Australian Government
Australian Transport Safety Bureau

Collision with terrain involving Robinson Helicopter Company R22 Beta, VH-LOS

36 km south of Ramingining, Northern Territory, on 14 November 2022

ATSB Transport Safety Report
Aviation Occurrence Investigation (Short)
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Addendum

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Executive summary

What happened

On the afternoon of 14 November 2022, a Robinson Helicopter R22 Beta, registered VH-LOS, was being operated near the Arafura Swamp, Northern Territory. The helicopter was being used as part of an animal mustering operation, which also included multiple land vehicles.

After the mustering operation had concluded for the day, recorded data indicated that the helicopter returned to the mustering camp. When members of the mustering operation returned to the camp, the pilot and the helicopter were not there. Realising that the pilot was missing and becoming increasingly concerned about the pilot's welfare, the mustering group commenced a search using land vehicles.

On the morning of 15 November members of the mustering operation organised an aerial search. The wreckage of VH-LOS was located at about 1300, about 6 km from the mustering camp. The pilot was deceased, and the helicopter was destroyed.

What the ATSB found

The ATSB found that the pilot of VH-LOS operated the helicopter after the end of nautical twilight in cloudy conditions and away from the direction of sunset. There was no celestial or terrestrial lighting, and as such the flight occurred in dark night conditions. The pilot did not have an appropriate qualification, and the helicopter was not suitably equipped, for night flight. While flying in dark night conditions, the pilot likely became spatially disoriented which led to a collision with terrain.

A pathologist's report found that the injuries sustained by the pilot in the collision were probably not fatal, and that the pilot probably succumbed to environmental exposure. VH-LOS was equipped with a manually activated personal locator beacon. However, the beacon was secured to the inside of the helicopter, and the pilot was probably unable to access it once outside the helicopter after the collision.

When members of the mustering operation identified that the pilot and the helicopter were missing, they considered that the pilot may have landed and would either return the following day, or would be waiting nearby. As a result, they did not contact emergency services. In combination with the absence of a distress signal from the personal locator beacon, this led to delays in initiating a formal search and rescue response and subsequent location of the accident site.

The ATSB found that the combination of the personal locator beacon not being activated and authorities not being notified when the aircraft was missing resulted in a delay to the pilot being located before succumbing to environmental exposure after sustaining survivable injuries in the accident.

Safety message

Various ATSB research and investigation reports refer to the dangers of flying after last light without the appropriate qualifications and equipment. Day visual flight rules (VFR) pilots should carefully consider the timing of last light when planning flight near the end of the day. The Civil Aviation Safety Authority *Visual Flight Rules Guide* provides guidance to pilots on methods for determining the timing of last light, and pilots should also consider the influence of nearby weather that may cause the onset of darkness to be earlier than expected. The requirement to only operate under the VFR in daylight conditions, and to return 10 minutes before last light, provides a reliable method for ensuring visual cues are available for safely operating an aircraft.

Dark night conditions provide no useable external visual cues and in these environments all VFR pilots, including those with endorsement to operate under the night VFR, will experience an increased risk of spatial disorientation. The ATSB's Avoidable Accidents publication *Visual flight at*

night accidents provides further discussion of these risks and how they have contributed to other accidents. The ATSB encourages all VFR pilots to take note of the tragic consequences associated with dark night flight in this accident.

The accident also highlights that when operating in remote locations, there is an increased risk of fatal consequences from otherwise survivable accidents. Pilots operating in remote locations should carefully consider the use and location of equipment such as a personal locator beacon, to maximise the likelihood it will be accessible to them in the event of an accident. The *Visual Flight Rules Guide* provides guidance on the use of emergency locator beacons.

The investigation

Decisions regarding the scope of an investigation are based on many factors, including the level of safety benefit likely to be obtained from an investigation and the associated resources required. For this occurrence, a limited-scope investigation was conducted in order to produce a short investigation report, and allow for greater industry awareness of findings that affect safety and potential learning opportunities.

The occurrence

On 14 November 2022, a Robinson Helicopter Company R22 Beta, registered VH-LOS, was being operated in the Arafura Swamp, about 30 km south of Ramingining Aerodrome, Northern Territory (Figure 1). The helicopter was being used as part of an animal mustering operation, which also included multiple land vehicles.

Figure 1: Map of the Northern Territory showing the location of the accident site and nearby locations

Source: Google Earth, locations labelled by ATSB

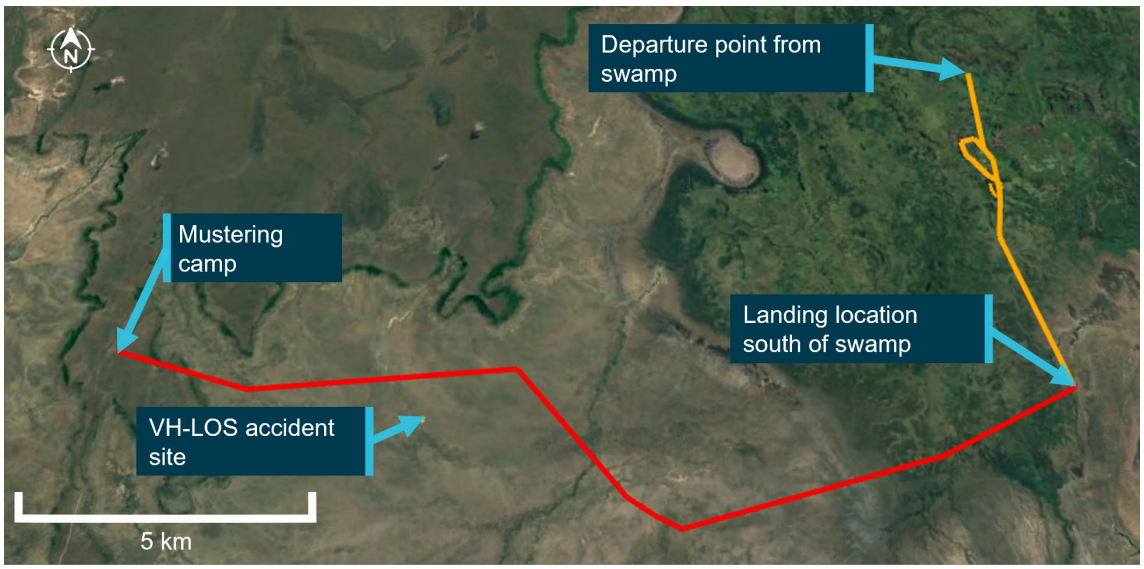
At about 1800 local time, the mustering operation concluded for the day. The pilot of VH-LOS instructed a member of the mustering group to drive a grader vehicle to the southern edge of the swamp. The pilot planned to collect the grader driver and fly them back to the mustering camp, located about 20 km to the west.

Other members of the mustering operation departed the swamp in land vehicles, heading towards the camp. A witness recalled that VH-LOS was on the ground when the group departed, and they expected the pilot would depart soon after they left.

Flight tracking information showed VH-LOS took off from the swamp at 1803, flew around the swamp before tracking to the south, landing at the edge of the swamp at 1818. The helicopter was

then started at 1837, and tracked to the mustering camp, landing and shutting down at 1854. The track of these flights is shown in Figure 2. The flight tracking information showed the helicopter was started again at 1921, before the flight tracking record ended about 1 minute later while the helicopter was still at the camp. The flight tracking device deactivated at 1925 after the helicopter had remained idle at the camp location and the device had lost external power (see *Recorded information*).

Figure 2: Map of Arafura Swamp and key locations, and track of VH-LOS



The yellow track shows the flight departing from Arafura Swamp at 1803 and shutting down south of the swamp at 1818. The red track shows the flight from the edge of the swamp to the mustering camp departing at 1837 and landing at 1854.
Source: Google Earth, with aircraft tracking plots overlayed by ATSB based on records obtained from recorder onboard VH-LOS

The grader driver travelled from the swamp towards the planned meeting point, which took about 30 minutes. They waited for about 10 minutes before deciding to return to camp on the grader when the helicopter did not arrive. The grader did not have a radio capable of communicating with the helicopter.

The other members of the mustering operation arrived back at the camp and noticed that neither the helicopter pilot nor the grader driver were there. One witness recalled it took about an hour to return to camp, and that the group arrived when it was close to dark, but not 'pitch black'. Another group member recalled that they arrived after dark, at about 1945 to 2000.

The grader driver arrived at the camp at about 2100. Members of the mustering operation became increasingly concerned about the wellbeing of the helicopter pilot and commenced a search using land vehicles from about 2100 until 0100 on 15 November.

Early on 15 November, members of the mustering operation phoned an acquaintance who had access to the aircraft flight tracking information. The internet-based display showed VH-LOS at the mustering camp, having not moved since the previous evening.

The mustering group members then contacted some acquaintances who attended the area in helicopters and commenced an aerial search from about 1100. The helicopter wreckage was located at about 1300, about 6 km from the mustering camp. The pilot was deceased, and was found outside and resting against the helicopter. The helicopter was destroyed.

Context

Pilot information

Licence and experience

The pilot held a Commercial Pilot Licence (Helicopter) and a valid Class 1 aviation medical certificate. The pilot also held a single engine helicopter rating, and a low level rating with aerial mustering (helicopter) and sling endorsements. The pilot did not hold an instrument rating or a night visual flight rules (VFR) rating.

The pilot's logbook recorded over 6,200 hours total aviation experience, however no records had been made of flights conducted after March 2022.

Events prior to the accident

The pilot flew VH-LOS to Ramingining on 10 November 2022 and operated around the Arafura Swamp in the days prior to the accident. Aircraft tracking records showed that the helicopter was operated until 1859 on 11 November and until 1931 on 12 November. It is likely that these flights were conducted near or after the end of civil twilight (see *Celestial illumination information*).

Post-mortem examination and medical information

A post-mortem examination of the pilot was conducted by a qualified pathologist, on behalf of the Northern Territory Coroner. The pathologist's report indicated that their examination was impeded due to the elapsed time between the accident and the recovery of the pilot's body to a suitable mortuary facility. Only limited toxicology analysis could be performed, and although a high concentration of alcohol was detected the analysis could not determine if some or all of the measured alcohol (0.18%) was the result of post-mortem changes.

The pathologist's report identified that the pilot sustained multiple injuries, including a fracture to the left femur, however the injuries were likely survivable. The report found that death was most likely the result of environmental exposure following the collision, with the left femur fracture contributing to reduced mobility.

The pathologist also observed no obvious evidence of injury consistent with being caused by a harness or seatbelt.

Witnesses recalled that the pilot was fit and healthy prior to the accident, and there were no indications that the pilot was experiencing any unusual stress. No witnesses recalled the pilot consuming alcohol or other drugs in the days before the accident.

Aircraft information

VH-LOS was a Robinson Helicopter Company R22 Beta helicopter, serial number 1715, powered by a Textron Lycoming, O-320-B2C, 4-cylinder piston engine. It was manufactured in the United States in 1991, and first registered in Australia in January 1995, and was equipped and maintained to a day VFR standard. The R22 has 2 seats, with the pilot flying from the right seat, and each seat was fitted with a seat belt and inertia reel shoulder strap, similar to those used in motor vehicles. VH-LOS did not have doors fitted at the time of the accident.

Recorded information

VH-LOS was not fitted with a flight data recorder or cockpit voice recorder, nor was it required to be.

The operator of VH-LOS tracked the aircraft using a system configured for the TracPlus tracking service. The system consisted of a RockAir device located in the helicopter, which was capable of

transmitting the aircraft location using satellite and cellular networks. Registered users could log into the TracPlus website to view the aircraft track and position.

At the accident site, the ATSB found the RockAir unit outside the helicopter. A data card recovered from inside the unit included records showing the recorded tracks of VH-LOS on the afternoon of 14 November, as well as log files for the RockAir system. The files showed the final recorded position of VH-LOS was at the mustering camp location at 1925.

The manufacturer of the RockAir reviewed the log file from the day of the accident and noted the following:

- The pilot of VH-LOS did not manually deactivate the aircraft tracker.
- The RockAir was performing normally on the day of the accident.
- The device was in a mode where it would deactivate if external power was removed, unless it detected the aircraft was moving above a speed threshold.
- The RockAir automatically deactivated at 1925 when the device lost power.
- There were 36 other instances on the day of the accident where the device lost power for 2-5 seconds, however the unit reverted to battery power because the aircraft was moving.
- It was not possible to determine the reason for the power supply interruptions, with mechanical movement of the power supply being a possibility.

Weather and environment

Weather

Members of the mustering operation recalled that conditions were fine while they were operating around the Arafura Swamp on the afternoon of 14 November, with no storms overhead. The grader driver recalled conditions as being cloudy, and that it was dark that night.

An analysis prepared by the Bureau of Meteorology (BOM) identified a thunderstorm to the east of the accident site at about 1730, which moved west during the evening. The analysis stated that outflow from the thunderstorm could have produced variable direction winds with gusts up to 35 kt. Near the thunderstorm, heavy rainfall with reduced visibility and broken low cloud were possible.

BOM also supplied observations for the evening of 14 November and the morning and afternoon of 15 November, at Milingimbi (about 60 km north of the accident site) and Bulman (about 130 km south-west of the accident site). BOM advised that these observations should be used as an estimate only for conditions at the accident site. These observations showed it was a hot and humid night in north-east Arnhem land, with temperatures from 27 to 33°C and humidity of 35 to 90% recorded.

Conditions became hotter and less humid during the day on 15 November. At 1300, when the helicopter wreckage and pilot were found, Milingimbi and Bulman recorded 33°C and 55-60% humidity. Witnesses recalled that conditions that day were hot.

Celestial illumination information

Sunset at the location of the mustering camp on 14 November 2022 was 1835 and the end of civil twilight (last light)[1] was 1858. Nautical twilight[2] was 1924 and astronomical twilight[3] was 1951.

The moon was a waning gibbous, rising at 2337 on 14 November with about 71.3% of the visible disk illuminated. There was no environmental lighting in the vicinity of the accident site.

Accident site and wreckage information

The accident site was located 6 km east of the mustering camp, in a flat clearing scatted with small trees and anthills. There were no sources of terrestrial light. None of the trees had damage consistent with a helicopter rotor strike, and there was no evidence of a bird strike or indications of a post-impact fire.

The helicopter was found on its left side, with significant compression of the nose and underside of the forward left section of the fuselage (Figure 3). The compression damage indicated that the helicopter collided with terrain at about 45° nose-down, and 30° left side low. There was a short wreckage trail extending about 13 m, with all helicopter parts present at the accident site and no evidence of an in-flight break-up.

Figure 3: VH-LOS wreckage

Source: ATSB

Indentations on the terrain nearby indicated a main impact point about 6 m aft and 4 m right of where the helicopter was found. Anthills forward of the main impact point showed damage consistent with having been struck by the rotor blades, and both rotor blades presented with evidence of ground strikes. One main rotor blade was liberated as the result of a ground strike,

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1 Geoscience Australia (GA) defined the ending of civil twilight as the instant in the evening when the centre of the sun is at a depression angle of 6° below an ideal horizon. At this time in the absence of moonlight, artificial lighting or adverse atmospheric conditions, the illumination is such that large objects may be seen but no detail is discernible.

2 GA defined the ending of evening nautical twilight as the instant in the evening when the centre of the sun is at a depression angle of 12° below an ideal horizon. At this time in the absence of moonlight, artificial lighting or adverse atmospheric conditions, it is dark for normal practical purposes.

3 GA defined the ending of astronomical twilight as the instant in the evening when the centre of the sun is at a depression angle of 18° below an ideal horizon. At this time the illumination due to scattered light from the sun is less than that from starlight and other natural light sources in the sky.

and was found about 30 m to the right of the wreckage trail. The cockpit windscreen had shattered and remnants were scattered around the accident site along with the contents of the aircraft.

The tail cone and tail rotor assembly remained connected to the fuselage, however presented as deflected down and curled under the helicopter. Site examination showed that both of the bladder-type fuel tanks remained intact and contained fuel. Examination of the helicopter's flight control system and drive train did not indicate any pre-existing defects that could have affected the control or function of the helicopter. Damage signatures to engine rotating components indicated that the engine was operating at the time of the collision with terrain.

The pilot was found in a reclined position on the north-western side of the aircraft (next to the right helicopter seat), with their head rested against the helicopter. There was a large water bottle on the ground nearby. The screw-cap lid had been removed and the drinking spout exposed, suggesting it was likely the pilot was capable of opening and drinking from the water bottle after the accident.

Helicopter restraints

Both helicopter seatbelts were found to be buckled. The lap belt was in its normal secured position at the base of the seat, while the shoulder belt (which connected from the top right to the lower left), was pulled behind the seat base.

The seatbelt assembly had three anchor points, with the two lower anchor points connected to the pilot's seat frame. The pilot's seatbelt was found to be secured to its anchor points. The pilot's seat had been significantly disrupted, pulled in the direction of impact away from the helicopter structure. The separation of the seat structure was very likely a result of the forces generated by the pilot restrained by the seat belt and being propelled in the direction of impact.

Regulatory information and guidance

Visual flight rules

Flight under the VFR must be conducted in conditions that enable the pilot to determine the aircraft's position by visual features in the external environment. VFR flights are only permitted at night if:

- the pilot in command is authorised to conduct a flight under the instrument flight rules or at night under the VFR, and
- the aircraft is appropriately equipped for flight at night.

The CASA VFR guide stated that 'night is that period between the end of evening civil twilight and the beginning of morning civil twilight... last light (is) the end of civil twilight'. The guide further stated that cloud cover or poor visibility may cause daylight to end at a time earlier than the forecast time, and allowance should be made for these factors when planning a flight near last light.

Civil Aviation Order 20.18 described the requirements for helicopters operating under the instrument flight rules (IFR) or at night under the VFR. Among other requirements, for a helicopter operating at night where attitude cannot be maintained using visual external surface cues, the helicopter must also either equipped for IFR flight with an autopilot or automatic stabilisation system, or be operated by a qualified 2 pilot crew. VH-LOS was not equipped for night flight under the VFR.

A member of the mustering operation who had flown with the pilot did not recall the pilot using procedures or routines for determining a 'last flight' time to avoid flying in the dark. They recalled that the pilot had emphasised the importance of having a visible horizon while flying in near dark conditions, to provide a reference for the position of the terrain.

Additional guidance for night VFR flight in dark night conditions

Dark night conditions exist when there is little or no celestial illumination, in locations where no significant ground lighting is available.

The CASA advisory circular *Night VFR rating* provided guidance to pilots conducting operations under the night VFR (NVFR). This guidance highlighted that while suitably endorsed pilots may safely fly visually in night conditions where there is adequate celestial illumination or other sources of light, visual flight is significantly more hazardous in dark night conditions.

> There may be times when there is bright moonlight or extensive ground lighting available, making a night operation only a little more difficult than flying in daylight. However, there may be dark night conditions (i.e. without moonlight or significant ground lighting) that can make it very difficult to discern the natural horizon and maintain control of the aircraft by reference to external visual references.

The absence of a visible horizon during dark night conditions is a particular hazard. As highlighted by Gibb and others (2010), seeing a horizon is 'crucial for orientation of the pilot's sense of pitch and bank of the aircraft'. The *Night VFR rating* advisory circular identified this risk, noting:

> CASA strongly recommends that NVFR operations take place only in conditions that allow the pilot to discern a natural visual horizon or where the external environment has sufficient cues for the pilot to continually determine the pitch and roll attitude of the aircraft.

The ATSB's Avoidable Accidents publication *Visual flight at night accidents* identified that of 26 accidents during night visual meteorological conditions (VMC), [4] almost all occurred on dark nights. *Visual flight at night accidents* highlighted that:

> When flying over land or oceans without light sources, on dark nights with no visible moon, visual flight at night is essentially the same as instrument flight.

Requirements for emergency locator transmitters

An emergency locator transmitter (ELT) is designed to send a distress signal to a network of satellites in an emergency. The Civil Aviation Safety Regulations Part 91 (General Operating and Flight Rules) Manual of Standards (MOS) required aircraft to be fitted with an ELT. For flights such as that conducted by VH-LOS, aircraft may be equipped with an automatic ELT, which is fixed to the aircraft and designed to automatically activate in the event of a severe impact (g) forces. Alternatively, the ELT can be a manually activated and removable survival ELT, also referred to as personal locator beacons (PLB). The MOS required that if an ELT is a PLB, the pilot in command must ensure it is carried either on their person, in or adjacent to a life raft, or adjacent to an emergency exit.

VH-LOS was equipped with an ACR ResQLink 400 PLB. To activate the ResQLink, the user needed to first lift the antenna and expose the on/off button, then press the on/off button for 2 seconds.

The ATSB observed that the PLB remained inside the helicopter post-accident, and was attached to the helicopter's centre console. There was no apparent damage to the unit, and the battery was in-date. The antenna was in the folded-down position with the on/off button covered. There was not evidence that the pilot had attempted to operate the PLB after the accident.

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[4] Visual Meteorological Conditions (VMC): an aviation flight category in which visual flight rules (VFR) flight is permitted – that is, conditions in which pilots have sufficient visibility to fly the aircraft while maintaining visual separation from terrain and other aircraft.

Figure 4: ResQLink activation instructions (left) and condition in-situ at VH-LOS accident site (right). The image on the right shows the antenna and power button guard remained in the down position

Requirements for search and rescue notification

The Part 91 MOS required that for VFR flights conducted in a designated remote area, the pilot must submit a flight plan, nominate a SARTIME (search and rescue time) for arrival, or leave a flight note with a responsible person. The Airservices Australia publication *En Route Supplement Australia* showed designated remote areas within Australia. The Arafura Swamp, the accident site, and all other areas the helicopter was operating in in the days prior to the accident were within a designated remote area.

The Part 91 MOS described the requirements of the holder of a flight note, including that they must immediately contact the Joint Response Coordination Centre (JRCC) if the flight becomes overdue.

The pilot of VH-LOS did not leave a formal flight note, however, it was understood the pilot would meet the grader driver at a particular location. When the helicopter did not meet the grader driver or return to the camp on the evening of 14 November, it was understood by the members of the mustering operation that the pilot was overdue. However, they did not contact any authority that night. The first call to emergency services (a 000 call) was made after the helicopter wreckage had been found on the afternoon of 15 November.

One member of the mustering operation recalled that it was not uncommon for the pilot of VH-LOS to arrive later than expected, as the pilot sometimes conducted additional unplanned flights.

They also recalled that there had been occasions that the pilot had landed in an out-location and not returned until the following day.

When the helicopter did not return as expected on 14 November, members of the mustering group considered the possibility that the pilot had landed and were hopeful of the pilot returning the following day. They also considered the possibility that the pilot encountered problems and landed, and would be waiting to be found by road vehicles. In this context, members of the mustering group reported that they did not become highly concerned about the pilot until the morning of 15 November.

Related occurrences

Since the 2013 publication of *Visual flight at night accidents*, the ATSB has investigated multiple fatal accidents involving light helicopter pilots operating on dark nights in areas that did not contain any local ground lighting. Examples include:

- AO-2014-144: The ATSB found that the pilot, who did not hold a night VFR rating or instrument rating, continued flying towards the destination after last light (end of civil twilight), then in dark night conditions without local ground lighting, inadvertently allowed the helicopter to descend into terrain.
- AO-2016-031: The ATSB found that the pilot, who was only qualified to operate in day-VFR conditions, departed on a night flight and continued towards the destination in deteriorating visibility until inadvertently allowing the helicopter to descend into water.
- AO-2021-006: The ATSB found that the pilot, who did not hold a night VFR rating or instrument rating, continued flying towards their destination after last light, through the period of civil twilight and into astronomical twilight. In dark night conditions without local ground lighting the pilot inadvertently allowed the helicopter to descend into terrain.

Safety analysis

Flight after last light

The helicopter collided with terrain sometime after 1925 on 14 November 2022. There was no indication of any mechanical problem contributing to the collision with terrain, the helicopter had sufficient fuel on board, and there was no evidence of collision with a bird or another objects. A post-mortem examination indicated the pilot probably survived the accident, and there was no evidence of medical factors that would have resulted in the pilot becoming suddenly incapacitated.

Although the timing of the accident could not be precisely determined, aircraft tracking records indicate that the accident flight took place after nautical twilight. The pilot did not have a rating to fly at night under the VFR. VH-LOS was not equipped for flight by reference to the aircraft instruments, and the pilot did not have a rating for flight under the instrument flight rules.

The accident occurred in an extremely remote location with no nearby terrestrial lighting. On the evening of the accident, the moon rose late and provided no illumination for the accident flight. Depending on how long the aircraft flew prior to the collision with terrain, conditions would have become darker later in the evening, and cloudy conditions associated with a westerly-moving storm system may have further reduced visibility. Considering the last recorded position of the aircraft and the accident location, it is likely that the accident flight was in an easterly direction, meaning sunset was behind the direction of travel. As such, the ATSB concluded that the accident flight was conducted in dark night conditions due to the absence of both celestial and terrestrial lighting.

Spatial disorientation describes the phenomenon of a pilot becoming unable to correctly perceive the position, movement and orientation of their aircraft. When flying under the VFR, pilots rely on external visual cues to maintain spatial awareness, including the orientation of the aircraft (which

way is up), and the proximity to terrain. In dark night conditions, when there is no celestial illumination and no nearby terrestrial lighting, there are no external visual cues available to pilots. In such circumstances, spatial disorientation is highly likely unless pilots have access to and utilise aircraft instrumentation. This risk was highlighted in *Visual flight at night accidents*:

> In very dark environments, VMC is essentially the same as IMC[5] in terms of available external visual information. The only real difference is that lights on the ground may be seen in VMC. In remote areas where there are no lights or ambient illumination, there is essentially no difference. Pilots cannot see the ground and have no external visual cues available to assist with their orientation.

The decision by the day VFR qualified pilot to operate a helicopter which was not equipped for night flight after last light was inherently unsafe and increased the risk of unintentional collision with terrain. The dark night conditions on the night of the accident meant that regardless of the pilot's ability to fly using external visual cues at night, there were none. In these conditions, the pilot likely became spatially disoriented, and unintentionally allowed the helicopter to descend into the terrain.

The significant nose-down and left-side down attitude of the aircraft wreckage, and the short wreckage trail, were consistent with the pilot flying at slow speed and developing an unusual aircraft attitude in the moments prior to collision. The wreckage, being only 6 km from the last known position of the helicopter, indicates that the disorientation and collision occurred soon after the commencement of the flight in dark night conditions.

Survivability

The post-mortem examination identified that the pilot was probably not fatally injured by the collision with terrain. The damage to the helicopter seat indicated that the pilot was at least partially restrained by the seatbelt during the collision. However, considering to the absence of observed bruising associated with a seatbelt, it is possible that the pilot was either only partially restrained (by the lap belt only), or slipped out of the seatbelt in the collision. The direction of impact (lower left) and shoulder belt orientation (top right to lower left), are consistent with the latter explanation. After the collision, it is likely the pilot manoeuvred out of the buckled restraint, outside of the damaged helicopter which was laying on its side. With injuries reducing the pilot's mobility, the pilot likely planned to wait for rescue.

The post-mortem report further identified it was likely that the pilot succumbed to environmental exposure. There were up to 17.5 hours from when the helicopter collided with terrain and when the pilot was found deceased the following day. Although the pilot likely had a water bottle available and was shaded by the helicopter on the morning of 15 November, conditions were hot and humid. Therefore, this analysis examined the safety systems that could have led to the earlier recovery of the pilot.

Personal locator beacon

The mandatory carriage of emergency locating equipment is a risk control used to facilitate the prompt identification of aircraft accidents, and the timely and accurate response by emergency services. VH-LOS was equipped with a manually-activated PLB, however the pilot did not activate this beacon following the accident. Had the pilot activated the PLB, it is almost certain that a search and rescue response would have located the aircraft, increasing the likelihood the pilot would have survived the accident.

To ensure the PLB is accessible after a collision, regulations require the PLB is carried on the person of the flight crew or adjacent to an emergency exit. The PLB carried in VH-LOS was

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[5] Instrument meteorological conditions (IMC): weather conditions that require pilots to fly primarily by reference to instruments, and therefore under instrument flight rules (IFR), rather than by outside visual reference. Typically, this means flying in cloud or limited visibility.

secured to the centre console, which, in a small helicopter such as a Robinson R22, is nearby the aircraft exits and the pilot's seated position.

When the helicopter collided with terrain, conditions were dark and the pilot may not have been able to locate the PLB. Once outside the helicopter, in poor visibility and with limited mobility (due to the significant leg injury), the location of the PLB inside the helicopter was effectively inaccessible to the pilot. This highlights the advantage of carrying a PLB on the person of pilots, particularly in one-person operations.

VH-LOS was not equipped with an automatically activated ELT. As in this accident, manually activated PLBs may not be effective in situations where a pilot survives an accident but is incapacitated or is otherwise unable to access the PLB. An automatic ELT will provide another opportunity to alert search and rescue authorities in these situations.

Notification to emergency services

Regulations within the aviation industry require pilots to notify responsible persons of the details of flights, including a planned departure and landing time. The requirements then follow that the Joint Response Coordination Centre (JRCC) should be notified of a potentially missing aircraft, so that a search and rescue response should be initiated.

In this instance, members of the mustering operation at Ramingining became increasingly concerned about the wellbeing of the pilot during the night of 14 November. They conducted a land-based search on the night of 14 November, hoping that the pilot had landed and could be seen from the road. Becoming significantly concerned on 15 November, they requested some acquaintances to conduct an aerial search, which led to the identification of the deceased pilot. Throughout this time, no calls were made to appropriate authorities.

When the pilot was first identified as missing, the level of concern and the perceived urgency of the situation was influenced by previous experiences where the pilot had returned much later than expected. The mustering operations, being conducted in an extremely remote environment, involved a necessity to frequently resolve problems without the assistance of formal authorities. Furthermore, the members of the mustering operation (other than the pilot) had limited engagement with aviation systems and regulation.

While noting the circumstances which contributed to emergency services not been immediately notified in this instance, a prompt formal notification of a missing aircraft is the most effective action personnel on the ground can take. Emergency calls will result in the JRCC being notified, and the JRCC are capable of deploying very capable assets for finding a missing aircraft with minimal delay or at first light the next day.

Findings

ATSB investigation report findings focus on safety factors (that is, events and conditions that increase risk). Safety factors include 'contributing factors' and 'other factors that increased risk' (that is, factors that did not meet the definition of a contributing factor for this occurrence but were still considered important to include in the report for the purpose of increasing awareness and enhancing safety). In addition 'other findings' may be included to provide important information about topics other than safety factors.

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

From the evidence available, the following findings are made with respect to the collision with terrain involving Robinson R22 Beta, VH-LOS, near Ramingining, NT on 14 November 2022.

Contributing factors

- The pilot operated the helicopter after nautical twilight. However, the pilot did not have an appropriate qualification, and the helicopter was not suitably equipped, for night flight.
- The flight was conducted in dark night conditions due to the absence of both celestial and terrestrial lighting. As a result, the pilot likely became spatially disorientated which led to a collision with terrain.
- The pilot did not activate the personal locator beacon, which was probably inaccessible to the pilot once they left the helicopter after the accident. In addition, authorities were not notified when the aircraft was missing. In combination, this resulted in a delay to the pilot being located before succumbing to environmental exposure after sustaining survivable injuries in the accident.

General details

Occurrence details

Date and time:	14 November 2022- After 1925 Australian Central Standard Time	
Occurrence class:	Accident	
Occurrence categories:	Collision with terrain	
Location:	36.4 km 181 degrees from Ramingining Aerodrome, Northern Territory	
	Latitude: 12.6851° S	Longitude: 134.8898° E

Aircraft details

Manufacturer and model:	Robinson Helicopter Company, R22 Beta	
Registration:	VH-LOS	
Serial number:	1715	
Type of operation:	Part 91 General operating and flight rules-Other	
Activity:	General aviation / Recreational-Unknown general aviation flying	
Departure:	Near Arafura Swamp, Northern Territory	
Destination:	Near Arafura Swamp, Northern Territory	
Persons on board:	Crew – 1	Passengers – 0
Injuries:	Crew – 1 Fatal	Passengers – 0
Aircraft damage:	Destroyed	

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- persons involved in the mustering operation at Arafura swamp
- crew of the helicopters who searched for the helicopter after the accident
- Civil Aviation Safety Authority
- Northern Territory Police Force
- aircraft manufacturer
- recorded data from the flight tracking device on the aircraft

References

Australian Transport Safety Bureau, 2013, Avoidable Accidents No. 7 – Visual flight at night accidents: What you can't see can still hurt you. Australian Government, Canberra

Gibb, R., Gray, R. and Scharff, L., 2010. *Aviation visual perception: Research, misperception and mishaps*. Routledge.

Civil Aviation Safety Authority, 2022, Advisory Circular AC 65-05 v1.1 - Night VFR rating. Australian Government, Canberra.

Civil Aviation Safety Authority, 2023, Visual Flight Rules Guide. Australian Government, Canberra.

Submissions

Under section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. That section allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the following directly involved parties:

- the aircraft owner and operator
- the aircraft manufacturer
- the aircraft tracking device manufacturer
- the aircraft tracking service provider

No submissions were received.

Australian Transport Safety Bureau

About the ATSB

The ATSB is an independent Commonwealth Government statutory agency. It is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers.

The ATSB's purpose is to improve the safety of, and public confidence in, aviation, rail and marine transport through:

- independent investigation of transport accidents and other safety occurrences
- safety data recording, analysis and research
- fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia, as well as participating in overseas investigations involving Australian-registered aircraft and ships. It prioritises investigations that have the potential to deliver the greatest public benefit through improvements to transport safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, international agreements.

Purpose of safety investigations

The objective of a safety investigation is to enhance transport safety. This is done through:

- identifying safety issues and facilitating safety action to address those issues
- providing information about occurrences and their associated safety factors to facilitate learning within the transport industry.

It is not a function of the ATSB to apportion blame or provide a means for determining liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner. The ATSB does not investigate for the purpose of taking administrative, regulatory or criminal action.

Terminology

An explanation of terminology used in ATSB investigation reports is available on the ATSB website. This includes terms such as occurrence, contributing factor, other factor that increased risk, and safety issue.