

EXERCISE NORTHUMBERLAND – O’DONNELL REVISITED

References:

- A. UK Civil Air Patrol (Northern Region) Operation Order 2/17.
- B. UK Civil Air Patrol Operations Manual.
- C. NATO Publication – ATP 10(D). Search and Rescue.

INTRODUCTION

1. In December 1987 and February 1988 a team from the Home Office Research and Development Branch, led by Dr S O’Donnell, completed a study to evaluate the ‘*Comparative Rate of Searching by Police Aircraft and Men on Foot*’. The objectives of this research included the cost effectiveness of a search by a police aircraft in a moorland terrain and the relative effectiveness of searches by different aircraft and men on foot.
2. The areas chosen for the search experiment were Cannock Chase (1.3 square miles) in Staffordshire and Beaulieu Heath (1.25 square miles) in Hampshire. The ‘bodies’ were formed from black heavy duty PVC sheeting measuring 2 ft x 4 ft with white PVC characters, to give a unique identification, measuring 20 inches. At Cannock Chase there were 9 bodies in the first experiment and 5 bodies in the second experiment. The third experiment, with an aircraft, at Beaulieu Heath involved 6 bodies. For comparison, the men on foot, 12 police officers, searched an area measuring 0.38 square miles at Cannock Chase; there were 7 bodies for this ground search.

RESULTS FROM 1987-88

3. In the first experiment the aeroplane, a BN Islander, found and identified, from the code letters, all 9 bodies in 35 minutes. The crew of the aircraft, a pilot plus 2 observers, were not required to provide the position of each body, just the code letter which avoided the same target from being identified more than once. The searchers were not told how many bodies were in the search area. At the initial search height of 800 ft the code letters were not always easily visible. In the second search, for 5 bodies, the crew of the aeroplane elected to fly at 500 ft above the ground from which the code letters were more easily visible to the naked eye. Four out of 5 bodies were located.
4. In the first 2 experiments, at Cannock Chase, the helicopter, a Bolkow BO105, found 9 out of 9 bodies in 17 minutes and 4 out of 5 bodies in 14 minutes. The helicopter, which was also crewed by a pilot with 2 observers, was flown at a search height of between 200 and 300 feet above the ground because of low cloud in the search area. In the first two experiments, in Cannock Chase, the crew of each aircraft was changed after the first flight.

5. In the third experiment, using an Optica light aeroplane with a crew of one pilot and one observer an alternative area of 1.25 square miles at Beaulieu Heath was searched. Six out of 6 bodies were found in 23 minutes.. The search height was 500 feet. In all cases it was observed that, **“Flying an accurate search pattern is not a trivial or easy task, particularly in relatively featureless terrain.”**

6. By comparison, the search by 12 police officers in an area measuring 0.38 square took 4 hrs 10 min, including breaks. Thirty percent of the area was searched and 2 out of 7 bodies were found.

UPDATE OF O’DONNELL – 2008

7. In October 2008 the Home Office Centre for Applied Science and Research (CAST) returned to Cannock Chase (1.3 square miles) to conduct a further search experiment. On this occasion there were 6 ‘bodies’ in scenario based situation. There were 5 live missing persons, one who was stuck in a gorse thicket, another who was sheltering behind as fallen tree, a mother and child were in a hollow among trees, and a fifth person was wandering among trees. Also, a ‘cold’ rescue dummy was hanging from a tree. The search team from Staffordshire Lowland Rescue (15 searchers) found all the bodies, including the dummy, in 1 hr 54 min. The police helicopter, an EC-135 with a pilot, 2 observers and modern role equipment, including and electro-optical camera with a thermal imager, found all the live targets within 50 minutes before leaving the search area to refuel. The ‘cold’ rescue dummy was not found by the crew of the police helicopter.

O’DONNELL REVISITED – 2017

8. In May 2017 The Centre for Search Research (CSR), together with Newcastle University Business School (NUBS), the Civil Air Patrol (CAP), Northumberland National Park Mountain Rescue Team (NNPMRT) and QuestUAV revisited the ‘O’Donnell Theory’ (the ‘theory’ that an aircraft can search moorland terrain more quickly than men on foot) with a further trial in a remote area of Northumberland. The area chosen was an area of open moorland, to the north east of Rothbury, measuring 0.83 square miles. Two of the boundaries are marked by the roads, the A697 and the B6341. The other two boundaries are marked by fence lines. A clearly defined track runs through the centre of the area. The highest point, Lamb Hill, is 1,010 feet above sea level.

TARGETS

9. The targets for Exercise Northumberland were in the form of ‘bodies’ formed from dark blue coveralls filled with ‘bubble wrap’ in the area of the torso. Each body had an A4 (12” x 8”) sheet of laminated white paper with a single code letter, approximately 10” high, attached to its chest. Unfortunately, these code letters could not be identified by the airborne observer when flying at the minimum permitted height of 500 ft above the ground. Moreover, the problem of

identifying individual ‘bodies’ was compounded by the total number of bodies in a relatively small area and the fact that all the bodies were identical. The crew of each manned aircraft was provided with an A4 sized, laminated map of the search area, together with a fine marker pen to record the position of each body, with the order of detection, starting at No.1, and the time that each body was detected. On Day 1 there were 16 bodies. On Day 2 there were 20 bodies. The crews of the aircraft were, as on previous occasions, not informed as to how many bodies had been deployed on each day.

10. It should be noted that when using a GPS navigation system the position of the aircraft is accurate but the position of a target, as it passes down the side of the aircraft, will always include an error which is dependent on the bearing and distance of the target from the aircraft.. This may be reduced by circling the target, noting the circle on the GPS chart and placing the target in the centre of the circle. The GPS navigation systems used by the aircraft taking part in Exercise Northumberland, which would not have been available in 1987, included Sky Demon, Memory Map and the Smart ‘phone App called View Ranger. A further GPS navigation system which is very popular, although not used on this occasion, is Airbox Runway HD which permits ‘points of interest’ to be tagged with an OSGB grid reference.

11. Unlike 1987-88 and 2008, where the larger search areas had a maximum of 9 ‘bodies’, the relatively small search area in Northumberland (0.83 square miles) was ‘saturated’ with ‘bodies’. On Day 1 there were 16 bodies, ‘scattered’ throughout the whole area which was searched by the manned aircraft. On Day 2 a total of 20 bodies were distributed on either side of a track measuring approximately one mile in length. This saturation, together with the inability to identify individual bodies by their code letter, plus the requirement to log the position of each body presented the aircrew taking part in the exercise with an unexpected challenge. With a large number of bodies, many of them in close proximity, it was all too easy to misidentify the same body and also count the same body more than once.

AIRCRAFT

12. The CAP proposed to deploy 6 aircraft, including a small unmanned aircraft (SUA), a DJI Inspire PRO. The manned aircraft were a Cessna 210, 6 seat high wing monoplane with retractable landing gear, a Vans RV-12 low wing monoplane with 2 seats, a Robinson R22 two seat light helicopter, an MT Cavalon 2 seat autogyro and a 2 seat Pegasus Quik flex-wing microlight. In the event, the autogyro was found to be unserviceable, with a cracked exhaust, and the flex-wing was grounded by the adverse weather (high wind speed). This left the 2 aeroplanes, the light helicopter and the SUA. In addition, QuestUAV deployed a fixed-wing SUA and NNPRT deployed a second DJI Inspire SUA.

BRIEFING

13. For the aircrew flying the manned aircraft Exercise Northumberland began with a formal briefing at the flying club at Eshott airfield at 11:15 hrs, Saturday, 6 May 2017. Although the CAP aircrew had received the exercise operation order (Ref A) in advance none of them had visited Eshott previously and none of them were familiar with the area to be used for the search exercise. Basic advice on search planning, together with radio communications and reporting may be found in the UKCAP Operations Manual, Ref B. The ‘Bible’ for search and rescue is the NATO unclassified publication, ATP 10(D) – Search & Rescue (Ref C). The latter 2 publications may be found in the Members area of the CAP website. The aircrew briefing was attended by an exercise observer, Gordon Milward who also attended the first debrief, for the crew of the Cessna C-210. The facilities at Eshott were made available to the exercise participants by the airfield operators. These facilities included the full use of the airfield without charge, together with the use of the club house for briefings, debriefing and relaxation between individual flights, also without charge.

WEATHER

14. The prevailing weather is critical to all aircraft operations. During Exercise Northumberland, 6-7 May 2017 the weather in the search area was reported, on Day 1 (6 May) as visibility good, when clear of cloud, overcast with a cloud base 1,500 ft above mean sea level (amsl). The cloud base in the exercise area was 500 ft, occasionally 700 ft above ground level, with a north easterly wind of 20 knots, gusting 25 knots. On Day 2 (7 May) the weather in the search area proved to be more challenging with a 1,500 ft cloud base amsl (500 ft above the ground), 6km visibility, clear of cloud, and a strong north easterly wind. Moreover, the weather on Day 2 quickly deteriorated as pulses of cloud and rain passed through the search area. On Day 2 only the R22 was able to complete a proper search, the line search along a track with a maximum of 2 passes along the track running through the search area. The Cessna 210 completed a ‘hasty search’ ahead of the deteriorating weather. The Vans RV-12 turned back before entering the search area due to forward visibility being below the limits for flight in visual meteorological conditions (VMC).

CESSNA C-210

15. The Cessna C-210 deployed from Turweston in Northamptonshire, a distance of 195 miles, with a crew of one pilot and 3 observers, to the forward operating base (FOB) at Eshott airfield on Friday, 5 May 2017. The aircraft carried round trip fuel and didn’t require fuel at Eshott.

Day 1

16. The aircraft departed the FOB at 12:35 hrs, entered the search area at 12:39 hrs, departed the search area at 13:00 hrs and landed at 13:11 hrs. Due to its relatively high speed, 85 knots indicated airspeed (IAS) the C-210 had a ground speed of 60 kts into wind and 110 kts down

wind. These relatively high speeds, combined with a small search area required the aircraft to complete steep turns outside the search area to complete a series of parallel tracks. The search was further complicated by low cloud on the eastern, southern and western edges of the search area. The search began with a series of tracks into wind to reduce the ground speed. Due to the low cloud and poor visibility in some areas this was changed to tracks running north-west, south-east. Due to deteriorating weather the C-210 left the search area after locating 9 targets. The search height was between 500 and 800 feet above the ground. The GPS navigation system was Sky Demon. As an additional search aid, a Garmin VIRB 'action' camera was used from inside the aircraft.

Day 2

17. On Day 2 the C-210, airborne at 10:45 hrs, completed a 'hasty search' in the face of advancing, deteriorating weather with a strong, northerly wind, together with low cloud and drizzle moving into the search area. Nevertheless, 4 targets were seen in the north east sector and 2 were seen in the south west sector; total 6 targets.

VANS RV-12

18. The Vans RV-12 low wing monoplane with 2 seats deployed from Perth in Scotland, a distance of 89 miles, on the morning of Day 1 (Saturday, 6 May) with a pilot and observer. Like the C-210, this aircraft also carried round trip fuel and didn't require fuel at Eshott.

Day 1

19. On Day 1 the RV-12 was the second aircraft airborne. Take-off was at 13:15 hrs, on task, in the search area, at 13:21 hrs, off task at 13:24 hrs and landed at 13:35 hrs after avoiding adverse weather to return to the airfield. The cloud base, in the search area, was reported as 1,300 ft, 300 ft above the ground with poor visibility. For the safety of the flight the sortie was, sensibly aborted.

20. With the permission of the exercise directors the crew of the RV-12 completed their sortie once the weather, in the search area, had improved. Take-off time was 15:09 hrs, on task at 15:14 hrs, off task at 15:36 hrs, land at 15:43 hrs. The search pattern was a modified creeping line ahead search, into wind, with a series of rectangular boxes flown inside the search area. Using 'Memory Map' the track of the aircraft was recorded and as each target was seen a red 'flag' was added to the electronic map. The crew reported that the targets were relatively easy to spot, but the challenge was to accurately record their position. This problem was compounded by the fact that each code letter, on the chest of each dummy, could not be read with the naked eye from 500 ft, the minimum permitted search height. Also, it's possible that some reported targets were duplicated due to the lack of easily identified ground features. Nevertheless, at the debrief the search maps, both the laminated map and GPS, show the location of 17 bodies.

Day 2

21. On Day 2 the crew of the RV-12 aborted their search mission due to the weather in the search area being outside their operating limits. Airborne at 10:55 hrs, they completed a 180 degree turn to head east, towards the coast, and then returned to their base at Perth.

ROBINSON R22

22. The crew of the Robinson R22, a 2 seat light helicopter flew from their base at Sywell, in Northamptonshire, to Eshott, via Leeds East (Church Fenton) to refuel, on Friday, 5 May, a total distance of 182 miles. The crew included 2 pilots with one pilot acting as the observer.

Day 1

23. On Day 1 the R22 took off at 13:52 hrs, reported on task at 13:57 hrs, off task at 14:32 hrs and landed at 14:37 hrs. The crew completed 2 creeping line ahead searches, the first with a NW-SE axis and the second with a NE-SW axis. The crew reported sighting 8 targets within the first 5 minutes but, like the crew of the RV-12, they found it difficult to geo-reference the targets due to the lack of identifiable ground features in the search area. However, this crew had removed the doors from their aircraft to improve their ability to take aerial photographs (Canon + 70-300mm lens). From 500 ft above the ground, flying at between 20 and 70 knots indicated airspeed, the crew reported sighting 17 targets between 13:58 and 14:20 hrs (22 minutes) and photographed 15 targets to obtain individual code letters in the following order: T, C, K, P, I, J, G, L, S, R, O, M, A, N, E. The 'body' with the code letter 'M' was particularly challenging! The crew then stayed in the search area for a further 12 minutes before returning to Eshott.

Day 2

24. As the aircraft with the lowest cruise speed the R22 was first airborne on Day 2 at 10:34 hrs. The briefing was to complete a line search of the track running through the centre of the search area, once in each direction. At this time the weather was reported as 6km visibility, cloud base 1,500 ft, above sea level (500 ft above the ground) with a strong northerly wind. After leaving the search area the crew of the R22 reported, by SMS, 20 targets sighted. Nine in the north east sector (Green) and 11 in the south west sector (Red).

PEGASUS QUIK FLEX-WING

25. The Pegasus Quik flx-wing microlight aircraft to be used in the exercise is based at Eshott and the crew attended the exercise on both days, with the pilot also attending the hot debrief at the Holiday Inn on the evening of Saturday, 6 May. Unfortunately the weather conditions, particularly the strong winds and associated turbulence at low level precluded the use of this aircraft on both exercise days.

COST

26. It's always difficult to provide a true indication of the utility of an aerial search although it is generally accepted that in the right circumstances an air search will always be quicker, although rarely an absolute substitute for a ground search in a land based setting. Factors include the type of terrain, the presence of trees and other foliage, which may obscure the target, and, of course, the prevailing weather. Nevertheless, manned aircraft may be used to clear open areas very, very quickly whilst the ground searchers, including search dogs, concentrate on those areas where the missing person may be hidden by foliage or, perhaps at the bottom of a gully. On this occasion the direct operating cost (fuel) for each of the participating aircraft was, today's prices:

Cessna C-210 £85 per flying hour.

Vans RV-12 £18 per flying hour.

Robinson R22 £53 per flying hour.

THE ADVANTAGE OF AN AIRCRAFT

27. The advantages of an aircraft in many situations, not least search and rescue, are summarised in the 'Principles of Air Power'. The first 3 principles are; Speed; Height; Reach. These 3 principles were demonstrated, very clearly during Exercise Northumberland. The 3 manned aircraft flew to the search from the forward operating base, at Eshott, within a few minutes. They then searched the whole of the search area from their aerial vantage point, very quickly; less than 25 minutes for each aircraft - the proverbial 'eye in the sky'. The principle of 'reach' was demonstrated by individual aircraft flying many hundreds of miles from Perth in Scotland, Sywell in Northamptonshire and Turweston, also in Northamptonshire to the forward operating base (FOB) at Eshott airfield in Northumberland. Had it been necessary, both aeroplanes could have flown directly to the search area from the home bases and returned to the home bases without using the FOB.

28. The other 3 principles of 'Air Power' are; Ubiquity; Agility; Concentration.

CONCLUSION

29. As on previous occasions, Exercise Northumberland demonstrated the utility of aircraft when search for missing persons in a rural setting. Despite the very challenging weather that, on occasion, required individual aircraft to abort their search missions all of the participating aircraft located many of the targets. The R22 helicopter and the Vans RV-12 aeroplane did particularly well to locate the majority, if not all of the 'bodies'. This exercise also went a long way to dispel the myth that a low wing monoplane, in this case the RV-12, is an inferior search aircraft.

30. Unlike on previous occasions, particularly in 19987-88, the objective on this occasion was to locate each 'body' with its individual position in the search area. Unfortunately, due to the large number of targets in a relatively small area, plus the fact that it was impossible to identify individual, identical targets by their code letter from 500 feet there was, inevitably, the possibility of counting the same target twice. Nevertheless, the crew of the R22 removed the doors of their helicopter to permit them to photograph individual targets. Using a Canon camera with a 70-300 zoom lens they positively identified 15 of the identical 'bodies'. A significant difference between the search experiments of 1987-88 and 2017 was that each aircraft had some form of GPS precision navigation and 2 of the aircraft used digital cameras which permitted near real time playback and target identification.

31. Finally, sincere thanks are due to the organisers of Exercise Northumberland, The Centre for Search Research, together with Newcastle University Business School and the Northumberland National Park who sponsored the exercise. Also, thanks are due to the other participants, the Northumberland National Park Mountain Rescue Team, to QuestUAV and to the operators of Eshott airfield which was used as a forward operating base by the Civil Air Patrol.

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