Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A08Q0231

CONTROLLED FLIGHT INTO WATER

ROBINSON R44 RAVEN I (HELICOPTER) C-GSVX
LAC SIMON, QUEBEC
03 DECEMBER 2008

Canada

Aviation Investigation Report

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Summary

At approximately 1721 eastern standard time, the privately operated Robinson R44 Raven I helicopter (registration C-GSVX, serial number 1727) departed Sainte-Anne-des-Plaines, Quebec, with the pilot/owner and three passengers on board for a night visual flight rules flight to the pilot's cottage located at Lac Simon, Quebec. The 52-nautical mile trip was uneventful. To establish the helicopter on approach to the lit landing pad positioned in front of the cottage, the pilot turned right onto final approach at an altitude of approximately 150 feet above the lake. On final approach, the helicopter continued the descent and struck the water. All occupants escaped uninjured. One passenger successfully swam approximately 1000 feet to shore, while another was rescued by two persons in a rowboat. The pilot and one passenger were unable to reach the shore and drowned. The helicopter sank in 25 feet of water and was substantially damaged. The occurrence took place at approximately 1805 eastern standard time under dark, night conditions.

Ce rapport est également disponible en français.

Other Factual Information

History of the Flight

The pilot, overseeing the construction of his cottage located at Lac Simon, Quebec, had invited a contractor to join him on the helicopter flight to take some measurements at the cottage. The pilot was in the right front seat and the contractor was in the left front seat. Also on board were two passengers. The passenger in the left rear seat was a fixed-wing pilot.

Upon arriving at Lac Simon at approximately 1800, [1] the pilot circled the cottage once, then flew by from the southwest side of the bay at approximately 150 feet above ground level (agl) and turned right over the open water for the final approach to the lit landing pad (see Appendix A – Estimated Robinson R44 Flight Path before Impact with Water). The landing pad was equipped with four low-intensity, solar-powered, light-emitting diode (LED) lights; three of the four lights were functional. A small bonfire was visible between the cottage and the landing pad. The helicopter's landing lights were on. Because it was off-season for cottagers, few lights from surrounding dwellings were lit. Only a few street lights were illuminated on the street that contours the bay. After executing a right-hand turn onto final approach, the helicopter descended below the normal final approach glide path to the landing pad and collided with the surface of the water. The helicopter was at an estimated speed of less than 20 knots at the time of impact and flipped on its left side.

All occupants were wearing their seatbelts and shoulder harnesses at the time of impact. The passengers were quickly instructed to unfasten their safety harnesses and evacuate by the right side doors that were not submerged. Once all the occupants were out, the helicopter sank quickly. No personal flotation devices were carried on board. All four occupants attempted to swim approximately 1000 feet to the nearest lit cottage. For reasons most likely attributable to the cold water temperatures and to the fact that the occupants were fully clothed, the pilot and right rear seat passenger were unable to reach the shore and drowned. The two other passengers continued towards shore. One passenger managed to reach the shore without assistance, while the other was assisted by two persons in a rowboat. They were taken indoors and assisted until taken to hospital by ambulance.

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

Rescue Efforts

Volunteer municipal rescue personnel/firefighters were on site within eight minutes of the 911 call, which was received at 1809. The Sûreté du Québec (SQ) [2] from Papineauville, Quebec, arrived at the site within 34 minutes. A total of approximately 13 volunteer rescue personnel were on hand; some combed the shores around the bay. Others searched for the two missing occupants, starting first with one boat and finally with a total of three boats. A few local residents and family members helped in the search. The search party was joined at 2045 by a search-and-rescue (SAR) helicopter squadron from Canadian Forces Base Trenton, Ontario. SQ divers found the missing pilot, passenger, and the wreckage on the morning after the occurrence.

Survivability

Hypothermia occurs when body core temperature decreases due to exposure to cold. It is known that in water temperatures of 0.3°C (32.5°F), exhaustion can occur after less than 15 minutes of exposure. Survivability depends on the length of time the person is exposed, their age, weight, sex, physical and mental condition, dress, water temperature, and preparedness. Symptoms of hypothermia set in rapidly, normally within minutes. They include shock, panic, gasping reflex, an initial increase of blood pressure, heart rate and adrenaline levels, and cardiac arrhythmia. Swimming accelerates the loss of core body temperature and hastens the onset of hypothermia, leading to muscle cramping, poor coordination, and difficulty swimming. Drowning often follows hypothermia. [3]

Life preservers, individual flotation devices, or personal flotation devices, such as those required in aircraft for each person on board when flight is planned over water, will help a person stay afloat, but provide no protection from loss of body heat. The water temperature was not measured at the time of the occurrence. However, considering it was early December, it is assumed that the water was near freezing temperature.

Aircraft Damage

The wreckage was salvaged and transported to a hangar for examination by TSB investigators. The helicopter's windshields and door windows were all intact, with the exception of a crack to the left windshield. There was no damage to the main cabin area. All doors opened and closed normally. There was no deformation to any of the seats or seat structures. All seat belts and shoulder harnesses remained intact and likely restricted forward upper body movement on impact, minimizing injuries to the occupants. The fuselage was distorted at the main transmission and engine support area. The tail boom was distorted at the aft fuselage attachment area.

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2 Quebec provincial police

3 Timothy M. Smalley, *Hypothermia…The Cold Facts.* Boat and Water Safety, Minnesota Department of Natural Resources, St. Paul, Minnesota, U.S., publication 5/07-110M 2007, 5-6

The helicopter was equipped with an emergency locator transmitter (ELT) manufactured by Pointer Inc. (model 3000-10, serial number 346213), which was found intact but had been submerged after impact. The ELT transmitter and remote switches were found properly positioned in the normal AUTO position when recovered. The ELT's annunciator light was illuminated, indicating that it was activated. However, it was not possible to confirm whether it activated due to impact forces or due to an internal short circuit when the unit was submerged in water. Although the ELT had activated, SAR Trenton did not receive an ELT signal, most likely because the unit was rapidly submerged in water.

Pilot Information

The pilot was certified and qualified for the flight in accordance with existing regulations. The pilot was familiar with the area in which the flight took place; he flew the trip to his cottage several times a week in order to oversee construction progress. Since acquiring the R44 helicopter, the majority of the flights to and from the cottage area took place during daylight hours. Although the occurrence flight took place after a day of work, fatigue was not considered to have contributed to the occurrence.

The pilot was issued his helicopter private pilot license in July 2007. His category 3 aviation medical certificate was valid at the time of the occurrence. He had completed approximately 246 hours of flying time, of which approximately 175 hours were completed on his R44 since purchasing it new in June 2007. Later in 2007 and in early 2008, the pilot undertook night training. He obtained his night rating in July 2008 and had the necessary requirements for the transportation of passengers at night. The exact amount of night flight time he had accumulated could not be determined. It is estimated that he had flown a total of approximately 25 hours at night, some of which were flown to and from his cottage in the months preceding the occurrence.

Aircraft Information

The Robinson R44 is a single-engine, piston-powered helicopter capable of carrying a pilot and three passengers. Records indicate that the aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures. Maintenance records indicate that the helicopter had flown approximately 175 hours since new and 53 hours since the last annual/100-hour inspection. The helicopter's weight and centre of gravity were within prescribed limits at the time of the occurrence. The pilot did not report any technical difficulties with the helicopter prior to colliding with the water.

The helicopter was certified and equipped for night visual flight rules (VFR) conditions in accordance with the *Canadian Aviation Regulations* (CARs). It was not equipped with an autopilot, a ground proximity warning system (GPWS), or a radar altimeter, nor were these required by regulation.

The helicopter was equipped with a Garmin 296 global positioning system (GPS). The GPS was examined by the TSB Engineering Laboratory, which confirmed entered waypoints and flight history. The GPS "save flight data" function had been disabled; therefore, any useful investigation data such as time, position, altitude, direction, and speed changes for the occurrence flight were unavailable. The helicopter was not equipped with a cockpit voice recorder (CVR) or flight data recorder (FDR), nor was either required by regulation.

Weather Information

The graphical area forecast (GFA) weather charts showed a low-pressure system moving eastward across the province of Quebec by 0100 local time on 04 December 2008 that would affect the region in which the occurrence flight took place. Lac Simon is situated slightly to the north and about halfway between the Gatineau Airport (CYND) and the Montréal International (Mirabel) Airport (CYMX), Quebec. Considering the reported weather conditions for both airports, it is estimated that the conditions at Lac Simon at the time of the occurrence were an overcast cloud layer at approximately 5300 feet above ground level, visibility 20 statute miles, and winds from the southeast at 3 knots. The weather was not a contributing factor in this accident.

Nightfall on 03 December 2008 was at 1654; therefore, the flight took place during official night hours. It was a dark night. Twenty-one per cent of the moon would have been visible, but due to the overcast sky, the moon would not likely have improved the light conditions.

Night Approaches

The pilot's cottage is situated in a large bay on Lac Simon (see Appendix A – Estimated Robinson R44 Flight Path before Impact with Water). Although there are cottages situated on the shore all around the bay, few were occupied at the time because it was the winter season. Therefore, very few surrounding dwellings were lit. The environment in which the pilot executed the final approach was dark with very few visual cues to help the pilot identify surrounding objects, textures, and features. These visual cues are necessary for a pilot to properly assess an aircraft's speed, altitude, rate of closure, and rate of descent while on a descent to land. It is also necessary for a pilot to scan the flight instruments and correlate that information with any perceived outside visual information.

The private helicopter landing pad used by the pilot was situated in a non-built-up area and was for private use only; therefore, it was not required to be certified as per the CARs. [4] Other than requiring lighting of the helipad, current regulations do not specify lighting intensity, colour, number of lights, or approach path aids.

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4 CAR 305 - Heliports, Standard 325 – Heliport Standards

The three functional low-intensity, solar-powered LED lights on the corners of the 16 by 16 foot landing pad and the bonfire in front of the landing area would not have lit the surrounding environment; they simply defined the landing pad perimeter. The helicopter landing lights were on; they are useful mainly during the landing phase for illuminating the landing surface and for when manoeuvring close to the ground.

Landing an aircraft involves three phases. First, the pilot must make an initial judgement of an appropriate glide slope or approach path, usually three degrees, then maintain the glide slope during the approach so as not to be too low or too high in reference to the landing area. The pilot must then judge ground proximity before touchdown. [5] Pilots judge height, speed, rate of closure, and rate of descent by using cues available from the environment in which the approach takes place such as objects, ground textures, and ground features. These cues are greatly reduced when the flight or the approach is done over water, over snow-covered terrain, or at night.

The black hole effect is an illusion that occurs when an aircraft is on a night approach over unlighted terrain such as water. When an aircraft is on approach to a landing area and all is dark below the approach path with only the distant lights providing visual stimuli, an illusory or false sense of height may be perceived. With no visual cues available other than the lit runway or landing area, the pilot perceives the landing area as being further away; it therefore seems smaller. The pilot believes the aircraft to be higher than it actually is, which then causes the pilot to execute the approach lower than the desired approach path and thus may be subject to controlled flight into terrain (CFIT).

When the pilot applies lateral cyclic pressure, the R44, like many helicopter types, will turn, but will also have a tendency to descend as thrust (that is, lift) generated by the main rotor tilts away from the vertical axis. To maintain altitude during a turn, the pilot must increase the aircraft's vertical lift component by applying additional collective pitch and/or aft cyclic pressure. If not perceived and corrected by the pilot, the helicopter would have tended to lose altitude during the right-hand turn. Slow, gradual changes in altitude may remain undetected by a pilot if visual cues are inadequate and if a scan of the flight instruments to correlate the information is delayed. Without the benefit of GPS information, it is not known if the helicopter descended during the right-hand turn onto the final approach leg.

The pilot initiated the turn onto final approach at approximately 150 feet agl. A normal circuit usually dictates that the pilot turn from the base leg onto final at approximately 500 feet agl. This allows ample obstacle clearance, especially when flying at night, and time to set up a stable approach path on final approach to land.

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[5] Roger G. Green et al, *Human Factors for Pilots,* Burlington, Vermont, U.S., Ashgate Publishing Co., 1991, 52

Subsection 602.62(1) of the CARs state: "No person shall conduct a take-off or a landing on water in an aircraft or operate an aircraft over water beyond a point where the aircraft could reach shore in the event of an engine failure, unless a life preserver, individual flotation device, or personal flotation device is carried for each person on board." The regulation suggests intent, in that it prohibits intentional flight over water without some safeguards. While the final approach phase was conducted over the lake, the flight was not planned to operate over the water beyond the point at which it could safely reach shore. It was not the pilot's intent to fly as low as he did when he attempted to land at his helipad on the night of the accident. Therefore, no personal flotation devices were carried on board, nor were they required by regulation.

Operating a single-engine helicopter at low altitude over water is not unusual for certain aerial applications, but it does place the aircraft and its occupants in a situation for which, if there is a loss of power or a loss of control, there is little time or altitude available for the pilot to execute a recovery. The helicopter was approximately 150 feet above water on final approach to land, and would not have been able to glide to the closest shoreline in the event of an engine failure or emergency over the water. The pilot normally approached the landing pad over the lake for noise abatement purposes, which also ensured that the aircraft was clear of obstacles.

Night Rating

In order to obtain a private helicopter night rating, an applicant shall have acquired a minimum of 20 hours of pilot flight time in helicopters, which shall include a minimum of:

- 10 hours of night flight time, including a minimum of:
    - 5 hours of dual flight time, including 2 hours of cross-country flight time;
    - 5 hours of solo flight time, including 10 take-offs, circuits, and landings; and
- 10 hours of dual-instrument time. [6]

Therefore, a pilot may only have completed 10 hours of actual night flight time. An additional five hours may be done in a flight simulator and five hours of dual-instrument time may be completed in-flight under a hood during daytime hours. Flight training schools are often located near populated areas; training is therefore conducted in and around cities or towns where the surrounding environment is lit. Take-offs and landings are usually executed from lit runways or heliports. Night-rated fixed-wing pilots will usually travel from one airport or aerodrome to another, always taking off from and landing on lit runways with varying lighting systems and approach path aids such as VASIS. [7] The environment in which the night-rated helicopter pilot may choose to fly can vary greatly due to the versatility of the aircraft and environment in which helicopter operations take place. Current regulatory requirements for night rating training are the same for private helicopter pilots as they are for fixed-wing pilots.

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[6] According to CARs subsection 421.42 (2), credit for a maximum of 5 hours of the 10 hours of dual instrument time may be given for instrument ground time, provided that the total instrument time shall be in addition to the 10 hours of night flight time described above.

[7] VASIS = Visual approach slope indicator system

A search of the Transport Canada database showed that in 1988 there were 210 licensed private helicopter pilots in Canada. These numbers increased to 331 in 1998 and to 542 licensed private helicopter pilots by 2007. In 2008, there were 120 current night-rated private helicopter pilots.

The United States (U.S.) Federal Aviation Administration (FAA) recently released its conclusions following a review of helicopter emergency medical services (EMS) accidents. Although not entirely on point for private helicopter operations, it found a total of 83 EMS accidents from 1998 through mid-2004 for which the main causes were CFIT, inadvertent operation into instrument meteorological conditions (IMC), and pilot spatial disorientation/lack of situational awareness in night operations. Because of the demanding environment in which night helicopter operations take place, the FAA intends to focus its efforts on certain areas, such as providing better training for helicopter night operations and promoting technology such as night vision goggles, terrain awareness and avoidance systems, and radar altimeters. [8]

Analysis

Visual cues in the environment such as trees, buildings, objects, terrain textures, and features, plus a cross-check with the flight instruments are necessary for a pilot to adequately assess a helicopter's speed, attitude, altitude, rate of descent, and rate of closure. The lack of visual cues inherent at night in poorly lit areas can make night flying, take-offs, and landings challenging.

While the weather conditions were appropriate for VFR flight at night, the dark lighting conditions of the surrounding area and the approach over the dark surface of the lake provided ideal conditions for the black hole illusion. It is likely that as a result of this illusion, the pilot believed the helicopter was higher than it was during the approach to land. The pilot unknowingly flew the helicopter lower than the intended approach path, causing the helicopter to collide with the surface of the water well before reaching the desired landing area.

The minimum requirements necessary to obtain a private helicopter pilot night rating may not be sufficient to adequately educate and demonstrate to private helicopter pilots the risks involved in night flying, including visual illusions. Present night rating requirements are the same for private helicopter pilots as for private fixed-wing pilots, yet the environments in which they may operate at night can vary greatly.

Flying over the lake on approach at night ensures a helicopter is away from obstacles and allows for a shallower approach to land. However, in the event of an unforeseen problem, the helicopter may not be within gliding distance from the shore, thereby posing a risk to the aircraft and its occupants. It is unlikely that the missing persons would have survived more than a few minutes given the cold water temperatures.

Current regulations do not specify light intensity, colour, number of lights, or approach path aids for private helicopter landing pads. The three (of four) low-intensity, solar-powered LED lights on the corners of the landing pad and the bonfire in front of the landing area would not have illuminated the surrounding area sufficiently to help the pilot judge a safe and constant approach angle over the dark, featureless surface of the water.

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8 FAA Fact Sheet, Helicopter Emergency Medical Service Safety, 27 April 2009

Findings as to Causes and Contributing Factors

1. It is likely that the effect of the black hole illusion caused the pilot, in full control of the aircraft, to unknowingly fly the helicopter lower than the intended approach path, causing the helicopter to collide with the surface of the water well before reaching the desired landing area.

2. The helicopter approached the landing pad over water and, after colliding with the lake surface, the occupants had to evacuate in near-freezing water temperature, exposing them to hypothermia.

Findings as to Risk

1. The minimum requirements necessary to obtain a private helicopter pilot night rating may not be sufficient to adequately educate and demonstrate to private helicopter pilots the risks involved in night flying, including visual illusions.

2. Current regulations do not specify light intensity, colour, number of lights, or approach path aids for private helicopter landing pads, thereby increasing the risk of accidents or incidents in degraded environmental conditions.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 08 December 2009.

Appendix A - Estimated Robinson R44 Flight Path before Impact with Water