoring of pilot schedules, the use of shoulder harnesses, and the pre-flight safety briefing.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 10 October 2006.