AIRCRAFT ACCIDENT SHORT REPORT

CA18/2/3/9803: Helicopter crashed during a game capture operation after a low main rotor RPM condition while manoeuvring at low level.

Date and time	: 10 September 2019, 1210Z
Aircraft registration	: ZS-RMZ
Aircraft manufacturer and model	: Robinson Helicopter Company, R22 Beta
Last point of departure	: The Hills Eco Estate
Next point of intended landing	: The Hills Eco Estate
Location of accident site with reference to easily defined geographical position (GPS readings if possible)	: The Hills Eco Estate, GPS position: 25°51'09.40" South 028°21'01.60" East
Meteorological information	**:** METAR FAWB 101200Z 27009KT CAVOK 31/00 Q1018
Type of operation	: Private (Part 91)
Persons on-board	: 1 + 0
Injuries	: Minor
Damage to aircraft	: Substantial

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Purpose of the Investigation:

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (2011), this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and ***not to apportion blame or liability.***

Disclaimer:

SYNOPSIS

1.1 On Tuesday afternoon, 10 September 2019, at approximately 1210Z, a pilot who was the sole occupant on-board a Robinson R22 helicopter was involved in a game capture operation in which twenty-one (21) zebras were earmarked to be captured from an Eco Estate. While manoeuvring at low level, herding some zebras towards the boma, the pilot reported that while executing a tight right turn the helicopter encountered a low main rotor revolution per minute (RPM) condition. The pilot was unable to recover the helicopter from the low main rotor RPM condition before its tail rotor blades struck several tree branches and the entire tail rotor assembly separated from the tail boom. The helicopter crashed and came to rest on its right side in dense bush-type terrain.

1.2 The pilot suffered minor cuts and bruises. The helicopter was substantially damaged during the accident sequence.

1.3 The investigation revealed that the pilot manoeuvered the helicopter at low level during a game capture operation in high density altitude conditions. The helicopter encountered a low main rotor RPM condition, which the pilot was unable to recover from. The helicopter's tail rotor struck a tree, causing the pilot to lose control and the helicopter to crash.

2. FACTUAL INFORMATION

2.1 History of flight

2.1.1 On Tuesday afternoon, 10 September 2019, the pilot had arrived at an Eco Estate, east of Pretoria, to assist a ground game capture team in catching 21 zebras. The ground team had erected the boma on the morning of the flight. The helicopter was towed on a trailer behind a light delivery vehicle to the location. According to a bystander, the pilot had performed a detailed pre-flight inspection of the helicopter before he became airborne from the trailer. Both doors were removed for the purpose of this flight and the pilot was the sole occupant on-board the helicopter.

2.1.2 The boma was erected between the boundary fence of the estate on the one side and there were some high-tension wires on the other side. This terrain is rocky and has a down slope as it is a mountainous area. The pilot stated that he managed to herd the first two groups of zebras into the boma, which comprised of 12 animals.

He further stated that the wind was blowing from the south when he started, and it changed to south-westerly as the day progressed. He further stated that when turning downwind, he noted that he needed to apply substantially more power to maintain the main rotor RPM. Being aware of the situation, he aimed to complete each turn into wind.

2.1.3 The third group of zebras', which consisted of 4 animals — included a foal that was being protected by its mother — was headed towards the boma. Two of the animals entered the 'main gate' of the boma and the other two turned away from the gate. The pilot stated that he descended to put pressure on them to stop them from running into the bush. He then initiated a climb and a left turn to give himself more space between the zebras and the 'main gate'. He continued with a right turn to position the helicopter into wind and entered hover flight when *"he realised he had run out of power and started going down".* The pilot was unable to recover from the low main rotor RPM condition due to him being too low and too slow. The tail rotor blades then struck several tree branches and separated from the tail rotor hub assembly; the tail rotor hub and gearbox assembly then separated from their attachments on the tail boom. The helicopter yawed approximately 90° to the left before it impacted a tree, rolled over to the right and came to rest in a nose-down attitude.

2.1.4 Low main rotor RPM

Source: Robinson R22, Flight Training Guide, Manoeuvre Guide

"During a low main rotor RPM (revolutions per minute) situation an audio warning will activate as well as an amber caution light will illuminated on the instrument panel. The recovery technique for the pilot would be to simultaneously add throttle and lower the collective pitch lever to regain operating RPM. A gentle aft cyclic movement will help the recovery, but the primary recovery controls are the collective and throttle. The pilot will need to avoid any forward cyclic input, which will inhibit RPM recovery. Once RPM is regained, slowly raise the collective to reduce the sink rate, while closely monitoring the RPM."

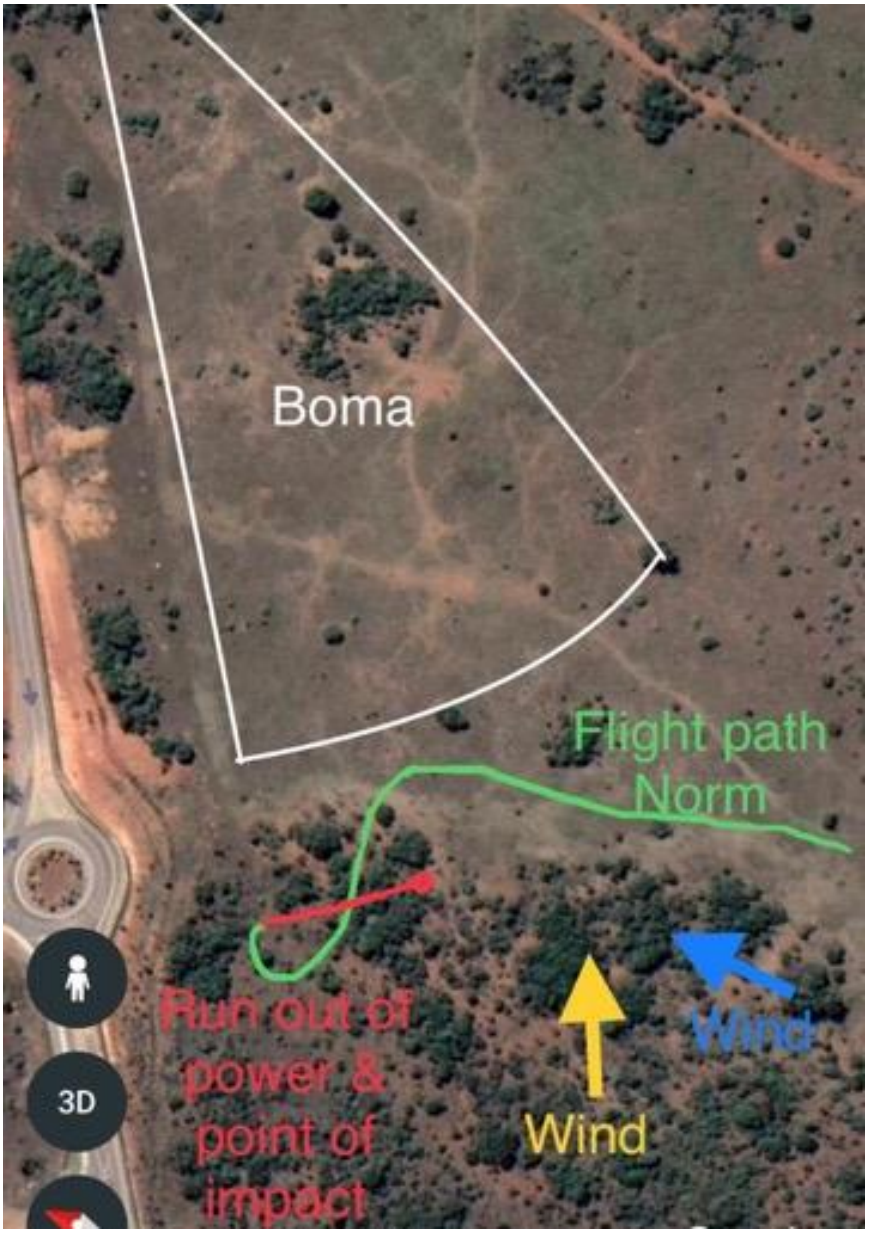

Figure 1: Google Earth overlay indicating the flight path of the helicopter. (Courtesy of the pilot)

2.1.5 The helicopter sustained substantial damage, but the cockpit/cabin area remained intact. The pilot, who was properly secured by the three-point safety harness, sustained minor cuts and bruises.

Figure 2: The helicopter as it came to rest on its right side.

Figure 3: The vertical stabiliser assembly that broke off was found lying below the tail boom.

Figure 4: A different view of the helicopter as it came to rest.

Figure 5: Aft view of the helicopter as it came to rest.

Figure 6: Damage to some of the tree branches, caused by contact with the tail rotor blade.

Figure 7: One of the fractured tail rotor blades that was located on-site.

Figure 8: The tail rotor gearbox and hub assembly as they were found on-site.

2.1.6 The accident occurred during daylight conditions at a geographical position that was determined to be 25°51’09.40” South 028°21’01.60” East, at an elevation of 4 896 feet (ft) above mean sea level (AMSL).

2.1.7 Fine weather conditions prevailed on the day. The Meteorological Aerodrome Report (METAR) for Waterkloof Air Force Base (FAWK) was not available for 1200Z but the data was available for 1300Z, which is reflected below. The data is limited to the wind direction which was captured at 260° and at the speed of 4 knots.

METAR FAWK 101300Z AUTO 26004KT //// // ///// ///// Q1020=

Due to limited content, the METAR for Wonderboom Aerodrome (FAWB) was obtained for 1200Z on the day of the accident. The data in this METAR was measured 10 minutes prior to the accident. The temperature at the time was measured at 31°C, with the wind blowing from the west at 9 knots.

METAR FAWB 101200Z 27009KT CAVOK 31/00 Q1018=

By the time the investigator arrived on-site, which was approximately 2½ hours after the accident occurred, there was no wind and clear sky conditions prevailed. The pilot questionnaire indicated the temperature to be 27°C at the time of the accident. Source for calculating density altitude: http://www.pilotfriend.com/pilot_resources/density.htm

Density altitude (FAWB data)

Elevation	4 896ft
Air temperature	31°C
Altimeter setting	1018
Dew point	0°C
Density altitude	**7 541ft**

The helicopter was operated during high-density altitude conditions.

2.1.8 Pilot-in-command (PIC)

The pilot, who was 32 years old, was the sole occupant on-board the helicopter. He held a valid commercial helicopter pilot licence with a total of 5012.5 flying hours, of which 230.4 were on the Robinson R22 type helicopter. The pilot was in possession of a valid cull/livestock rating and held a valid Class 1 aviation medical certificate with an expiry date of 30 June 2020.

2.1.9 Weight and Balance

Item	Weight (lbs)	Arm (inches)	Moment (in - lb)
Helicopter basic empty weight	870	104.1	90 567.0
Remove right door	-5.2	77.5	- 403.0
Remove left door	-5.2	77.5	- 403.0
Pilot weight (85kg) and baggage (right seat)	200	78.0	15 600.0
Baggage underneath the left seat	40	78.0	3 120.0
Zero usable fuel weight	**1 099.6**	**98.6**	**108 481**
Useable fuel main tank	50	108.8	5 440.0
Useable fuel auxiliary tank	26	103.8	2 698.8
Take-off gross weight	**1 175.6**	**99.2**	**116 619.8**

The maximum take-off weight (MTOW) for this helicopter is 622 kilograms (kg) (1 370 pounds), according to the Pilot's Operating Handbook (POH).

A total of 19 bottles of engine oil were recovered on-site (see Figure 9) with most of the oil stored in the baggage hold underneath the left seat. The volume of each bottle was 946 millilitres (ml), with a specific weight of 889 grams (g) per bottle, which amounted to a total weight of 16.9kg (37.3lbs). The dual controls, which consisted of the cyclic, collective pitch lever and the yaw pedals were also located in the baggage hold underneath the left seat. The weight of the dual controls amounted to 1.2kg (2.6lbs).

Figure 9: The 19 bottles of engine oil that were recovered from the cockpit/cabin area.

The pilot's headset was located inside the cockpit. His headset bag was in the baggage hold underneath his seat. His pilot licence booklet was found inside the headset bag, as well as a spare set of penlight (AA) batteries for his headset. There was also a first aid kit on-board.

The last time the helicopter was weighed prior to the accident flight was on 12 February 2018.

The helicopter was operated within the weight limitation as stipulated in the POH.

3. FINDINGS

3.1 The pilot was in possession of a valid commercial helicopter pilot licence issued on 19 February 2009 with an expiry date of 7 July 2020. He had the helicopter type endorsed on his licence.

3.2 The pilot was in possession of a valid aviation medical certificate (Class 1) issued on 25 June 2019 and valid until 30 June 2020.

3.3 This operation was a private flight.

3.4 The helicopter was in possession of a valid Certificate of Airworthiness, which was issued on 7 June 2018 with an expiry date of 30 June 2020.

3.5 The Certificate of Release to Service for this helicopter had been issued on 26 April 2019 with an expiry date of 25 April 2020 or at 5 944.6 airframe hours, whichever comes first.

3.6 The last annual inspection carried out on the helicopter prior to the accident flight was certified on 16 April 2019 at 5 844.6 airframe hours. A further 3.7 hours had been flown with the helicopter since the inspection.

3.7 The pilot sustained minor cuts and bruises in the accident sequence and the helicopter was substantially damaged.

3.8 The prevailing wind at the time of the flight was south south-easterly at 7 knots, and the temperature was 27°C, according to the pilot.

3.9 The density altitude was calculated to be approximately 7 541ft, which would have had a substantial degraded effect on the normally aspirated engine power output during the flight.

3.10 The weight of the helicopter at the time was within the weight limitations as stipulated in the POH for this helicopter type, even though there were 19 bottles of engine oil on-board at the time of the accident.

3.11 By the time the investigator arrived on-site, the boma had been taken down and the game capture team had left the estate. The pilot had also left the scene with the trailer on which the helicopter was transported.

3.12 The investigation revealed that the pilot manoeuvered the helicopter at low level during a game capture operation in high-density altitude conditions. The helicopter encountered a low main rotor RPM condition, from which he was unable to recover. The tail rotor struck a tree, causing the pilot to lose control and the helicopter to crash.

4. PROBABLE CAUSE

4.1 The pilot manoeuvered the helicopter at low level during a game capture operation in high-density altitude conditions. The helicopter encountered a low main rotor RPM condition, from which he was unable to recover. The tail rotor struck a tree, causing the pilot to lose control and the helicopter to crash.

5. CONTRIBUTING FACTOR

5.1 High-density altitude conditions prevailed at the time of the flight.

5.2 The manoeuvring area of the helicopter was limited by high-tension wires on the one side and the estate perimeter fence on the other side. The terrain was also rocky and mountainous, which made it difficult to herd the animals to the boma.

6. REFERENCES USED IN THE REPORT

6.1 Robinson R22 POH.

6.2 Density altitude calculation. Source: http://www.pilotfriend.com/pilot_resources/density.htm

6.3 METARs from the South African Weather Service (SAWS).

7. SAFETY RECOMMENDATION

7.1 None.

8. ORGANISATION

8.1 According to the pilot, this was a private flight.

9. Appendices

9.1 None.