Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A11W0070

LOSS OF CONTROL – COLLISION WITH WATER

CAMPBELL HELICOPTERS LTD.
BELL 212 C-FJUR
SLAVE LAKE, ALBERTA, 12 NM W
20 MAY 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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Synopsis

The Campbell Helicopters Ltd. Bell 212 (registration C-FJUR, serial number 30728) was conducting water bucketing operations in support of forest fire suppression services in the vicinity of Slave Lake, Alberta. At approximately 1449, Mountain Daylight Time, during an approach to Lesser Slave Lake to pick up water, the helicopter crashed into the lake on its right side. The helicopter sustained major damage. There was no post-crash fire. The pilot, who was the sole occupant, was fatally injured. The emergency locator transmitter signal was not detected by search and rescue until after the helicopter was removed from the water.

Ce rapport est également disponible en français

Other Factual Information

History of the Flight

The Bell 212 helicopter (C-FJUR) departed from the Slave Lake airport at 1323,[1] proceeded to the Lesser Slave Lake shoreline near the Canyon Creek hamlet, and began water bucketing operations. Water pickups were made near the south shore of the lake and drops were made on a fire approximately 0.8 nautical miles (nm) south of the shoreline. On its 12th pickup, while on short final, the helicopter abruptly descended forward, in a near-level attitude, to within several feet of the water surface. Subsequently, the helicopter climbed to approximately 100 feet above the lake surface and then rolled rapidly to the right and descended vertically into the water.

Within approximately 3 to 4 minutes, municipal fire fighters in the vicinity entered the water and removed the pilot from the wreckage. The municipal fire fighters administered first aid until emergency medical personnel arrived. However, the pilot succumbed to head injuries as a result of the impact.

Aircraft

The Bell 212 is a twin-engine, single main-rotor helicopter that can carry up to 14 passengers with 1 pilot. Records indicate that the helicopter was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The helicopter had no known deficiencies before the occurrence flight. The weight and centre of gravity were within the prescribed limits and there was sufficient fuel on board to complete the flight.

The helicopter was equipped with a Skytrac satellite tracking system that transmitted position reports every 2 minutes that were stored in the Alberta Sustainable Resource Development (ASRD) database. In addition, ASRD requires pilots to make position reports every 30 minutes.

Water Pickup Location

In calm wind conditions, water can take on a glassy, mirror-like appearance which significantly reduces a pilot's depth perception. If a pilot does not have adequate visual references when flying over glassy water surfaces, difficulties may be encountered in judging height above water and gauging forward speed. The TSB has investigated numerous occurrences where glassy water was either a causal or contributing factor. [2]

To help ensure adequate visual references to safely manoeuvre a helicopter during a water pickup, it is common practice to make pickups as close to shore as possible. This allows the pilot to use the shoreline and surrounding terrain to help judge height above the water as well as the rate of closure during the approach.

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1 All times Mountain Daylight Time (Coordinated Universal Time minus 6 hours) unless otherwise stated.

2 A02P0256, A05P0262, A06C0131, A06W0106, A90W0206

The pilot carried out pickups between 300 feet and 1050 feet from the shoreline. The investigation examined the water pickups conducted by another pilot. On average, the other pilot's pickup location was between 100 feet and 200 feet from the shoreline. The occurrence pilot had been advised by another company pilot to make his pickups as close to shore as possible due to the smoke and glassy water conditions in order to maximize visual references.

Meteorological Information

The aviation routine weather report (METAR) issued for the Slave Lake Airport at 1400 reported winds 290° true (T) at 6 knots, visibility 3 statute miles (sm) in smoke, a few clouds at 7100 feet above ground level (agl) , temperature 14°C, dew point 11°C and an altimeter setting of 30.13 inches of mercury (in. Hg). The METAR issued at 1500 reported winds 300°T at 9 knots, visibility 4 sm in smoke, sky clear, temperature 18°C, dew point 11°C and an altimeter setting of 30.11 in. Hg.

The investigation determined that visibility in the fire area, approximately 12 nm from the Slave Lake Airport, was variable: from 0.5 sm to 3 sm in smoke. The wind was calm and the lake surface was glassy.

Water Bucketing Operations

The helicopter was configured to carry external loads on a hook mounted on the underside of the helicopter's belly. This belly hook was rated for a maximum load of 5000 pounds. A 100-foot long line attached to the belly hook was being used with a 350 imperial gallon water bucket. When full of water, the combined weight of the long line and the water bucket was approximately 3650 pounds. The bucket was 23 feet long when suspended, for a total long line length of approximately 124 feet.

The water bucket is electrically opened by a button located on the collective control.

The belly hook can be released either electrically or manually. A button on the cyclic control stick is the primary release. To arm this electrical release, the pilot must select the hook release switch, which is guarded and located in the overhead console. The manual release is designed as a backup in an emergency, if the electric release fails. To activate the manual release, the pilot must take one foot off the anti-torque control pedals and use it to push the release pedal.

Bell 212 Flight Manual Supplement (BHT-212-FMS-3) directs pilots to arm the hook for take-off, disarm it for in-flight operations (i.e., cruise), and arm it before final approach. Arming the hook prior to take-off and final approach allows the pilot to quickly release the load should a problem arise during a critical phase of flight. Disarming the hook during cruise reduces the risk of an inadvertent release.

In many cases, dropped loads are the result of pilots accidently triggering the electrical release. As previously established in TSB occurrence A09P0249, many pilots choose to fly with the belly hook electrically disarmed to reduce the risk of an inadvertent load release.

Pilot Competencies for Helicopter Wildfire Operations

The Canadian Interagency Forest Fire Centre (CIFFC) is composed of agencies responsible for forest firefighting from all provinces and territories. CIFFC has a mandate to gather, analyze and disseminate fire management information to ensure resources are shared cost-effectively. In addition, it actively promotes, develops, refines, standardises and provides services to member agencies to improve forest fire management in Canada.

After the 2007 Helicopter Association of Canada (HAC) convention, a number of these agencies (notably Alberta, British Columbia, and Saskatchewan) and the HAC agreed that pilot eligibility for roles in wildfire suppression should be based on a task-competency model rather than relying solely on flight hours. In 2010, the HAC, through its Air Taxi Committee subgroup, the Pilot Qualifications Working Group, developed a document titled *Pilot Competencies for Helicopter Wildfire Operations – Best Practices Training and Evaluation*.

Alberta Sustainable Resource Development (ASRD) developed an operating handbook for pilots in 2010 and issued an amended version, the *2011 Pilots Handbook*, the following year. The *2011 Pilots Handbook* endorses the use of qualifications and training competencies identified in the HAC document "Pilot Competencies for Helicopter Wildfire Operations".

At the time of the occurrence, Campbell Helicopters was operating C-FJUR under a contract with the ASRD. Although it was not required to meet the 2011 standards because the contract was signed before the new standards came into effect, Campbell Helicopters did apply these standards for its pilot checks at the start of 2011 season.

Wreckage and Impact Information

The helicopter was found on its right-hand side in Lesser Slave Lake at 55°22.154′ N and 115°03.319′ W. The helicopter was approximately 290 feet from the southern edge of the lake and oriented parallel to the shore, facing west (see Photo 1).

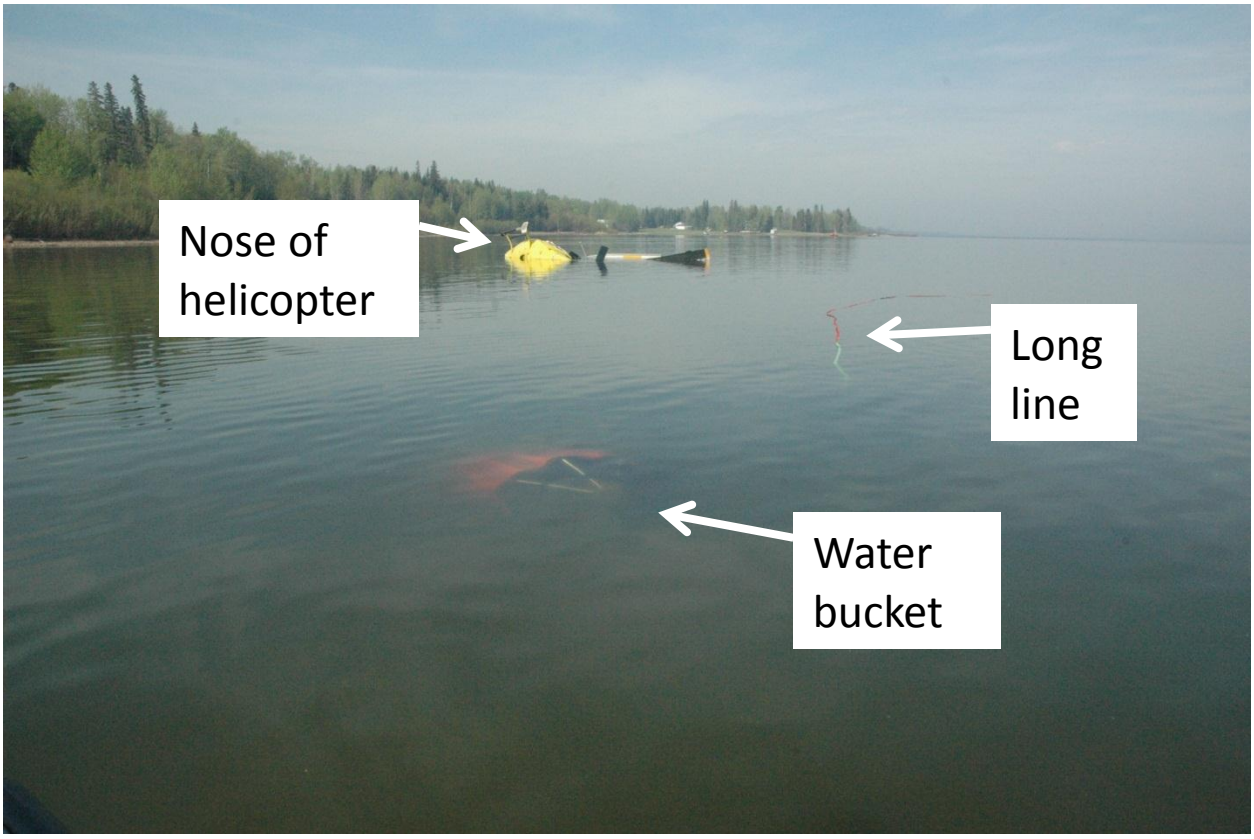

Photo 1. Helicopter Crash Location

An examination of the wreckage revealed that the engines were developing high power at the time of impact. The collective was found in the full up position, and all collective connections to the engines were consistent with full power being requested. There was no indication of any system malfunction prior to the occurrence.

The helicopter experienced extensive hydroforming of the right-hand sub-floor panels as well as the right-side roof and sliding door. In addition, the 2 left attachment points on the tail boom failed due to overload toward the right side of the helicopter. This is consistent with the helicopter landing with a high downward velocity on its right side at impact.

The pilot seat had little structural damage. All the seat safety harness systems were tested following the occurrence and found to be serviceable. However, the left side lap belt attachment point had torn loose as a result of the impact. There was no shock-absorbing mechanism in the seats. It was also determined that the pilot was not wearing the available shoulder harnesses at the time of impact.

These harnesses are designed for use when the pilot is sitting upright in a normal flight position. It is common practice for pilots not to wear the shoulder straps while long-lining because it can hinder upper body movement to the bubble window. An aftermarket vertical reference seat is available that permits pilots to lean without removing their shoulder straps.

The electric release for the belly hook was found in the disarmed position. The long line, which was found disconnected from the belly hook, was loosely strung in a more or less straight line from the bucket toward the helicopter at approximately the same distance from the shoreline.

The long-line top-end clevis and the belly hook showed no indications of damage and the water bucket dump valve was in the normal closed position for a pickup. The water bucket was tested on another company helicopter, and functioned normally.

Emergency Locator Transmitter

A signal was not received from the emergency locator transmitter (ELT) after impact. However, once the helicopter was lifted out of the water during recovery, the signal was detected by the COSPAS-SARSAT satellite system.

The 406 Mhz ELT is designed to transmit a distress message repeatedly. The repetition period is randomized around a mean value of 50 seconds to ensure that no 2 beacons have coincident data bursts. The distress message is not retransmitted until at least 1 repetition period has elapsed, making it possible to differentiate between legitimate distress messages and messages sent by error during maintenance or testing. [3]

When an aircraft crashes into water, there is a strong possibility that the fixed ELT antenna will be submerged before the 50-second delay has elapsed. If the antenna is under water, an ELT signal may be severely attenuated and may not be detected.

Pilot

The pilot held an Airline Transport Pilot Licence – Helicopter, validated by a flight medical on 18 April 2011. Available records indicate that the occurrence pilot had between 4900 to 5500 total flight hours, of which about 200 flight hours were on the Bell 212. The license was endorsed for 7 different helicopter types. In April 2011, the pilot participated in Bell 212 training at Campbell Helicopters and passed the company Pilot Proficiency Check (PPC). The training provided by Campbell Helicopters included the HAC-developed and ASRD-approved pilot competencies for helicopter wildfire operations.

Prior to 2006, the pilot had accumulated approximately 500 hours carrying out external load operations, of which approximately 20 were long line work. He had no external load experience with any of the 3 operators with whom he had been employed since 2006. However, on the Canadian Interagency Forest Fire Centre (CIFFC) Pilot Directory, the pilot had listed 500 hours slinging, 50 hours long lining and 50 hours water bucketing. This discrepancy could not be reconciled.

Flight Helmets

The pilot, who was not wearing a flight helmet, received severe head injuries during the impact sequence. The pilot's flight helmet was found inside its bag at the rear of the helicopter cabin.

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[3] Specification for COSPAS-SARSAT 406 Mhz Distress Beacons, C/S T.001, Issue 3 – Revision 12, October 2011.

The occurrence pilot was not required by Campbell Helicopters to wear a helmet, nor is there a regulation requiring helicopter pilots to wear head protection.

The second most frequently injured body region in survivable helicopter crashes is the head. [4] According to United States military research, the risk of fatal head injuries can be as high as 6 times greater for helicopter occupants not wearing head protection. [5] The effects of non-fatal head injuries range from momentary confusion and inability to concentrate to full loss of consciousness. [6] Incapacitation can compromise a pilot's ability to escape quickly from a helicopter and assist passengers in an emergency evacuation or survival situation.

In 1988, the National Transportation Safety Board (NTSB) reviewed 59 emergency medical services (EMS) aviation accidents between 11 May 1978 and 03 December 1986. This study resulted in NTSB's recommendations A-88-009 to the FAA and A-88-014 to the American Society of Hospital Based Emergency Aeromedical Service asking them to require that flight crew and medical personnel wear protective helmets, and encourage them to do so, to reduce the chance of injury and death.

Transport Canada recognized the safety benefits of using head protection in its 1998 Safety of Air Taxi Operations Task Force (SATOPS) [7] report in which it committed to implementing the following recommendation:

> Recommend Transport Canada continue to promote in the Aviation Safety Vortex [8] newsletter the safety benefits of helicopter pilots wearing helmets, especially in aerial work operations, and promote flight training units to encourage student pilots to wear helmets.

In addition, SATOPS directed the following recommendation to air operators:

> Recommend that helicopter air operators, especially aerial work operators, encourage their pilots to wear helmets, that commercial helicopter pilots wear helmets and that flight training units encourage student helicopter pilots to wear helmets.

The TSB has documented a number of occurrences [9] where the use of head protection likely would have reduced or prevented the injuries sustained by the pilot.

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4 Shanahan, D., & Shanahan, M. (1989). *Injury in U.S. Army Helicopter Crashes October 1979 – September 1985*. The Journal of Trauma, 29(4), 415-423.

5 Crowley, J.S. (1991). *Should Helicopter Frequent Flyers Wear Head Protection? A Study of Helmet Effectiveness*. Journal of Occupational and Environmental Medicine, 33(7), 766-769.

6 Retrieved from http://www.braininjury.com/injured.html on 31 August 09.

7 Transport Canada (1998). SATOPS Final Report, TP 13158.

8 The Aviation Safety Vortex newsletter has now been discontinued, but is combined with the Aviation Safety Letter.

9 TSB Occurrences: A98W0086, A95A0040, A94W0147, A94Q0101, A93Q0237, A91W0046, A87P0089, A87P0025, A87P0023, A86C0060, A85P0011, A05P0103, A95P0215, A99P0070 and A09A0016.

TSB investigation A09A0016 found that despite their well-documented safety benefits, and the challenging nature of helicopter flying, the majority of helicopter pilots continue to fly without head protection. Likewise, that investigation also found most Canadian helicopter operators do not actively promote, or require, the use of head protection by company pilots.

In recognition of the benefits of head protection, on 27 June 2011, a resolution passed by the HAC Board of Directors stated that:

> HAC strongly recommends to its Operator-Members that they should promote the use of helmets for helicopter flight crew members under all operational circumstances which permit their use.HAC also points out, however, that certain pilot/aircraft type configurations may preclude safe helmet use.

The following TSB Laboratory reports were completed:

> LP082/2011 - Examination of Servo Cylinder Fracture
> LP077/2011 - Annunciator Panel Examination

Analysis

There was no indication that an aircraft system malfunction contributed to this occurrence. As a result, the analysis will focus on the operational and environmental factors which contributed to the occurrence and the injuries sustained by the pilot.

The investigation determined that the occurrence pilot was conducting water pickups at a considerable distance from shore over glassy water. The glassy water conditions that would have made depth perception difficult were compounded by the lack of visual references due to the distance from shore. The helicopter had not yet come into the hover when the water bucket inadvertently entered the water. This resulted in a violent pull rearward and to the left, causing it to descend and roll to the right. The pilot likely overestimated the helicopter's altitude while on final approach, due to glassy water conditions and a lack of visual references, which led to the water bucket inadvertently entering the water.

The helicopter then descended to within several feet of the water. The pilot's subsequent attempt to recover would have required both hands on the controls, precluding arming the belly hook's electrical release. When the helicopter climbed, it is likely that the combination of the long-line tension, helicopter movement, and high power setting caused the helicopter to roll to the right and descend quickly into the water.

Because the belly hook was electrically disarmed, the pilot's ability to jettison the water bucket was limited. It is possible that the pilot released the belly hook using the manual release located between the pedals using one of his feet or it may have been released on impact. Irrespective of how the hook was released, the helicopter impacted the water before the pilot was able to regain control.

The pilot was not wearing his flight helmet, which contributed to the severity of his head injuries, given that his upper body was not restrained by a shoulder harness (shoulder harnesses can hinder upper body movement to the bubble window). Despite the recognized benefits of head protection, there is no requirement for helicopter pilots to wear helmets. The

lack of regulation or policies requiring helicopter pilots to wear helmets places them at greater risk of incapacitation due to head injuries incurred during ditching or a crash.

If an aircraft crash occurs over land, an ELT that survives a crash will normally transmit at full strength after the required 50-second delay. In this case, the fixed ELT antenna was submerged within the 50 seconds. As a result, it is probable that the ELT signal was severely attenuated and could not be detected by the COSPAS-SARSAT satellite system. It was not until the wreckage was recovered that the signal was received. As long as ELTs are not set up to transmit a signal immediately, water attenuation of useable ELT signals from submerged aircraft will continue to pose a risk of an ELT signal not being received and SAR resources not being deployed soon enough.

Findings as to Causes and Contributing Factors

1. The pilot likely overestimated the helicopter's altitude while on final approach, due to glassy water conditions and a lack of visual references, which led to the water bucket inadvertently entering the water before the helicopter was established in the hover.

2. The helicopter was pulled violently rearwards and to the left, as a result of the water bucket entering the water. This caused the helicopter to descend and the pilot to lose control.

3. The helicopter was being operated with the belly hook electrically disarmed, limiting the pilot's ability to jettison the water bucket before losing control.

4. The pilot was not wearing his flight helmet, which contributed to the severity of his head injuries, given that his upper body was not restrained by a shoulder harness.

Findings as to Risk

1. The lack of regulation or policies that requires helicopter pilots to wear helmets places them at greater risk of incapacitation from head injuries incurred during ditching or a crash.

2. Without an immediate signal being transmitted from an ELT installation, water attenuation of useable ELT signals from submerged aircraft will continue. This increases the risk of an ELT signal not being received and SAR resources not being launched in a timely manner.

Other Finding

1. Inconsistencies in recorded flight hours were noted in the pilot's external load experience.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 24 January 2012.

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