Coroners Act, 1996
[Section 26(1)]

Western Australia

RECORD OF INVESTIGATION INTO DEATH

Ref No: 21/13

I, Alastair Neil Hope, State Coroner, having investigated the deaths of ***Bradleigh Michael ROULSTON and Daniel Joseph KEAN****, with an Inquest held at Perth Coroners Court on 20-24 May 2013 find that the identities of the deceased persons were* ***Bradleigh Michael ROULSTON and Daniel Joseph KEAN*** *and that death occurred on 13 February 2008 at Kennedy Range National Park as a result of Multiple Injuries in the following circumstances -*

Counsel Appearing :

Sergeant Lyle Housiaux assisting the State Coroner
Carol Conley (State Solicitor's Office) appeared on behalf of the Department of Environment and Conservation and the Department of Agriculture
Brian Morgan (DLA Piper) appeared on behalf of All Sky Helicopters Pty Ltd, William Maher and Dr Anthea Henwood
John Taylor, Principal Lawyer, ATSB appeared for Stuart MacLeod

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INTRODUCTION

Daniel Joseph Kean and Bradleigh Michael Roulston (the deceased men) died on 13 February 2008. The two men had been in a Piper Aircraft Corporation PA-18 Super Cub light aircraft (the Super Cub) which was involved in a mid-air collision with a Robinson Aircraft Company R44 Raven helicopter (the R44 helicopter). In the collision the helicopter rotor blades severed both wing lift struts of the right wing of the Super Cub, following which the Super Cub crashed upside down into the ground. As a result of the crash both men died and subsequent post mortem examinations revealed that both died as the result of multiple injuries.

Following the mid-air collision the pilot of the helicopter retained sufficient control of it to land the helicopter safely and its occupants did not suffer any injuries.

At the time of the collision the two aircraft had been involved in goat culling activities organised by the Department of Environment and Conservation (DEC).

At the time of the collision Bradleigh Roulston was the pilot of the Super Cub and he was 23 years of age. Mr Roulston held a Commercial Pilot (Aeroplane Licence) which had been issued on 20 April 2006. He held the required aircraft class and design feature endorsements to operate the Super Cub.

The Super Cub was owned by Norwest Air Work Pty Ltd, operated by Eric Roulston, the deceased's father. The company had contracted to provide the Super Cub and pilot for the goat culling work.

At the time of the incident Daniel Kean was employed by DEC and was working as a spotter. He was 39 years of age. His task in the aircraft was to locate goats for culling.

The primary role of the Super Cub's occupants was to assist those in the R44 helicopter to locate the feral goats for culling.

The expectation was that the Super Cub was to fly at a higher altitude than the R44 helicopter. The occupants of the Super Cub were to locate goats and contact those in the R44 helicopter who would then cull the goats.

The pilot of the R44 helicopter was William Joseph Maher. Mr Maher had flown for the helicopter operator, Helidoc Pty Ltd, since 1997 performing aerial work and charter operations. He held a Commercial Pilot (Helicopter) Licence that was issued in 1994 and was endorsed on the R44 in 1997. He also held an Agriculture Pilot (Helicopter) rating Grade 2, and an approval to undertake aerial stock mustering operations.

The helicopter was owned by All Sky Helicopters Pty Ltd and the operator was Helidoc Pty Ltd trading as BB Helicopters

and Fitzroy Helicopters which had contracted to provide the helicopter and pilot.

Mr Maher had considerable experience with more than 4000 hours operation of R44 helicopters and he estimated that about one-third of his flying experience was gained conducting operations in the vicinity of other aircraft, principally other helicopters.

Also in the helicopter was a shooter, Michael William Elliott. Mr Elliott was employed by the Department of Agriculture and Food, Western Australia (DAF). His normal employment was as a Bio Security Officer and in his role as a marksman he was seconded to DEC.

Mr Elliott's role was to lean out of the helicopter when it was flying at a very low altitude and to shoot feral goats using a rifle.

The only surviving witnesses to the incident were Mr Maher and Mr Elliott.

There were no other aircraft in the area when the collision took place between the Super Cub and the R44 helicopter and it was obvious that the collision could have been avoided. This inquest was held in order to determine how the deaths occurred and whether it would be possible to make recommendations with a view to avoiding deaths from occurring in similar circumstances in future.

THE GOAT CULLING EXERCISE

On 13 February 2008 the Department of Environment and Conservation (DEC) with support from the Department of Agriculture and Food (DAF) was conducting aerial goat shooting operations in the Kennedy Range National Park in the Gascoyne region of Western Australia. The operations involved the use of the two aircraft involved in the collision.

Evidence at the inquest revealed that feral goats cause a significant problem in large areas of Australia and at the time were posing particular problems for the Kennedy Range National Park.

DEC was responsible for operations on the land that it managed under the *Conservation and Land Management Act 1984 (WA)*. DAF had statewide responsibility for dealing with vertebrate pests.

During the period 1991-2002 DEC participated in a feral goat eradication program coordinated by DAF but that program was abandoned in 2003 when the status of feral goats was changed to stock.

In 2006-2007 DEC received special funding for a three year statewide biodiversity conservation initiative and as part of this a program of aerial goat control in a number of key locations was approved.

In both 2007 and 2008 projects were endorsed which included culling of feral goats. The Kennedy Range location was chosen to be part of the project because the goat population there was in very difficult terrain which precluded standard procedures such as mustering or trapping on waters from being effective.

In respect of the 2008 shooting the planning phase was completed in February 2008 and a shoot plan was prepared by a Shoot Controller using a template from the previous year's operations.

On 11 February 2008 aerial shooting operations commenced. Four sorties were successfully conducted during the day, between sunrise and sunset.

The plan was that each sortie for the shoot would be of between about 2 to 3 hours.

On Tuesday 12 February a further four sorties were successfully conducted.

On Wednesday 13 February the first sortie commenced at 7.04am with operations planned to take place in the northern area of the National Park. Radio communication difficulties were experienced in the Super Cub and both aircraft were landed so that the communication problem could be addressed. The difficulty was relatively straightforward and the program continued.

As a result of the disruption caused by the radio failure, the flying operations scheduled for the day were reduced to three sorties (from the four originally planned).

During the early afternoon the Cub owner/operator (Mr Eric Roulston) flew into Gascoyne Junction and successfully fixed the radio problem.

With the radio problems fixed, the second sortie for the day was conducted from 2.32pm to 4.55pm.

The third and final sortie for the day commenced at 6.07pm. The sortie started off as normal. In accordance with the shoot plan half hourly search and rescue (SAR) calls were made to the operating base at 6.35pm and 7.02pm.

The SAR call expected by 7.32pm was not received. At 7.35pm the Shoot Controller commenced "uncertainty phase" SAR procedures and repeatedly attempted to contact the Super Cub and the R44 helicopter using the portable UHF radio used for SAR watch. When the Shoot Controller received no response he attempted calling the Super Cub and R44 helicopter using a more powerful radio fitted in a DEC vehicle without success. In the final attempt to contact the Super Cub and R44 helicopter by radio, the Shoot Controller drove up to the airstrip which was at a higher elevation, but again attempts at contact were unsuccessful.

Tragically the two aircraft had collided at about 7.15pm.

While the Shoot Controller had been attempting radio contact with the Super Cub and R44 helicopter a telephone call was received at the Gascoyne Junction Hotel where an off duty DEC spotter had been taking a scheduled rest break. The call was from Fitzroy Helicopters and advised that the pilot of the R44 helicopter had just called using his satellite phone to advise that there had been a mid-air collision and that the pilot and passenger in the Super Cub had been killed.

THE CIRCUMSTANCES SURROUNDING THE CRASH

The last approximate 15 minutes of the flight immediately prior to the collision was plotted by the ATSB using GPS track data for both aircraft. It appears that both aircrafts' onboard GPS units recorded their respective aircraft's position at 30 second intervals.

The map overleaf is taken from the ATSB Safety Report (Aviation Occurrence Investigation – AO-2008-010 Final report at Figure 2, p2).

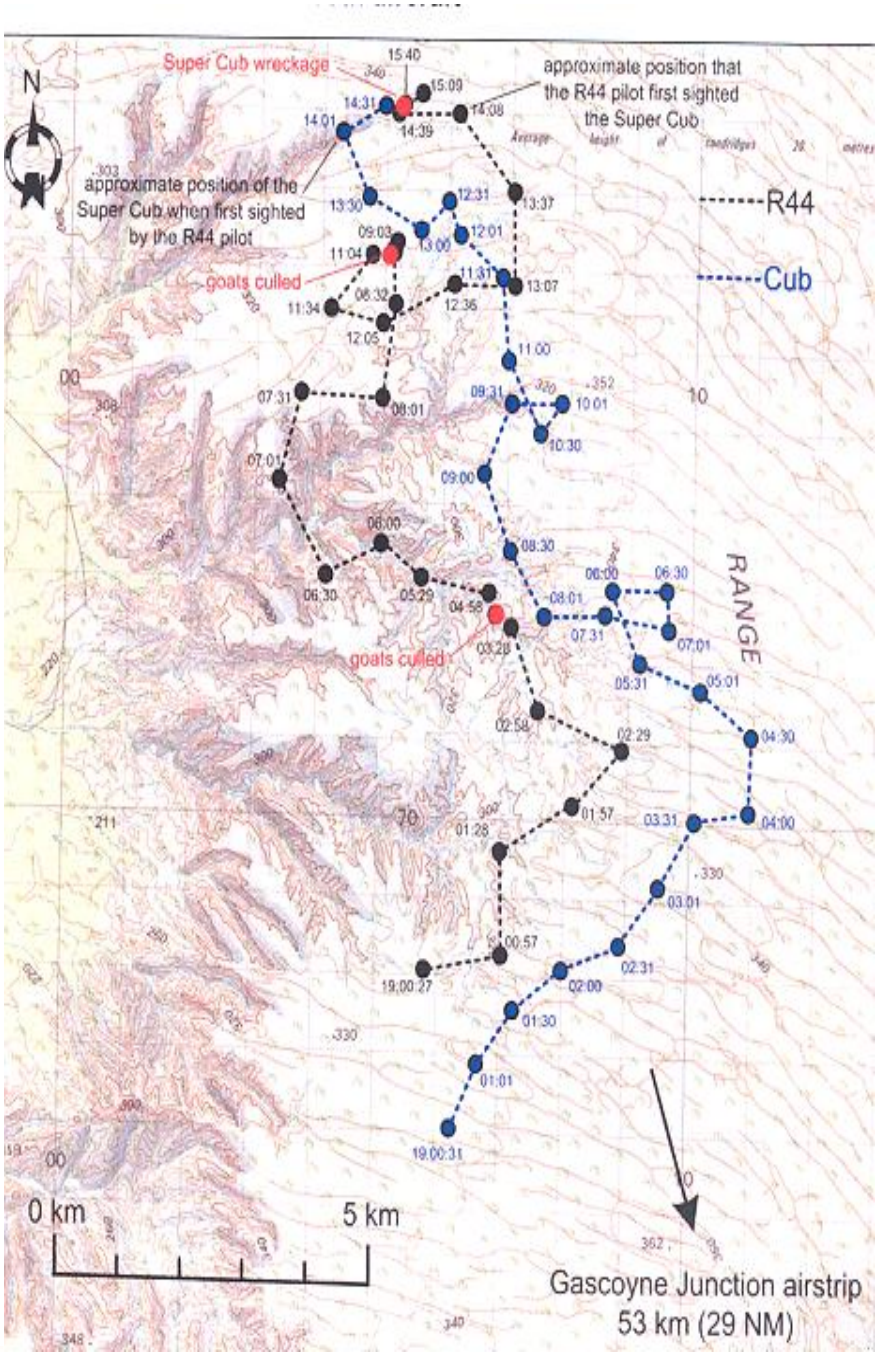


Figure 2 – GPS Track Data for both Aircraft contained in ATSB Transport Safety Report Aviation Occurrence Investigation[1]

It is clear from an examination of the map that in the 15 minutes prior to the crash the two aircraft were separately searching for goats and on two occasions the occupants of the

[1] Exhibit 4 page 2

helicopter were involved in goat culling, unassisted by the occupants of the Super Cub.

Measured distances which the aircraft were apart at the various intervals were calculated and provided to the court by Mr Morgan on behalf of All Sky Helicopters Pty Ltd and Mr Maher in a document titled, "time versus distance apart".[2]

It is clear from this comparison that until shortly before the collision the two aircraft were generally a significant distance apart, from about 6.3 kms to 1.2 kms.

The paths of the two aircraft converged immediately before the collision.

Mr Elliott, the marksman in the helicopter, provided police with a statement on the day after the collision, he later provided a further statement which was undated and unwitnessed but which he believed was completed in 2010, and he gave evidence at the inquest.

According to Mr Elliott, immediately before the collision he was in the R44 helicopter looking for goats and saw the Super Cub approaching in the distance. He stated that the plane appeared to be about 500 metres away but on the same height and to their left.

[2] Exhibit 3

He stated that this was unusual as normally the plane would be much higher.

He stated that he pointed the plane out to Mr Maher, but he had already noticed it.

According to Mr Elliott, he then turned away from looking at the plane and started looking for more goats. Neither he nor Mr Maher said anything about the approaching plane, even though the circumstance was unusual.

In his statement to police dated 14 February 2008 Mr Elliott recalled: *"I did notice the plane start to peel off to his right, away from the helicopter".*[3]

He went on to state that Mr Maher turned to follow the plane, turning to his left.

He stated that as they went around a bucket of full magazines shifted across on the floor of the helicopter pushing his foot towards a communication button located on the floor. He said that he reached down and with his right hand pushed the bucket away towards the console.

He stated that as he bent over he felt the helicopter lift and then later heard a loud bang and the helicopter was moved sideways.

[3] para 25.

Mr Elliott stated that, *"Butch [Mr Maher] said something like 'What the fuck was that?'."* He stated that he was hanging on and Mr Maher was wrestling with the helicopter.

In his evidence Mr Elliott recalled that when he saw the plane approaching it, the helicopter was *"probably a little lower"* than the plane. This was disputed by Mr Maher in his evidence.

In evidence Mr Elliott stated that he could not now be sure that it was Mr Maher who had said *"What the fuck was that?"*. In evidence Mr Maher claimed that it was Mr Elliott who made that comment.

The significance of who made this comment was that if it was Mr Maher, the comment appeared to indicate that he did not see the plane immediately before the collision.

In respect of this inconsistency, I note that Mr Elliott again attributed the comment to Mr Maher in his statement made in 2010 and I consider it most unlikely that Mr Elliott would have made an error in that regard in his account to police on 14 February 2008, very shortly after the incident.

Mr Maher provided police with a statement on 15 February 2008 in which he described first seeing the plane flying towards them when it was about 4 kms away. He stated that at that time the helicopter was at about 300 feet above ground level.

He stated that they were on a "converging course" and that he noticed the plane make a "level turn to his right".

In his statement to police he gave the following account in relation to the collision:

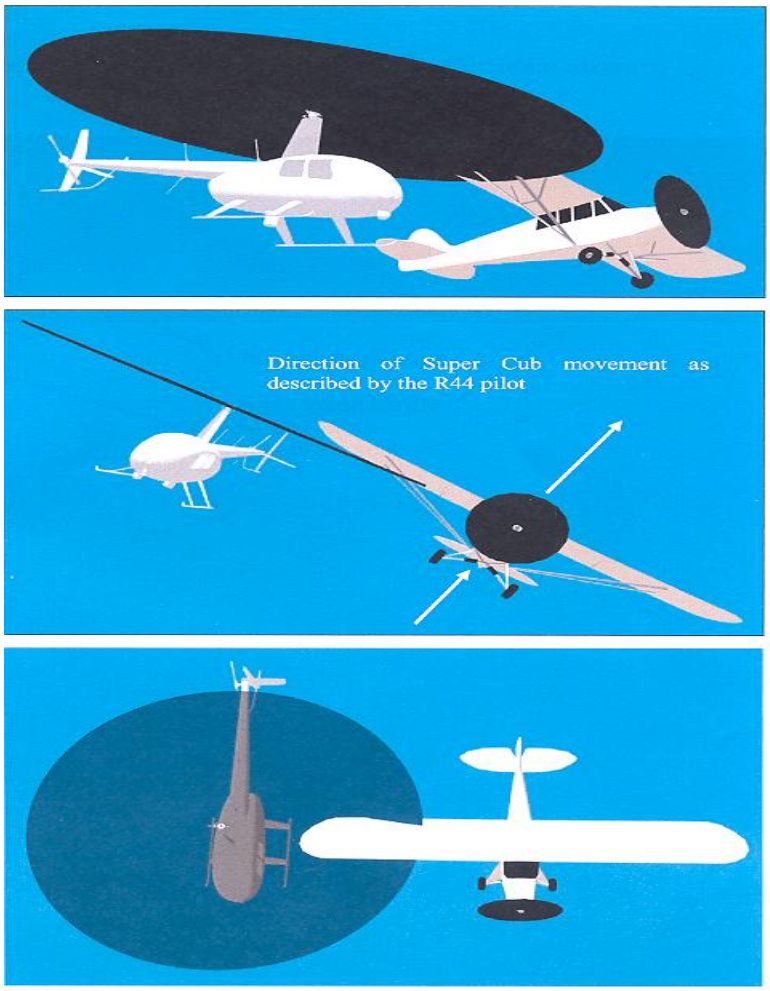
> I started a climbing turn to the left. This was primarily to return to our search area and to keep Brad in sight. I didn't want to be at the same height so that is why I made a climbing turn.
>
> During my turn I observed Brad level out. I was still climbing.
>
> Brad passed underneath me as he levelled out.
>
> I can't say how far beneath me he passed.
>
> I was still climbing to the left in a bank.
>
> Both aircraft were now facing in a roughly easterly heading.
>
> The last thing I saw of Brad's plane was his right wing tip as he passed under me.
>
> The wing tip appeared to be rising towards me.
>
> I steepened my turn to the left and increased power.
>
> Brad's wingtip was still rising towards me.
>
> There was a massive jolt in the helicopter. This caused the emergency beacon in my helicopter to go off. This caused a loud siren to go off in my headset.

In evidence Mr Maher stated that although in his statement he had made the observation, *"I noticed Brad make a level turn to his right"*, he considered that the plane did not make a full turn but only deviated a relatively small distance off course to the right.

He gave evidence that he believed the plane went approximately 80-100 feet underneath the helicopter and to the left of it as they passed each other.

OBJECTIVE EVIDENCE PROVIDED BY THE ATSB

The ATSB conducted a comprehensive examination of both aircraft and came to the conclusion that the rotors of the helicopter struck the struts underneath the right wing of the plane when the aircraft were in relative positions as shown in Appendix A to the report (reproduced below).



In addition it appears that the ATSB were provided with a photograph of the front of the helicopter which showed paint

transfer which was consistent with contact with the end of the wing of the plane and a copy of this photograph was provided in the report at Figure 10. In respect of that paint transfer it appears that this may have occurred after the initial collision and that was the understanding of Mr Elliott.

This evidence revealed that at the time of contact the rotors of the helicopter were underneath the wing of the plane and first contact was with the struts under the right wing following which it appears that the wing tip of the plane struck the front of the helicopter a glancing blow.

The relative positions at impact appear to be consistent with the helicopter rising up into the plane, not the other way round as suggested by Mr Maher.

The positions at impact were consistent with Mr Elliott's recollection that when they passed each other the plane was higher than the helicopter.

According to Stuart MacLeod, Senior Transport Safety Investigator with the ATSB who spoke to the ATSB Report, it would be possible for the wing of the Super Cub to have gone from below, between the rotating rotors of the helicopter, to above the rotors, without the rotors striking the wing, and so Mr Maher's account of the plane climbing up into the rotors of the helicopter was a possibility.

I accept that this is a theoretical possibility, however, if the wing of the plane and the rotors of the helicopter had not been aligned on a near identical plane, the speed of climb necessary to clear the rotors would have been unrealistically great and I do not consider that this was a likely scenario.

IMPORTANT QUESTIONS AT THE INQUEST

Important questions for the inquest were as follows:

The Separation of the Aircraft

1. Why were the aircraft flying at the same elevation towards each other, as a general rule the plane should have been flying significantly higher than the helicopter and at all times there should have been safe separation between the two?

The decision of the helicopter pilot to make a left turn

2. When the aircraft were travelling towards each other why did the pilot of the helicopter turn to the left? The relevant rule understood by all concerned was that in the event of aircraft approaching each other a collision should be avoided by each turning to the right, thereby turning away from each other. It appeared difficult to understand why the pilot of the helicopter turned to the left at all. In addition it appeared difficult to understand why the pilot of the helicopter climbed to a higher altitude when the accepted approach was for the helicopter to be below the plane.

The lack of response of the pilots to the fact the aircraft were converging

3. Why did the pilots of the two aircraft not react more positively when the aircraft were converging? It appears that they spoke on the radio shortly before the collision and that there was no concern raised during that brief discussion even though the pilots did see that they were on a converging course. Particularly as the aircraft came within close proximity to each other it appears surprising that there was no radio contact between the pilots.

Dealing with these issues in turn I make the following observations:

1. THE SEPARATION OF THE AIRCRAFT

There were no formalised operating procedures in place detailing the conduct of pilots of aircraft involved in culling operations which would have required a specified separation between the aircraft.

This was seen as a contributing safety factor in the collision by the ATSB investigators.

While it was recognised by all concerned that separation was an important issue, there appeared to be a lack of clarity as to precisely what was required.

Neither DEC nor DAFWA had put in place any protocols or guidelines which detailed required separation between aircraft and there were no applicable Civil Aviation Safety Regulations.

Witnesses gave different accounts as to what they understood the separation distances should be. Andrew Longbottom, a shooter employed by DAF, gave evidence and provided a statement in which he claimed that following a meeting in Exmouth separation differences were discussed in the presence of both pilots and it was agreed that the helicopter was not to go above 400 feet and the plane was not to go below 500 feet above ground level (AGL). This would have involved a separation of only 100 feet and in evidence Mr Maher stated that he would not have been agreeable with such a short distance of required separation.

Eric Roulston, the father of the deceased Bradleigh Roulston and his employer, himself an experienced pilot, gave evidence that he understood that in these circumstances the expectation was that the spotter aircraft should be higher than 800 feet with the helicopter operating below 300 feet. He understood that there was some form of legal obligation for there to be at least a 500 feet separation between aircraft involved in such activities.

While I do consider that it would have been helpful in the circumstances for there to be a very clearly determined required distance of separation, in this case it is clear that both pilots were aware of the importance of remaining separated.

In addition there was the well known "see-and-avoid" rule (see CAR (163A)) which imposed a responsibility on flight crew to maintain vigilance to see and avoid other aircraft. Clearly it was an unsafe situation for the two aircraft to be approaching each other at the same altitude and this should not have occurred.

In understanding the problems associated with maintaining adequate separation between small aircraft of the type involved in this collision, it is important to recognise the fact pointed out by Senior Constable Troy Baker in his excellent police report to the coroner, that pilots of these small aircraft rely heavily on visual height estimation. The altimeters in these aircraft only display height above sea level, not height above terrain. While the approximate terrain height may be known at various times by the pilot, it is not possible for a pilot to always be aware of his height above terrain using instruments alone.

In this case, while the pilots may have communicated with each other to ensure that their altimeters were displaying consistent readings, this would not have avoided the difficulty, particularly as the terrain in the vicinity of the collision was uneven.

As indicated earlier in these reasons it appears clear that for at least the 15 minutes prior to the collision the two aircraft were on different courses searching separately for goats until a time when their paths converged. Had they been working together I consider it likely that both pilots would have ensured that the

helicopter was flying much lower than the plane, but in the circumstances when they were both searching for goats it is perhaps not surprising that the helicopter may have been flying higher than usual while the plane may have been flying significantly lower than usual.

The situation was potentially complicated by issues relating to fatigue to be considered later herein.

2. THE DECISION OF THE HELICOPTER PILOT TO MAKE A LEFT TURN

In respect to the question why it was that the pilot of the helicopter turned to the left and not to the right and did not go low, Mr Maher gave evidence that he was endeavouring to keep the plane within his vision and believed that the plane was significantly lower than the helicopter.

He stated that he had "no reason to turn to the right" because they were not on the same heading and they were not on an "exactly" converging course. He said that the rule which requires pilots of converging aircraft to turn to the right only applies if they are going to collide.

In my view this did not adequately explain the decision to turn to the left. The aircraft in fact went into a converging course which resulted in the mid-air collision. There was clearly not adequate separation for safety and the rule to the effect that converging aircraft should each turn to the right is intended to ensure that

good separation is achieved quickly. If this occurs the need for constant visual monitoring is greatly reduced.

3. THE LACK OF RESPONSE BY THE PILOTS TO THE FACT THE AIRCRAFT WERE CONVERGING

In respect of the failures of the pilots to react more and to communicate by radio, Mr Maher gave evidence that he regrets this did not happen but was not aware of the emergency situation arising until about the time of the contact.

In my view it is obvious from the fact that the aircraft collided that one or both of the pilots was not able to see the other aircraft at the time of the collision. In addition it is obvious that both pilots failed to take robust action to ensure that the aircraft did not come close to each other.

I consider it most likely that each of the pilots was unable to see the other aircraft immediately before the collision and this explains the lack of evasive action. Had Mr Maher seen the aircraft close to the helicopter, for example, I am confident that with his skill as a pilot and the manoeuvrability of the helicopter he would have been able to take effective evasive action.

I am, however, entirely confident that both pilots were both competent and safety conscious and that neither pilot would have taken any deliberate action which he considered could be unsafe.

How it was that the pilots allowed such a dangerous situation to occur is difficult to determine and in that context I am convinced that fatigue must have played an important role.

It was suggested at the inquest that one possible explanation for low flying of the Super Cub could have been that the pilot may have inadvertently turned off the fuel while changing fuel tanks. It was also suggested that some form of unidentified mechanical failure might have caused the Super Cub to be flying lower than expected. I consider that these explanations are extremely unlikely. Mr Maher gave evidence that the pilots spoke to each other by radio after they had seen each other flying at about the same altitude and though he could not recall precisely what was said, he was satisfied that Mr Roulston was not raising any concerns. Had the Super Cub run out of fuel or had Mr Roulston been searching for a location to land after the plane experienced some form of mechanical failure, I consider it most unlikely that he would have failed to draw those matters to Mr Maher's attention during this radio call.

2. THE QUESTION OF FATIGUE

The plan in relation to the goat culling exercise was that there would be four sorties flown each day of between approximately two to three hours. It was planned that there would be a significant break in the middle of the day when temperatures were hottest.

In respect of the spotters and shooters, arrangements were in place for relief so that fatigue would be reduced, but in the case of

the pilots there was no relief and the pilots were expected to fly in each sortie.

While both pilots were undoubtedly well aware of fatigue issues and could have cancelled flights in the event that they were suffering from fatigue, it is possible that they became gradually fatigued over time and that the fatigue was insidious.

The SAR logs which were kept reveal that on the two days immediately before the crash both pilots were involved in flying for over nine hours. On the day of the crash they were on the airstrip at 7.01am and the crash occurred over 12 hours later. While the number of sorties was reduced from four to three because of the radio problem referred to earlier herein, there was still a substantial amount of work done and flying hours were considerable.

The maximum temperatures were 39°C on 11 February, 40°C on 12 February and 42°C on 13 February.

In my view in these circumstances both pilots were likely to have suffered from fatigue towards the end of the day at the time of the collision. Fatigue is well known to be a potential significant factor in poor decision making, particularly in responding to unexpected situations.

It is my view that both pilots failed to take the robust action which would have been expected in the circumstance where the aircraft were approaching each other. The fact that the aircraft

were allowed to come too close was the result of poor decision making by both pilots and I am convinced that fatigue must have played a significant role in that decision making, even if this was not recognised at the time by the pilots concerned.

No other satisfactory explanation has been advanced or raised by the evidence which would account for these highly competent and safety conscious pilots allowing such a dangerous situation to occur.

While I recognise that the pilots were used to working in extreme conditions, sometimes hotter than those experienced on 13 February 2008, I agree with Senior Constable Baker's thoughtful observations in relation to fatigue and note that in his evidence he stated that police experienced fatigue issues when investigating the scene of this crash and performing necessary tasks in relation to removal of the bodies as a result of the harsh conditions.

CONCLUSION

Daniel Joseph Kean and Bradleigh Michael Roulston died on 13 February 2008 as a result of multiple injuries which they sustained after the Super Cub in which they had been working contacted the ground following a mid-air collision between it and a Robinson R44 helicopter.

At the time of the collision the deceased men were working, involved in goat culling activities on behalf of DEC.

Pilot fatigue was a major factor in decision making which resulted in the fatal crash.

I find that the deaths arose by way of accident.

COMMENTS ON SAFETY ISSUES

1. THE NEED FOR FORMALISED GUIDELINES IN RELATION TO SEPARATION

At the time of the incident there were no clear protocols or procedures in place for establishing and maintaining aircraft separation in multi aircraft operations, including aerial shooting operations.

While DAF has taken action since the incident to amend their guidelines for safe aerial work in remote areas to specifically provide for there to be at least a 200 foot vertical buffer and 200 metre horizontal buffer between aircraft involved in aerial work involving DAF, I consider that this vertical separation requirement is insufficient and the situation needs to be clarified.

I RECOMMEND that both DEC and DAF put in place guidelines in respect of aerial work which would specifically cover feral animal culling, to ensure that there is at least a 500 foot vertical buffer between spotter and shooter aircraft in addition to any horizontal buffer.

2. AVOIDANCE TECHNOLOGY

In this case I am satisfied that at least one pilot and probably both were not in a position to view the other aircraft immediately before the collision. Had the pilots been aware that the collision was likely to occur, it is obvious that they would have taken action to avoid the collision, which they did not do.

In that context avoidance technology which would alert pilots to the potential for an air crash requires consideration.

At the inquest Walter Thomson of Thomson Design gave evidence in relation to available electronic avoidance systems. Mr Thomson gave evidence in relation to five types of system currently available namely:

1. The Traffic Collision Avoidance System (TCAS), which emits signals which trigger other aircraft transponders to emit a position report.

   Mr Thomson advised that this system is very costly and would not be appropriate for use in small aircraft of this type.
2. The Traffic Avoidance System (TAS) which is a lower cost and functionality system. While this system relies on other aircraft having a functional transponder, which is not a legal requirement in remote areas of Australia at present, it is a system which could be of use in circumstances of this type.

3. The Personal Collision Avoidance System (PCAS) which is a system which listens for transponder emissions, but does not itself transmit the trigger signals to cause a transponder to emit a position report. This is a passive system which Mr Thomson did not recommend as in remote work these would be a substantial risk that there would be no ground based radar or other aircraft causing transponder emissions from approaching aircraft.
4. The Automatic Dependent Surveillance Broadcast (ADSB) System which uses a transmitter in the aircraft, which determines the aircraft position from a GPS receiver and then repeatedly transmits this information as digital data packages.

   While this system is not classed as a collision avoidance technology, being a position advisory system only, it is a system which could be of use in a small aircraft involved in activities of this type and it is supported by CASA, particularly in a context where there is a move away from air traffic control at some airports. Its use in detecting and tracking other traffic would be limited until most aircraft have this equipment and it is not known when the fleet penetration will reach levels where it could be regarded as reliable traffic advisory data for small aircraft. The cost of this system is currently high.

5. The FLARM (this does not appear to be an acronym, but rather is a name inspired from 'flight alarm') which is a small, light weight, collision warning system used in gliders and sport aircraft. This unit calculates its own position and flight direction from a GPS receiver and transmits this continuously. Only other aircraft using the same system can pick up the signals. The units calculate the distances between aircraft and only calculated collision threats are the subject of alarms, which prevents clutter and false alarms when multiple aircraft are in the area. This is an inexpensive system which may be appropriate for DEC and FESA aircraft involved in multiple aircraft operations.

Based on the above information it appears likely that anti-collision systems could have an important use in future multiple small aircraft operations to alert pilots of the need to take action to avoid possible collisions.

I RECOMMEND that DEC and DAF take action to ensure that ongoing consideration is given to possible use of available anti-collision systems and particularly the FLARM system.

Alastair Hope
State Coroner