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Assessing the safe and effective use of aerial baiting for the control of wild dogs in Victoria

Alan Robley

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Assessing the safe and effective use of aerial baiting for the control of wild dogs in Victoria

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Front cover photo: Preparing aerial baits (Alan Robley). Helicopter used to deploy aerial baits (Alan Robley).

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Summary

Wild dogs — dingoes (*Canis lupus dingo*) and feral or wild-living domestic dogs (*Canis familiaris familiaris*), and their hybrids can reduce farm productivity and prey on native animal species, but they may also reduce the abundance of other introduced mammalian carnivores such as red foxes (*Vulpes vulpes*) and feral cats (*Felix catus*) (Glen and Dickman 2003; Robley et al. 2009). In Victoria, dingoes have recently been listed as a threatened species (*Flora and Fauna Guarantee Act* 1998), and loss of genetic integrity through hybridisation with wild dogs is listed as one of the main threatening process (Scientific Advisory Committee 2007). In Victoria, the state government invests approximately $4.4 million per annum in managing the impact of wild dogs on agricultural enterprises.

Aerial baiting for the control of wild dogs is used in Queensland, Western Australia, New South Wales and the Northern Territory, but its long-term cost-effectiveness has gone largely unassessed. In 2005, the Victorian Minister for the Environment and Water announced that trials would be undertaken on the safe and effective use of aerial baiting for the control of wild dogs in Victoria. Trials were undertaken between 2005 and 2007 in north-eastern Victoria and Gippsland.

These trials had three aims:

1. To determine the accuracy of aerial bait delivery.
2. To assess the effect of bait presentation on uptake by wild dogs, foxes, feral cats and non-target species.
3. To assess the safe and effective use of aerial baiting in Victoria in relation to Spotted-tailed quolls (*Dasyurus maculatus*) and wild dogs.

A trial to assess the accuracy of aerial baiting was undertaken along Elliot Ridge, which runs south from a point c.10 km south-east of Corryong in north-eastern Victoria in December 2005. Non-toxic meat baits were used during the trial. To help locate the baits on the ground, 13 baits had micro-transmitters inserted into them and a further 17 were dyed fluorescent pink. Prior to deploying baits from a helicopter, 30 drop-points were located at 1 km intervals along Elliot Ridge and marked with fluorescent pink dye. Dropped baits were located, and measurements taken to determine their distance and direction from the intended target they landed. Baits dropped from a helicopter flown at 100 feet and 30 knots in moderate wind conditions (10–15 knots) were found within an average distance from the drop-point of 5.6 m ± 1 m in mountainous terrain.

Trials to assess the influence of presentation on bait uptake by wild dogs and non-target species were conducted in north-eastern Victoria and in Gippsland in December 2005 and February 2006 respectively. Thirty-two baits were laid at the north-eastern Victoria site, and fifty-two at the Gippsland site. Baits were 200–250 g semi-dried, non-toxic predator meat baits. The removal of non-toxic baits was monitored by remotely activated digital cameras. Surface-laid baits were more likely to be taken than buried baits by non-target species, which has implications for the effectiveness of aerial baiting programs, and is consistent with results from other research programs undertaken in Australia.

Three aerial bating trials to assess the impact on wild dogs were undertaken at two sites, one site was in north-eastern Victoria (Lucyvale – one trial) in November 2006 and one site in Gippsland (Nunniong Plain – two trials) in May 2007 and November 2007. Five additional sites, two in north-eastern Victoria (Mt Jack and Scrubby Creek) and three in Gippsland (Rocky Range, Ingeegoodbee Track and Cobungra) were also assessed. At all sites captured wild dogs were fitted with GPS tracking collars and the presence of Spotted-tailed quolls were assessed using a combination of cage trapping and remotely activated digital cameras.

At Mt Jack and Scrubby Creek insufficient wild dogs were captured to proceed with a trial. Rocky Range and Ingeegoodbee Track were to be used to assess the impact of aerial baiting on Spotted-tailed quoll; however insufficient quoll were captured to make this trial viable. Cobungra was to be used to assess the impact of aerial baiting on wild dogs, however due to the presence of Spotted-tailed quoll the Aerial Baiting Stakeholder Consultative Committee decided not to proceed with a trial at this site.

After the trial at Lucyvale and the initial trial at Nunniong Plain it was discovered that incorrect dilution of the poison 1080 during bait manufacturing rendered the baits used and the trials ineffective. At the re-trial at Nunniong Plain, ten wild dogs were known to be present at the time of baiting in November 2007. Of these one was known to have died from the aerial bating trial.

This study implemented the first aerial baiting of wild dogs in Victoria for 37 years across three separate trials, collected movement and habitat data on wild dogs using GPS technology for the first time in Victoria, and established the status of the Spotted-tailed quoll on seven sites in north-eastern Victoria and Gippsland.

Spotted-tailed quolls were found to occur at low densities at two East Gippsland sites. In Victoria where there are low densities and small, potentially isolated populations of Spotted-tailed quolls, even small increases in mortality would significantly increase the risk of local extinctions.

If aerial baiting were to be reintroduced into Victoria, the following areas of investigation should be considered.

- In areas where Spotted-tailed quoll are suspected or likely to occur, investigations need to be conducted to confirm their presence.
- There is currently no information available to land managers on the comparative effectiveness of different baiting rates. There are currently some trials being conducted in NSW by NSW Department of Primary Industries on different baiting rates of 10 and 40 baits per linear kilometre. This should help inform best practice in Victoria.
- How best to integrate aerial baiting with ground-based baiting.
- Long-term monitoring of the costs and benefits of aerial baiting. This should include impacts on stock losses and the effect on native species predated by wild dogs.
- The likely impact that wild dog baiting has on population levels of foxes and the potential flow-on effects to population levels of feral cats and the potential impact on native species.

1 Background

Wild dogs — dingoes (*Canis lupus dingo*) and feral or wild-living domestic dogs (*Canis familiaris familiaris*), and their hybrids — occupy a complex place in the Australian environment. They can reduce farm productivity and prey on native animal species, but they may also reduce the abundance of other introduced mammalian carnivores such as red foxes (*Vulpes vulpes*) and feral cats (*Felix catus*) (Glen and Dickman 2003; Robley et al. 2009). In Victoria, dingoes have recently been listed as a threatened species (*Flora and Fauna Guarantee Act* 1998), and loss of genetic integrity through hybridisation with wild dogs is listed as one of the main threatening process (Scientific Advisory Committee 2007).

The economic impact of wild dogs across Australia has been estimated at between $66.3 million and $48.5 million per annum (McLeod 2004; Gong et al. 2009 respectively). In Victoria, the state government invests approximately $4.4 million dollars per annum in managing the impact of wild dogs on agricultural enterprises.

An announcement by the New South Wales Environment Minister in 2004 that aerial baiting for wild dog control would resume led to requests by the Victorian Farmers Federation to introduce aerial baiting in Gippsland and the north-eastern regions of Victoria. At the time, there was considerable debate about the potential impacts of aerial baiting on native species — in particular the Spotted-tailed quoll (*Dasyurus maculatus*) — its effectiveness in providing ongoing control of wild dogs, and the risks it posed to other animals (including humans) and the environment.

The current strategic approach in south-eastern Australia is to reduce wild dog numbers at the interface of private and public land by integrating a range of control options, including trapping, baiting, fencing and shooting (Fleming et al. 2001). At the time of the trials reported here, the only legal option in Victoria for baiting for the control of wild dogs was to bury baits 10–15 cm beneath the surface using either fresh or manufactured meat baits containing 4.5 mg of sodium fluoroacetate ('1080') poison.

The product 1080 pest animal bait is registered as Agricultural Chemicals with the Australian Pesticides and Veterinary Medicines Authority (APVMA) under the provisions of the *Agricultural Veterinary Chemicals Code Act 1994* (Commonwealth of Australia). 1080 is a restricted schedule 7 poison and is listed as a dangerous chemical under provisions of the *Drugs, Poisons and Controlled Substances Act 1981* (Victoria), administered by the Victorian Department of Human Services. Other restrictions apply to its use, manufacture and distribution, including the manner in which baits are deployed.

In Western Australia, the Northern Territory, Queensland and New South Wales, aerial baiting with 1080 is used to control wild dogs and foxes. In Victoria, aerial baiting for the control of wild dogs was first undertaken in 1953 in Gippsland and continued intermittently until 1969 (Corbett 1974). However, aerial baiting is not currently a registered control technique in Victoria.

Despite the reasonably widespread use of aerial baiting in Australia for the control of wild dogs, there are only four published studies on its effectiveness for reducing wild dog numbers, and none on its effectiveness for mitigating attacks on stock. Three of the four studies were undertaken in arid or semi-arid Australia (Newsome et al. 1972; Thomson 1986; Burrows et al. 2003), where environmental conditions are significantly different from temperate south-eastern Australia.

In 2005, the Victorian Minister for the Environment and Water announced that trials would be undertaken on the safe and effective use of aerial baiting for the control of wild dogs in Victoria. Trials were undertaken between 2005 and 2007 in north-eastern Victoria and Gippsland, with the implementation of these overseen by the Aerial Baiting Stakeholder Consultative Committee (ABSCC).

These trials had three aims:

1. To determine the accuracy of deploying baiting from the air.
2. To assess the effect of bait presentation on uptake by wild dogs, foxes, feral cats and non-target species.
3. To assess the safe and effective use of aerial baiting in Victoria in relation to spotted-tailed quolls and wild dogs.

This report summarises the conduct and outcomes of the trials. At the end of each section there is a summary of outcomes, and at the end of the report there is a final discussion of the results with recommendations for future areas of investigation.

2 Assessing the accuracy of aerial bait delivery

2.1 Introduction

In eastern New South Wales escarpment and tablelands areas, wild dogs frequently use topographical features such as ridges for ease of movement (Harden 1985). Therefore, a degree of precision is required in dropping the majority of baits within the confines of the ridge tops. The less accurately baits are placed, the less likely it might be for wild dogs to find them as they may land in water bodies or be lost in thick vegetation.

Inaccurate bait placement and bait distribution have been identified as factors influencing the effectiveness of aerial baiting campaigns (Tomlinson 1954; Newsome et al. 1972; Thomson 1986). Harden (1985) concluded that it was unlikely that fixed-wing aircraft could adequately bait many of the routes used by wild dogs. Consequently, Thompson et al. (1990) compared the accuracy of fixed-winged aircraft and helicopters to deliver baits. They reported that in rugged, forested terrain helicopters were more accurate than fixed-wing aircraft.

This trial investigates bait displacement patterns and assessed the influence of canopy closure on the accuracy of bait placement via helicopter.

2.2 Methods

2.2.1 Study site and aircraft

The trial was conducted along Elliot Ridge, which starts c.10 km south-east of Corryong in north-eastern Victoria (Figure 1) and runs south for c.40 km. This site was selected as typically wild dog aerial baiting is conducted along ridgelines in operations in NSW and was considered likely to represent a site were aerial baiting might take place in Victoria. The area is steeply undulating, with timbered ridges up to 1030 m above sea level, and is surrounded by cleared, flat grazing and cropping land. Vehicle assess was also an important factor in sites election, as we needed to be able to retrieve the dropped baits.

The aircraft used to deploy baits was a Bell Jet Ranger B206 helicopter fitted with a specially designed baiting chute. In this report altitude is given in feet (1 ft = 0.305 m) and airspeed is given in knots (1 kn = 1.852 km/h) to conform with international air navigation conventions.

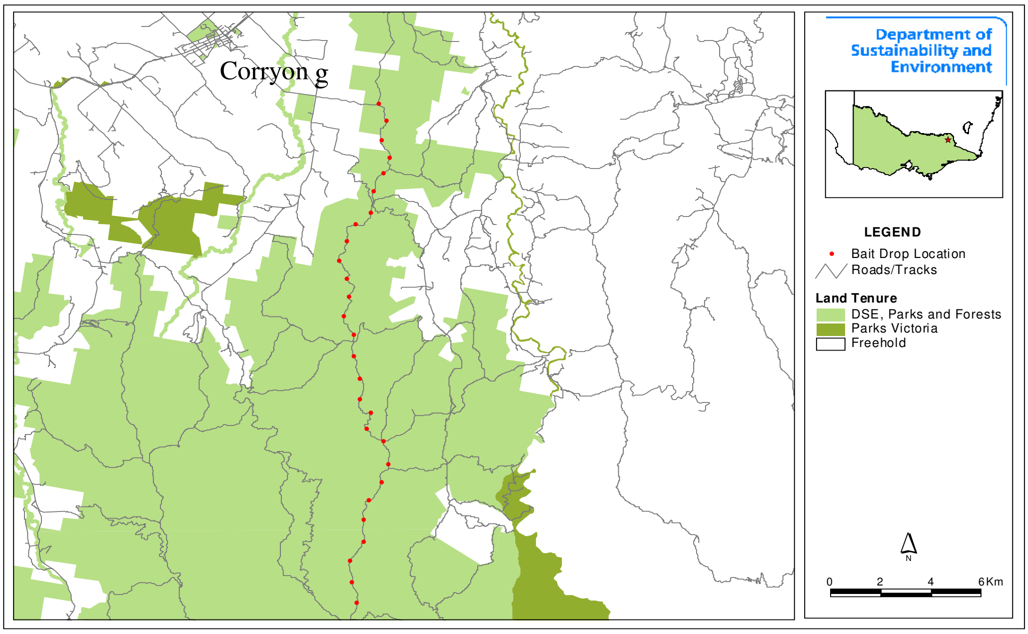

Figure 1. Location of Elliot Ridge and pre-determined drop-points used in the accuracy trial.

2.2.2 General methodology

The trial was conducted on 13 December 2005 on a day of fine and clear weather with occasional moderate wind gusts to a maximum of 15 kn. Airspeed of 30 kn and altitude of 100 ft were set for the flight.

Non-toxic, semi-dried kangaroo meat baits (200–250 g) were used for the trial. To help locate the baits on the ground, 13 baits had inserted micro-transmitters (150 MHz, Sirtrack, New Zealand) and a further 17 were dyed fluorescent pink. Prior to flying, 30 drop-points were located at 1 km intervals along Elliot Ridge (Figure 1). The locations of these drop-points were recorded using a hand-held GPS unit (Garmin GPS II Plus, Garmin International, USA) and the locations on the ground were marked with fluorescent pink dye to help locate them from the air. After the drop the baits were located, and measurements taken to determine the distance and direction from the intended target. The canopy above the drop-points was assessed visually as closed, partially closed or open to differentiate its influence on bait displacement.

A search time (maximum five minutes by two observers) and area (15 m either side of the target line) was allocated for each bait. The area limit was imposed because the land fell away steeply beyond c.20 m from the ridge top, making bait retrieval unsafe.

2.3 Results

Twenty-nine non-toxic baits were deployed on 13 December 2005. One dyed bait was not dropped because the drop-point was missed. This resulted from a combination of sharply changing landscape features and difficulty in following the ridge track.

Twenty-one baits were recovered within three hours of deployment. All baits with micro-transmitters were recovered, and eight of the 16 dyed baits were recovered.

The displacement of recovered baits in any direction from the intended drop-point ranged from 0.5 m to 18 m, with a mean of 5.6 m ± 0.9 m SE. There was a trend towards greater displacement from the drop-point with increasing canopy closure (Figure 2). Three baits were located off the ridge track, but all were within 2–3 metres of the edge of the track. Of the baits that were not recovered, five were dropped at open canopy sites, two at partially closed canopy sites, and one at a closed canopy site. If we assume that all these baits landed 18 m or greater from the intended drop-point, i.e., outside the measured displacement distance, the overall average displacement distance was 9.0 m ± 1.2 m SE.

Drop-points that were below the ridge on a contour line or either side of a peak were less accurately targeted. Observations made during the trial also indicated that rapid changes in terrain and wind conditions influenced the accuracy of the drops.

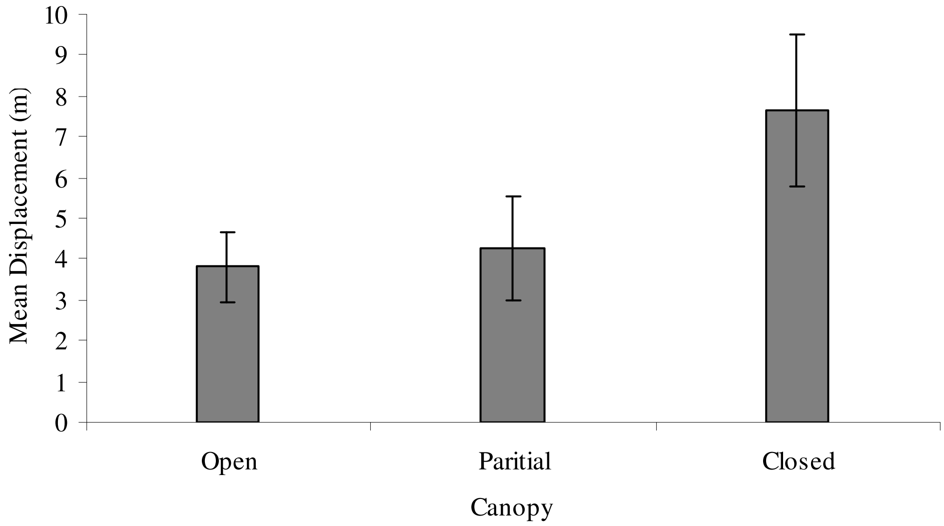

Figure 2. Mean displacement distance of baits under open, partially closed and closed canopy. Vertical lines represent standard error.

2.4 Outcome

The results of the trial indicate that 200–250 g meat baits can be accurately dropped from a helicopter flown at 100 ft and 30 kn in moderate wind conditions (10–15 kn) over steeply undulating terrain. The degree of accuracy in our trial seemed to be related to the topographic position of the drop-point.

The results of this trial are consistent with trials conducted in New South Wales in similarly forested terrain, also using a Bell Jet Ranger flown at 100 ft and 30 kn. Bait displacement in that trial was 11 ± 2.1 m (Thompson et al. 1990). The estimated mean for recovered baits in our trial was 5.6 m ± 1 m and if we include an estimate of those not recovered based on the maximum recorded displacement distance was 9.0 m ± 1.2 m. This later figure represents a pre-cautionary approach, and assumes that baits that were not recovered landed greater than 18 m from the intended drop-point.

In some areas wild dogs frequently use ridges for ease of movement (Harden 1985). Therefore, the less accurately baits are placed, the less likely it might be for wild dogs to find them as they may land in water bodies or be lost in thick vegetation. In this trial, the accuracy and recovery of baits dropped from the helicopter would indicate that wild dogs should have a reasonable chance of finding them. In Australian states where aerial 1080 baiting is permitted, baits must be placed by helicopter >10 m from any private property boundary; 10% of baits dropped from the helicopter during this trial landed >10 m from the target line.

This trial confirms that baits can be accurately deployed via helicopter in mountainous terrain in calm weather conditions. However, when aerial baiting for wild dogs, unfavourable weather conditions (particularly high wind speeds) should be avoided. Thompson et al. (1990) questioned the ability to place baits accurately from aircraft in wind speeds greater than 17 kn. In areas of known wild dog activity, including spurs, pads, watering points and camps, it may be beneficial to take extra time and care with bait placement. Hovering over target areas should provide the increased accuracy required.

3 Influence of presentation on bait uptake by wild dogs and non-target species

3.1 Introduction

In areas that are accessible, ground-based baiting offers a number of potential advantages over aerial baiting, including greater control over placement of baits and the ability to bury baits, reducing the likelihood of non-target species taking and consuming poisoned baits.

This trial was conducted in north-eastern Victoria and in Gippsland to assess the effect of bait presentation (buried versus simulated aerial baiting) on the uptake and interference of baits by non-target species.

3.2 Methods

3.2.1 Study sites

North-eastern Victoria

The Wabba Wilderness was selected for the trial because it was known to contain populations of wild dogs and habitat considered suitable for Spotted-tailed quolls, a key non-target species considered to be at risk from 1080 poison programs. The location of bait station is shown in Figure 3.

Gippsland

The study site for this trial was west of the Snowy River, near Suggan Buggan (Figure 4). This area was selected because of recent records of both Spotted-tailed quolls and wild dogs in the area. It was also the best available area outside the footprint of Southern Ark, a large-scale fox control program using buried baiting. The general location of the study site is shown in Figure 4. The precise location of the bait stations is not available because GPS locations were not recorded by field staff for this study.

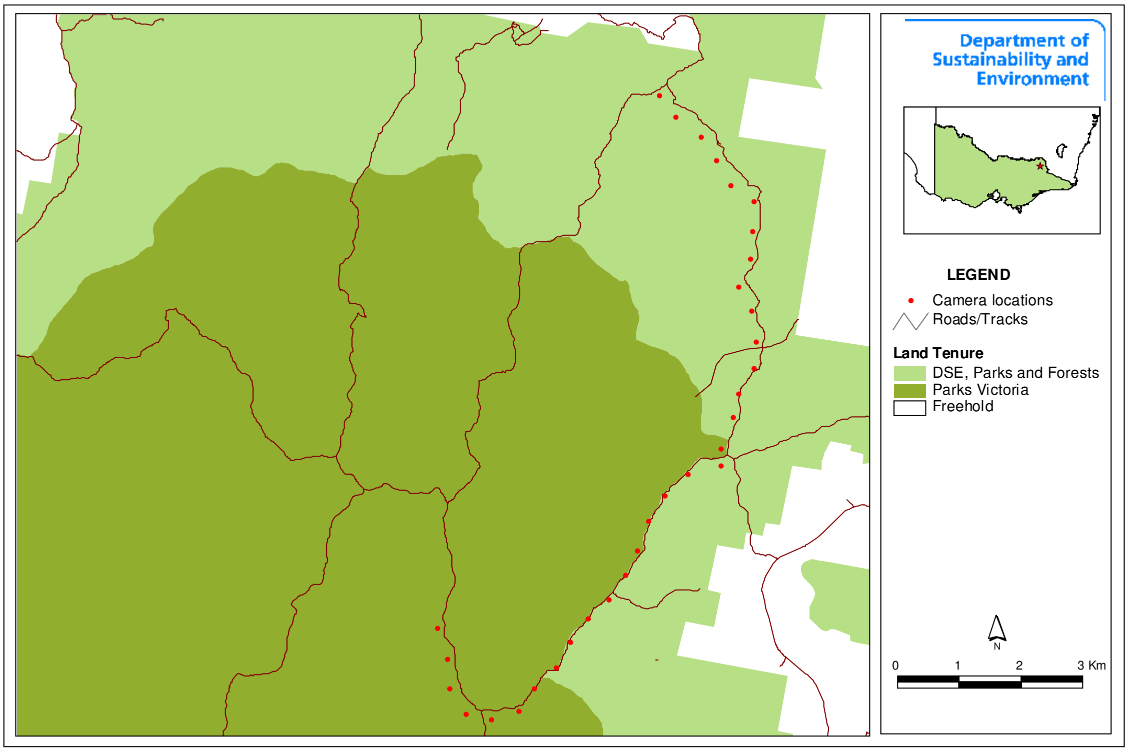

Figure 3. Location of cameras and bait stations in the Wabba Wilderness used to assess bait uptake.

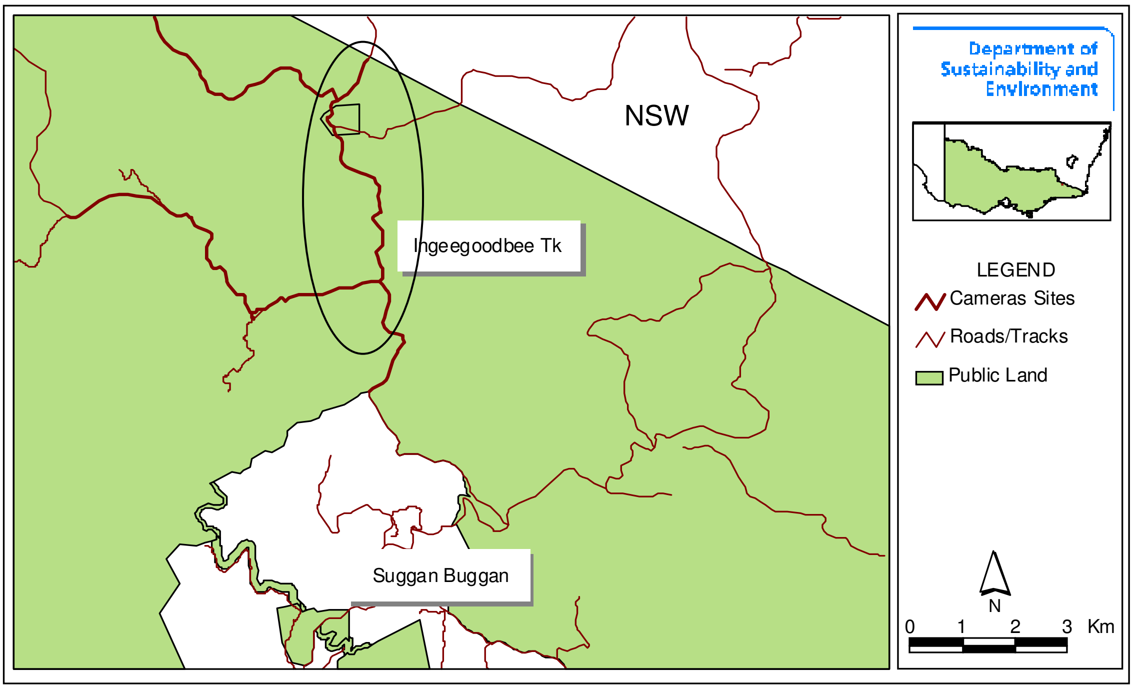

Figure 4. Location of Gippsland sites used to assess bait uptake. Ellipse indicates general survey area.

3.2.2 Bait presentation

Bait stations were placed along vehicle tracks every 500 m, alternating between baits laid on the surface and baits buried 10–12 cm deep. Thirty-two baits were laid at the Wabba Wilderness site, and fifty-two at the Gippsland site. Baits were 200–250 g semi-dried, non-toxic predator meat baits.

3.2.3 Fate of baits

The removal of non-toxic baits was monitored by remote cameras. At each bait station, a 35 mm film camera was placed atop a steel star-picket at approximately 45° to the ground, facing the bait station (Figure 5).

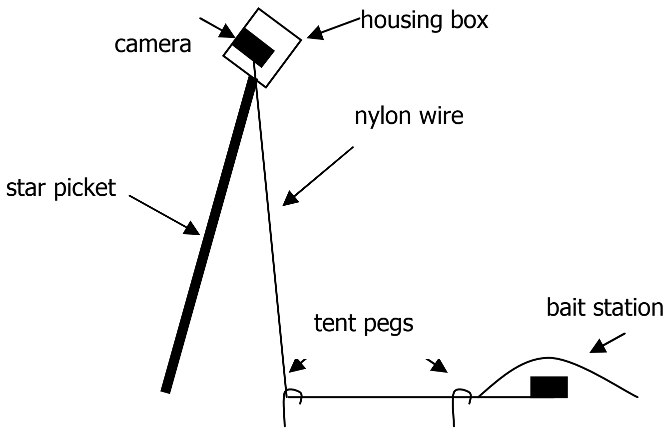

Figure 5. Bait station set-up with remotely triggered camera (after Glen and Dickman 2003).

The cameras used were those described by Glen and Dickman (2003), modified slightly by housing the cameras in a plastic box to prevent moisture entry. In the lid of each box a glass cover was placed in front of the lens to ensure a clear picture. Bait was connected to the shutter mechanism of the camera by a nylon line, and a picture was taken when the bait was moved.

In the Wabba Wilderness trial the bait stations were established for 13 days, 7 - 21 December 2005, resulting in 416 bait nights. The bait stations in the Gippsland study site were established for 11 days, 10 - 21 February 2006, resulting in 572 bait nights.

3.3 Results

No Spotted-tailed quolls were recorded taking either buried or surface laid baits. For both trials combined, the mean rate of surface bait removal was 41.8% (n = 18), and the mean rate of buried bait removal was 26% (n = 11). Wild dogs took 2.4% (n = 1) of all surface baits and 5% (n = 2) of all buried baits (Table 1, Figure 6). Overall, non-target bait take was higher for surface-laid baits (91%) than for buried baits (77%). Foxes removed 18% (n = 8) of both buried and surface baits. On four occasions wild dog tracks were observed passing buried bait stations, and on three occasions passing surface stations without taking the bait.

Table 1. Overall bait take from trials conducted in north-eastern Victoria and Gippsland.
Numbers in parentheses are percentage of bait take.

Species	Surface bait	Buried bait
Red Fox	8 (18.0)	8 (18.0)
Wild dog	1 (2.4)	2 (5.0)
Raven	5 (12.0)	0 (0.0)
Feral cat	1 (2.4)	0 (0.0)
Common Wombat	3 (7.0)	1 (2.4)
Total	18 (41.8)	11 (25.4)

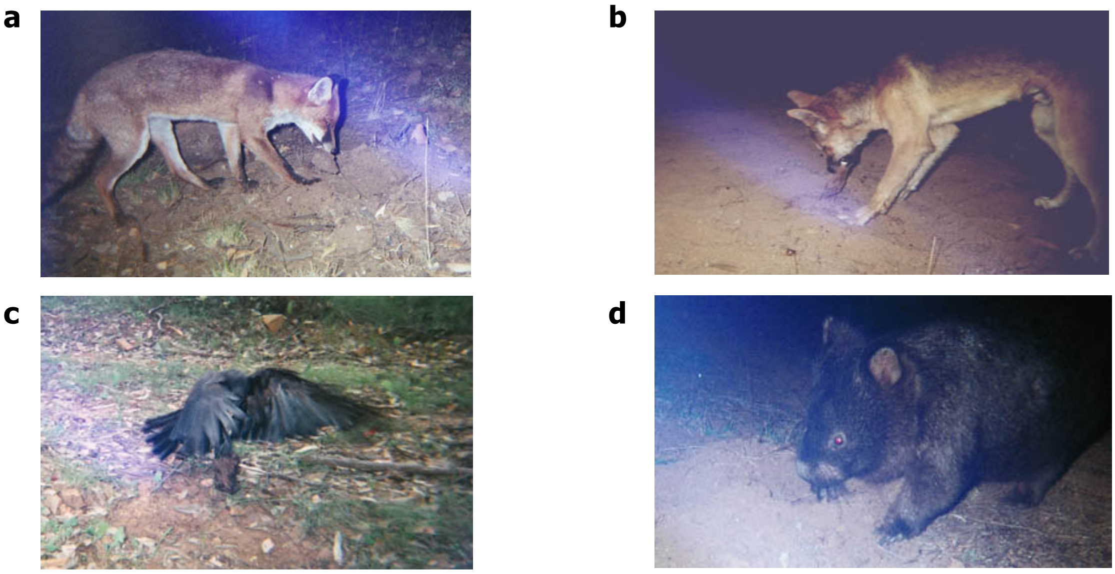

Figure 6. Species photographed taking baits: (a) fox, (b) wild dog, (c) raven (*Corvus* sp.), and (d) common wombat (*Vombatus ursinus*).

3.4 Outcome

These results support the findings of other studies. Allen et al. (1989) assessed the effect of bait presentation on control program efficiency and non-target hazard by comparing the attractiveness and palatability of buried meat baits and surface-laid meat baits. They found that buried baits were equally attractive and palatable to wild dogs compared with surface-laid meat baits, yet had a greatly reduced non-target bait take in their study. Of the 70 surface-laid meat baits eaten by non-target species, 80% were removed by birds. Baits were also removed by ants, reptiles and feral cats. In comparison, only four buried meat baits were removed by non-target species (ants, a bird and a feral cat). Glen and Dickman (2003) investigated buried bait removal using remote cameras. They found that 46.2% (n = 49) buried baits were taken by spotted-tailed quolls, 8.5% (n = 9) by wild dogs, 6.6% (n = 6) by foxes and the remainder by a variety of other non-target species such as brush-turkeys (*Alectura lathami*), superb lyrebirds (*Menura novaehollandiae*) and small mammals.

Bait presentation can have an important influence on bait take by wild dogs. Burying baits can reduce the frequency of non-target bait take by a range of non-target species; however the study by Glen and Dickman (2003) indicates that this maybe an issue for spotted-tailed quoll. An increased rate of non-target bait take reduces the likelihood of wild dogs encountering bait and subsequently having the chance to consume bait. In a study looking at the effectiveness of buried baiting, Robley et al. (2009) reported that foxes removed twice as many baits as wild dogs.

The small sample size in this trial inhibits our ability to draw any robust inferences. In order to increase the sample size and therefore the robustness, the number of buried and surface laid baits would need to be increased, increase the time baits were available in the field, or repeat the trials at more than two locations. During this study it was not feasible to implement any of these options because of logistical and time constraints.

4 Assessing the safe and effective use of aerial baiting-north-eastern Victoria

4.1 Introduction

In 2005, the Department of Sustainability and Environment asked the Arthur Rylah Institute to investigate the safe and effective use of aerial baiting in Victoria to control wild dogs for the protection of livestock. In order to do this, the number of wild dogs in the study area had to be known in order to determine the proportion of a population that succumbed to aerial baiting by determining a kill rate.

The spotted-tailed quoll is a non-target species that is likely to be at risk from aerial baiting in Victoria using 1080 poisoned baits (McIlroy 1981, 1986; Todd and Robley 2006). We aimed to assess the safe and effective use of aerial baiting at three locations in north-eastern Victoria by establishing the presence of a known population of spotted-tailed quoll and wild dogs prior to toxic aerial baiting, and then assessing their fate after baiting.

4.2 Methods

4.2.1 Study areas

Three sites were selected on the basis of being within 3–5 km of the public–private land interface (i.e. within the buffer zone for wild dog control activities), being accessible by a network of tracks to facilitate travel for monitoring purposes, having had no wild dog control in the previous 12 months, having a history of wild dog attacks on nearby private land, and having historical records of Spotted-tailed quoll in the area (Figure 7).

Figure 7. Landscape in north-eastern Victoria showing public–private land interfaces where wild dog control typically occurs.

The three study sites were Mt Jack, Lucyvale and Scrubby Creek (Figure 8). Final site selection was based on the above criteria and discussions with Department of Primary Industries wild dog controllers, the North East Wild Dog Management Group, Parks Victoria, and Department of Sustainability and Environment regional staff. Terrain at all sites was similar, consisting of steep valleys with some rocky outcrops on their peaks, which run into drainage lines and watercourses. Mean annual average rainfall at the sites is 700–1200 mm. Mean daily temperature ranges from 2°C to 33°C degrees. All three study areas measured approximately 7 x 10 km (7000 ha).

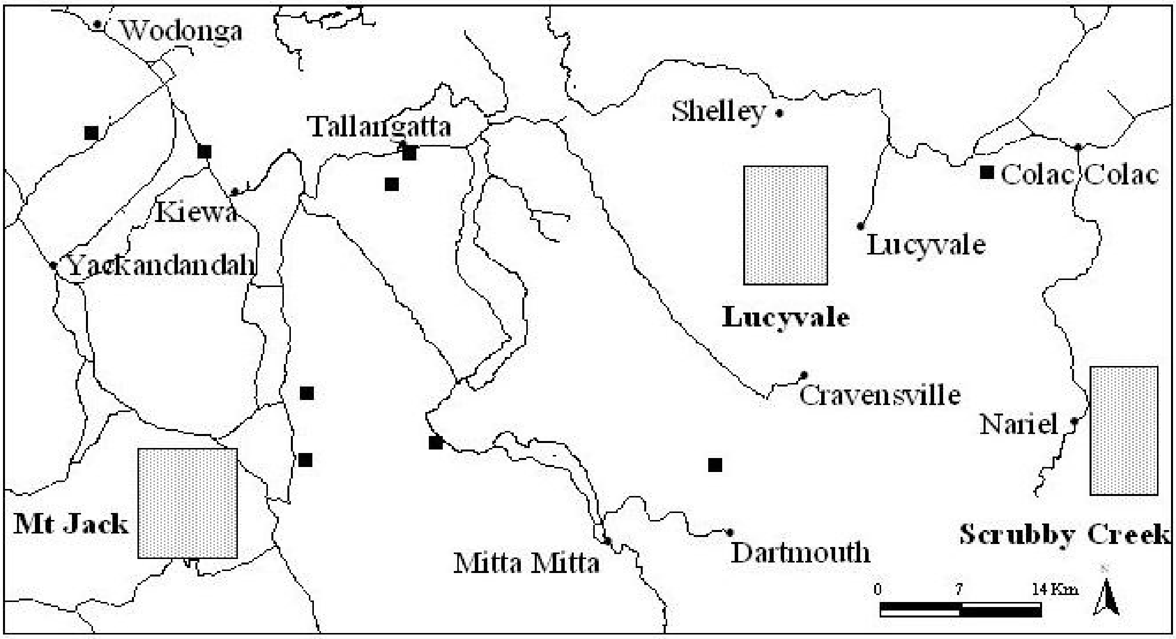

Figure 8. Location of Mt Jack, Lucyvale and Scrubby Creek study sites in north-eastern Victoria. Solid squares indicate locations of Spotted-tailed quoll records from the Atlas of Victorian Wildlife.

4.2.2 Spotted-tailed Quoll surveys

Cage trapping

Surveys were conducted over two sessions in February and early March 2006 at all three sites. Thirty collapsible wire cage traps (300 mm × 300 mm × 600 mm; Mascot Wire Works, NSW) were set adjacent to major forest roads along a pre-determined 30 km transect at each of the three sites (1200 trap nights). Traps were set at several sites identified as probable spotted-tailed quoll latrine sites, and at saddles between two gully heads, rocky outcrops, ridges, heath areas and streams. Traps were baited with pieces of raw chicken supplemented with lamb. Traps were checked as close as possible to dawn each morning.

Additional trapping was undertaken at the Lucyvale site in late August 2006 in a further attempt to assess the presence of spotted-tailed quoll at this site. Forty cage traps were set for 10 nights (i.e., 400 trap nights) between 21–31 August following the same procedures as in March 2006. Trapping beyond this date was not possible given concern that breeding female spotted-tailed quolls would deposit pouch young in dens. Young in the den are at risk of hyperthermia and/or starvation if females are captured and hence unable to return to their young during this time.

Camera surveys

Twenty TrailMac digital heat-in-motion activated cameras (Trail Sense Engineering, USA) were deployed at the Lucyvale site in June 2006. Cameras were placed in the centre of randomly selected 1 km^2 plots. Cameras were set for 12 days and then relocated to the centre of 20 newly randomly located 1 km^2 plots and set for another 12 days (Figure 9). A lure of chicken, pilchards and tuna oil was placed three metres from each camera and protected from predators and scavengers by a 20 cm square steel cage mounted on top of a 1.8 m steel post (Figure 10). Images were date and time stamped. This sampling effort sampled 48% of the available 1 km^2 grids on the study site.

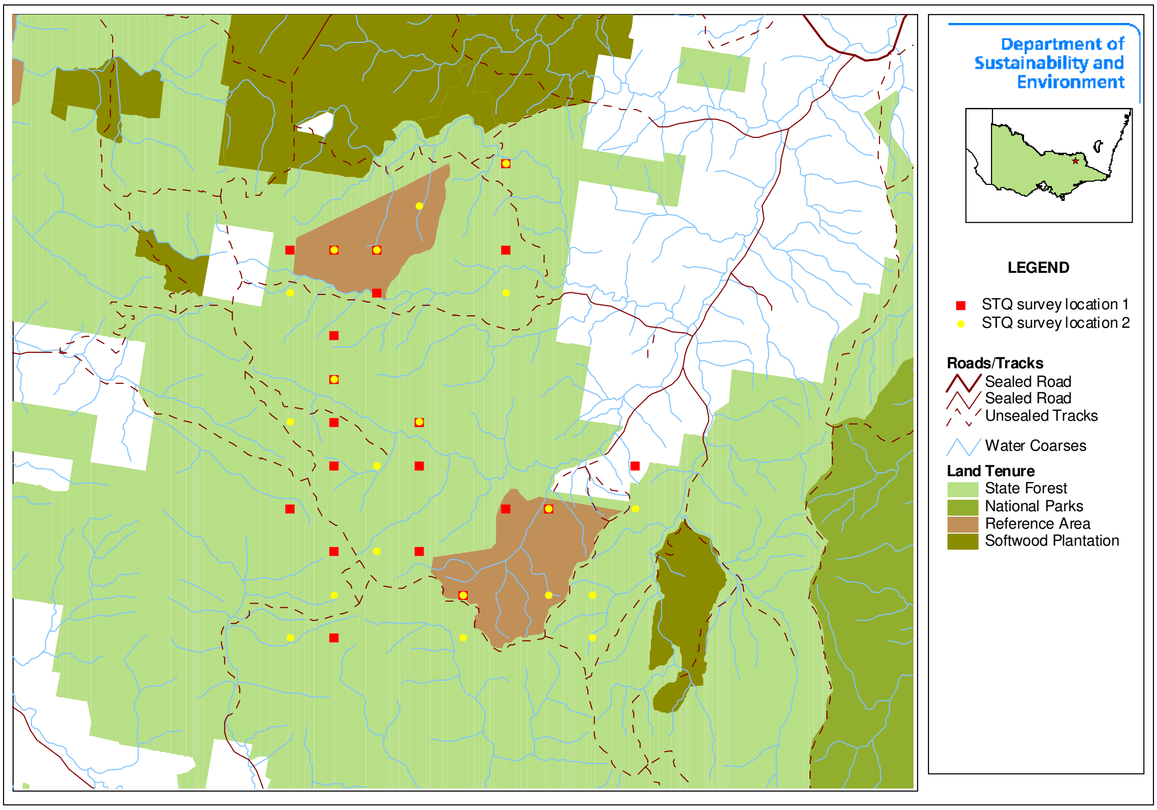

Figure 9. Location of 20 heat-in-motion activated digital cameras at the Lucyvale site: red squares = location of cameras in the first sample period, yellow circles = location in second sample period. Some areas were sampled twice. Cameras were located in the centre of a randomly located 1 km^2 square.

Figure 10. Camera and cage set up at Lucyvale.

4.2.3 Capturing wild dogs

Department of Primary Industry wild dog trappers and Land Stewardship Officers from the Department of Sustainability and Environment established 30 Lanes soft-jaw leghold traps (Coast to Coast Vermin Traps, Baldivis, Western Australia) at each of the three study sites beginning on the 1 February 2006 and finishing on the 30 March 2006 (Figure 11). Traps were set in the usual manner by trappers using visual or olfactory queues. Traps were checked daily early in the morning to reduce the chance of injury to animals. Additional traps were set as time permitted and if additional 'fresh' signs were identified by trappers.

Captured animals were restrained using a Ketach-All pole (Animal Care Equipment, Moorabbin, Victoria), removed from the trap, restrained on a 'catch-board' with a hessian cloth placed over their head and legs, and inspected for injuries. Once restrained, the animals became settled. They were then weighed and sexed, their reproductive status and coat colour noted and a biopsy of ear tissue was collected for later DNA analysis to assess dingo purity. DNA samples were analysed at 25 microsatellite loci and their allele frequencies compared with a reference population of putatively pure dingoes to assign them to 'dingo', 'dog', or 'likely hybrid' using the methods of Wilton (2001). Trappers estimated age from the physical appearance of the dog, e.g. muzzle and coat colour and condition.

Figure 11. Wild dog controller setting trap.

4.2.4 Tracking wild dog movement and fate

Dogs were fitted with either a GPS data-logging collar (Televilt Posrec C120, TVP Positioning, Sweden) or an Argos-GPS data-logging collar (Sirtrack, New Zealand) and then released at the point of capture. To maximise the number of foxes recorded over the expected life of the project the GPS data-logging collars were programmed to record a GPS location once every day at 0200 hours for 11 months, storing GPS data 'on board' the collar; GPS data was only available once the collar was retrieved. The Argos-GPS data-logging collar used the Argos satellite network to calculate a wild dog location and stored GPS locations, taken every four hours, 'on board' the collar. Collars were also fitted with a timed release mechanism allowing the collar to drop-off and then be retrieved. Collars also had a VHF beacon that transmitted for five hours between 0900 and 1400 hours while the collar was attached and for 80 days after the collar detached (Figure 12). This enabled contact with the collared dogs during the trial by tracking the VHF beacon by helicopter and acquiring a location, which was recorded using a hand-held GPS (Garmin GPS II Plus, USA).

a

b

Figure 12. Processing a wild dog: (a) fitting GPS tracking collar, and (b) releasing the dog.

4.2.5 Bait preparation

Predator meat baits were prepared by the Department of Primary Industries. Baits were 200 g fresh horse meat injected with an aqueous 1080 solution to provide a dose of 4.5 mg/kg of 1080 poison per bait. Injecting liquid compound 1080 provides a reliable dose rate per bait (Thomson 1986). The standard operating procedure was to dissolve powdered 1080 in water to form a solution. However, advice was that powdered 1080 degrades overtime (B. Parker, Department of Primary Industries and Fisheries in Queensland, pers. comm.) and the available powdered stock was several years old so it was considered appropriate to use an aqueous stock diluted to the appropriate amount in these trials. This required the higher concentration aqueous stock solution to be diluted to provide a measured dose of 4.5 mg/kg.

Baits were laid on drying racks for 12 hours to form a 'crust', before being injected and then frozen. A biomarker, RhodamineB, was added to the compound 1080 solution at the time of injection to aid in the identification of the cause of death of wild dogs (Fisher 1999).

4.2.6 Baiting technique

Baits were dropped from a Bell Jet Ranger helicopter fitted with a bait dispensing chute, at a height of 100 ft and airspeed of 30 kn (Figure 13). The height and airspeed were based on results of work reported in section 1 of this report and that of Thompson et al. (1990), which indicated that this height and speed resulted in an accurate deployment of baits. Predefined bait lines were selected from 1: 25000 topographic maps, in consultation with wild dog trappers who had worked in the area. Bait lines were mapped into Arcview 3.3 GIS software (ESRI, USA) and loaded into the onboard flight navigation system. Baits were dispensed at a rate of 1 per 100 m of linear transect as per Australian Pesticides and Veterinary Medicines Authority regulations.

4.2.7 Assessment of the effectiveness of aerial baiting

Wild dogs were tracked from a helicopter on several occasions over eight months prior to the toxic baiting to ensure they remained within the proposed baiting area, and on day 2, 6, 10, 14, 20, and

28 post aerial baiting to assess their fate. If a dog was recorded as dead, as determined from the signal pulse rate of the VHF transmitter, a GPS location was recorded and the carcass and collar retrieved. Staining of the mouth parts and stomach of retrieved dead dogs by the biomarker RhodamineB indicated that the animal died of 1080 poisoning.

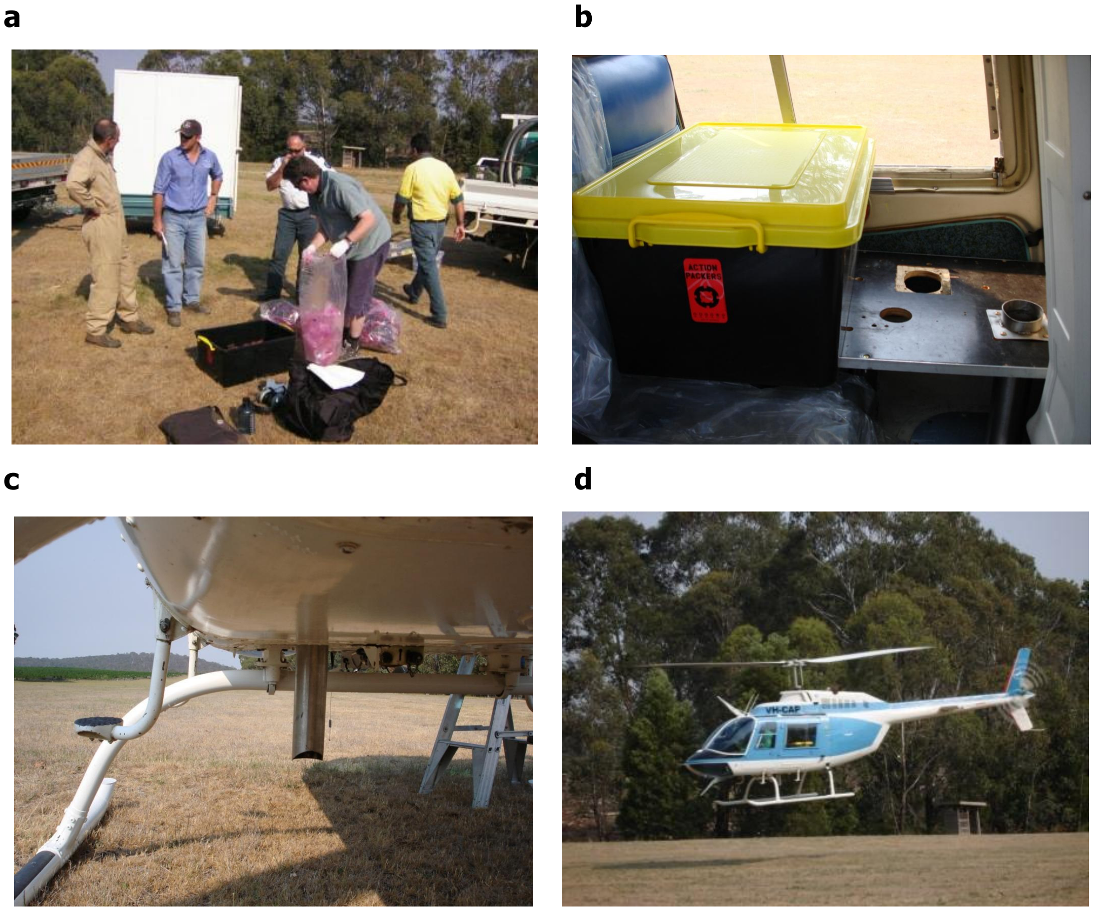

Figure 13. Preparation and application of aerial baits: (a) pre-prepared baits with RhodamineB markers, (b) bait box and dispensing table inside helicopter, (c) dispensing shute, and (d) Bell Jet Ranger used in baiting trials.

4.2.8 Determining area of use by wild dogs

Area of use was calculated using the 95% floating area minimum convex polygon option in the Home Range extension of Arcview 3.3 from GPS data retrieved from the collars.

Data from the GPS data-logging collars included latitude, longitude, time (GMT), date, fix status (3D+ = 5 or more satellites used to calculate a position location, 3D = four or more satellites, 2D = three satellites and 1D = less than three satellites). To assess the accuracy of location estimates, an additional collar was placed at a reference location.

Locations from the Argos-GPS data-logging collars were calculated from all messages received during a satellite pass.

4.3 Results

4.3.1 Cage trapping for spotted-tailed quoll

A total of 1890 trap nights were conducted across the three locations (630 trap nights per site) in two sessions. No spotted-tailed quolls were captured. There were 21 non-target captures (Scrubby Creek 14, Lucyvale 6, Mt Jack 1) involving three mammal and two reptile species.

Captured species were ten blotched blue-tongue lizards (*Tiliqua nigrolutea*), two common blue-tongue lizards (*Tiliqua scincoides*), four unidentified blue-tongue lizards (*Tiliqua* spp.), three common brush-tailed possums (*Trichosurus vulpecula*), one short-beaked echidna (*Tachyglossus aculeatus*) and one feral cat (*Felis catus*). No spotted-tailed quolls were detected during the additional trapping that was carried out in August 2006.

Bush Rats (*Rattus fuscipes*) were detected from scats as having been visitors to closed traps on 12 occasions, but chew marks on baits suggest that they may have also contributed significantly to the closed trap occurrences.

4.3.2 Camera survey for spotted-tailed quoll at Lucyvale

In 480 camera trap nights, no spotted-tailed quolls were detected. Table 2 lists the species detected and the percentage of sites at which they were detected.

Table 2. Species detected by camera traps at Lucyvale and the percentage of sites each species was detected at in each session.

Common Names	Scientific Names	Session 1	Session2
Common Brush-tailed Possum	*Trichosurus vulpecula*	35	45
Common Ring-tail Possum	*Pseudocheirus peregrinus*	5	0
Eastern Grey Kangaroo	*Macropus giganteus*	0	5
Swamp Wallaby	*Wallabia biocolor*	50	50
Common Wombat	*Vombatus ursinus*	35	20
Bush Rat	*Rattus fuscipes*	0	10
unidentified *Antechinus* spp.	*Antechinus* spp.	5	10
Feral Cat	*Felix catus*	15	15
European Rabbit	*Oryctolagus cuniculus*	5	15
Superb Lyrebird		45	35
unidentified currawongs	*Strepera* spp.	5	5
unidentified ravens	*Corvus* spp.	5	25

4.3.3 Wild dog captures

A total of nine wild dogs were captured, five males and four females (Table 3) from 4590 trap nights (i.e., 1 dog per 510 trap nights). Two dogs were caught at Mt Jack, six at Lucyvale and one at Scrubby Creek.

Males had a mean body weight of 18 ± 2.0 kg and females had a mean body weight of 15.3 ± 2.6 kg. None of the females were pregnant, although one had enlarged nipples suggesting pups had recently been weaned.

DNA samples collected from each dog indicate that two were genetically pure dingoes and the remainder were dingo–domestic dog hybrids. It should be noted that back-crossing can result in a genetically ‘pure’ dingo arising from hybrid parents.

Table 3. Details of wild dogs trapped at the three study locations.

Study site	Date captured	Age	Sex	Weight (kg)	Purity	Colour
Mt Jack*	11/02/2006	adult	F	16.5	Hybrid	yellow/black
Mt Jack	20/02/2006	-	M	19.0	Pure	tan/white
Lucyvale	14/02/2006	-	M	16.5	Hybrid	yellow
Lucyvale	18/02/2006	-	M	16.5	Hybrid	white/brindle
Lucyvale	19/02/2006	-	F	14.5	Pure	yellow
Lucyvale**	10/03/2006	young	F	12.0	Hybrid	yellow/brindle
Lucyvale	11/03/2006	-	M	17.0	Hybrid	brindle/white
Lucyvale	19/03/2006	adult	M	21.0	Hybrid	yellow
Scrubby Creek	10/02/2006	adult	F	18.0	Hybrid	yellow roan

* recaptured on 5/3/2006

** recaptured and killed on 27/8/2006 in response to a request for assistance from a landholder.

4.3.4 Bait deployment

Because of the small number of captures at Mt Jack and Scrubby Creek, aerial baiting was undertaken only at Lucyvale. Four hundred fresh meat baits were deployed at an average of one every 100 metres over 40 km of transects at Lucyvale in four hours in November 2006. Figure 14 shows the flight line and the area used by the collared wild dogs present at the time of baiting.

4.3.5 Fate of wild dogs and their collars

All collared wild dogs were tracked from the air on four separate occasions between 21 February and 21 March 2006. Dogs moved a mean of 2 km from the point of capture and were all located within the proposed baiting area.

At the time of baiting at Lucyvale, five wild dogs were determined to be available for the trial from tracking the VHF signal from a helicopter. One dog was killed by a wild dog controller responding to a request for assistance from a nearby landholder. The dog was at the time inside the study area. Of the five wild dogs present in the study area at the time of baiting, all were still alive six weeks later.

Four collars were retrieved; one released as per its timer release programming, two were retrieved from dogs recaptured after the baiting was undertaken, and one was the Argos-GPS data logger. Location data was available for this animal until the collar stopped transmitting 11 months after being attached, when the battery discharged. The fifth collar stopped transmitting its VHF beacon shortly after the captured dog was released and hence this collar could not be retrieved.

4.3.6 Area of use of wild dogs

The average area used by the four dogs over the five months that all dogs were present at the study site (one left the site in January 2007) was 2391 ha ± 1678 ha (Figure 14). Data from the reference collar indicated that positional error ranged from 11 m for 2D fixes to 3 m for 3D+ fixes.

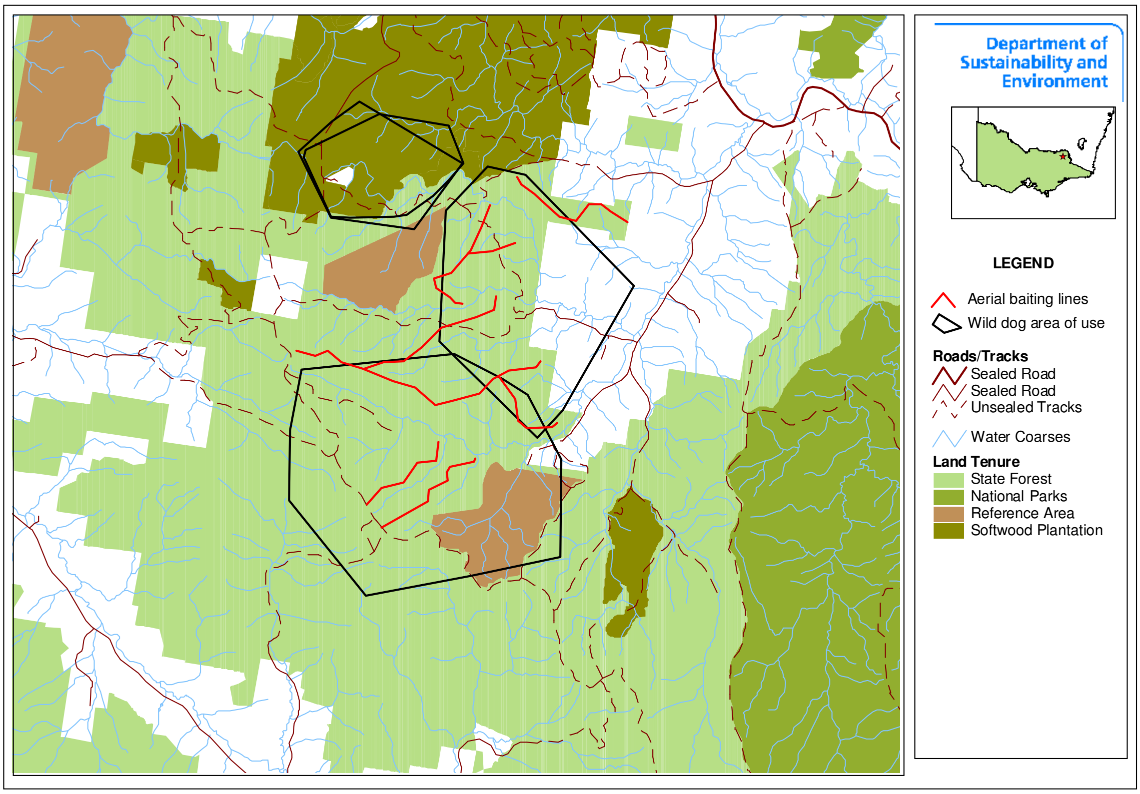

Figure 14. Aerial baiting flight lines and area used by the four wild dogs present at the time of baiting at Lucyvale.

4.4 Outcome

This trial implemented the first aerial baiting for wild dogs in Victoria for 37 years, collected movement and habitat data on wild dogs using GPS technology for the first time in Victoria, and investigated the status of the spotted-tailed quoll on three sites in north-eastern Victoria.

No wild dogs were killed by aerial baiting during this trial. A factor that had an unknowable influence on this was baits being under-dosed by a factor of 10 due to incorrect dilution of the aqueous solution during bait manufacturing. This was discovered in October 2007 as a result of a sample of the baits from the second trial being sent to the Alan Fletcher Laboratory (DPII, QLD) for testing to determine the concentration of 1080 present in the baits.

While we did not detect the presence of spotted-tailed quolls in our cage trap surveys in either March or August 2006 at Lucyvale, the species has been recorded in the general area. For example a road-killed spotted-tailed quoll was found near Tallangatta in May 2005 (30 km from Lucyvale; J. Alexander, DSE Wodonga, pers. comm.), nine records from the Atlas of Victoria Wildlife from 1937 to 2000 are in the general vicinity of the three study sites, and local residents have reported seeing them. Our March surveys were undertaken at a time of year when female spotted-tailed quoll were unlikely to be moving widely throughout the landscape (Belcher 2003). In autumn it is likely that some young from the previous year are still resident in their natal home range, and resident females are moving in preparation for the breeding season (e.g. establishing territories), but little is known about male behaviour and movement at this time. Trapping was undertaken at this time at Lucyvale to fit in with the overall timelines for the delivery of the aerial baiting project. However, the probability of trapping quolls is generally considered to be greatest in May–

July, because males and females are actively moving during the breeding season (J. Nelson, Arthur Rylah Institute, pers. comm.). Cage trapping was undertaken in Gippsland in August (one week prior to the second round of trapping at Lucyvale) in an attempt to locate a suitable site for a toxic trial in November. This survey successfully detected three quolls. Heat-in-motion digital camera surveys undertaken in Gippsland at the same time (as part of another research project) as the cage trapping for this study was able to detect the presence of spotted-tailed quoll (J. Nelson, Arthur Rylah Institute, pers. comm.). The second survey at Lucyvale in August again did not detect spotted-tailed quolls. Although cage trapping and heat-in-motion camera surveys detected quolls at the Gippsland site, they did not do so at Lucyvale despite three trapping sessions, extensive camera trapping and physical searches for signs. The weight of evidence indicates that there are no resident spotted-tailed quolls at Lucyvale, Mt Jack and Scrubby Creek.

5 Assessing the safe and effective use of aerial baiting - Gippsland

5.1 Introduction

A second trial was undertaken to establish the impact of aerial baiting on spotted-tailed quoll populations and its effectiveness in controlling wild dogs in Gippsland. The purpose was to replicate the initial trial in north-eastern Victoria to test whether different environmental conditions would influence the effectiveness of aerial baiting. Furthermore, populations of spotted-tailed quoll are more common in eastern Victoria. The planned approach was the same as the north-east Victorian trials, i.e., to establish the presence of a population of spotted-tailed quoll and wild dogs and then to assess the effectiveness of toxic baiting by determining the kill rate of a known number of individuals of both spotted-tailed quolls and wild dogs.

5.2 Methods

5.2.1 Study areas

Four sites were selected based on criteria outlined in section 3.2.1. Two sites were selected to investigate the potential impact of aerial baiting on spotted-tailed quolls, and two for a possible toxic aerial baiting of wild dogs and spotted-tailed quolls. The sites were Rock Range (37° 02′ E, 148° 18′ S), Ingeegoodbee Track (36° 54′ E, 148° 20′ S) for impact on spotted-tailed quolls (Figure 15), and Nunniong Plain (147° 56′ E, 37° 07′ S) and Cobungra, 10 km to the west of Omeo (147° 28′ E, 37° 10′ S) for impact on spotted-tailed quolls and wild dogs (Figure 16).

5.2.2 Capturing wild dogs

Wild dog trapping was undertaken by DPI wild dog trappers and DSE Land Stewardship Officers 14 days from the 20 March 2007 at Nunniong and Cobungra. Twenty Lanes soft-jaw leghold traps were set at each site using visual or olfactory signs. Traps were checked daily, early in the morning to reduce the chance of injury to animals. Additional traps were set as time permitted and if additional 'fresh' signs were identified by the trappers.

Restraint and processing of wild dogs followed the same methodology as section 3.2.3. Dogs were fitted with a GPS-Argos satellite linked collar. The collars were programmed to acquire a GPS location every 30 minutes for 75 days and then every six hours for another six months. All collars were fitted with a timed release device and a VHF beacon, allowing us to maintain contact with the collared dogs before and after the trial and retrieve the collars by tracking the beacon by helicopter.

5.2.3 spotted-tailed quoll surveys

Surveys were undertaken at all four sites following the procedures set out in section 3.2.2.

5.2.4 Aerial bait preparation

See section 3.2.5 for details of method.

5.2.5 Aerial baiting technique

See section 3.2.6 for details of method.

5.2.6 Assessing the effectiveness of aerial baiting

See section 3.2.7 for details of method.

5.2.7 Determining wild dog area of use

See section 3.2.8 for details of method.

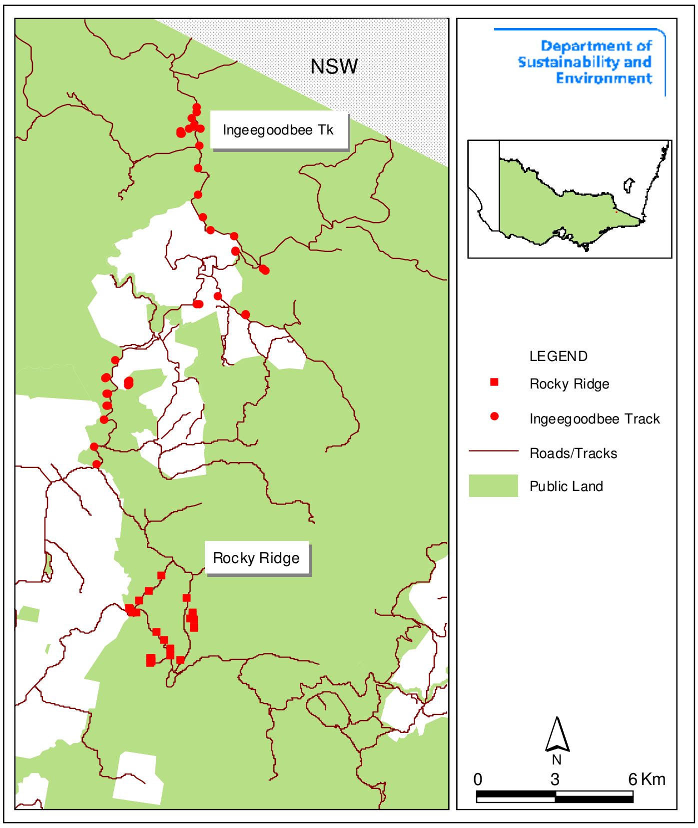

Figure 15. Location of cage traps used to survey spotted-tailed quoll at Rocky Ridge and Ingeegoodbee Track.

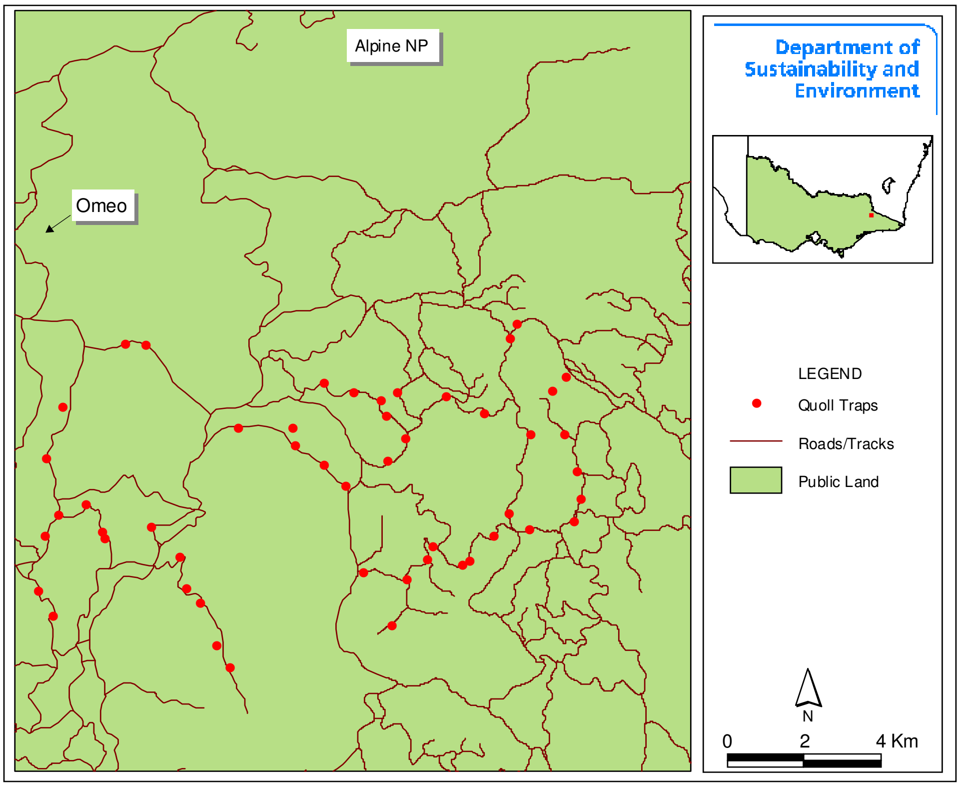

Figure 16. Location of cage traps used to survey spotted-tailed quolls at Nunniong Plain.

5.3 Results

5.3.1 Wild dog captures

Ten wild dogs (five males, five females) were caught at Nunniong Plain over 180 trap nights. The mean body weight of males was 17 ± 2 kg and females 12 ± 4 kg. None of the females were pregnant. Three male wild dogs were captured at Cobungra. Because of the small numbers of wild dogs captured at Cobungra, the Aerial Baiting Stakeholder Consultative Committee agreed that no aerial baiting trial would be undertaken at this site.

Table 4. Details of wild dogs captured at Nunniong Plain in March 2007.

Location	Date captured and collared	Date collar dropped off	Number of days collared	Sex	Weight (kg)	Approx. age (yrs)	Home range (km^2)	Purity
Nunniong	26/03/07	24/04/07	29	F	17.5	2–3	—	Pure
Nunniong	23/03/07	30/03/08	373	F	14.0	—	95	Hybrid
Nunniong	20/03/07	—	—	M	14.0	1	—	Hybrid
Nunniong	26/03/07	19/12/07	268	M	18.0	4	59	Hybrid
Nunniong	22/03/07	03/06/07	73	M	19.0	—	171	Hybrid
Nunniong	24/03/07	30/09/07	190	F	9.0	1	41	Hybrid
Nunniong	22/03/07	12/12/07	265	F	7.0	1	71	Hybrid
Nunniong	20/03/07	14/11/07	239	F	13.0	1	36	Hybrid
Nunniong	21/03/07	09/12/07	263	M	17.0	5	231	Hybrid
Nunniong	25/03/07	14/11/07	234	M	18.5	—	156	Hybrid
Cobungra	21/03/07	31/12/07	285	M	20.0	—	91	Hybrid
Cobungra	21/03/07	16/10/07	209	M	20.0	2–3	45	Hybrid
Cobungra	24/03/07	04/03/08	345	M	24.0	—	63	Hybrid

5.3.2 Cage trapping for spotted-tail quoll

Surveys were conducted in August 2006 at Rocky Ridge and Ingeegoodbee Track, and in April 2007 at Nunniong Plain. A total of 770 trap nights were conducted across the Rocky Ridge and Ingeegoodbee Track, and 280 nights at Nunniong Plain. One male and two females were captured at Rocky Ridge and one female at Ingeegoodbee Track (Figure 17). All females had pouch young, ranging in estimated age from several days to one month (Chris Belcher, pers. comm.). No quolls were captured at Nunniong Plain.

Figure 17. spotted-tailed quoll at Rocky Range, Gippsland.

5.3.3 Aerial bait deployment

Seven hundred and thirty fresh meat baits were dropped at Nunniong Plain at an average of one every 100 metres over 80 km of transects in six hours on 8 May 2007 (Figure 18). Due to the low number of wild dog captures no baiting was undertaken at Cobungra.

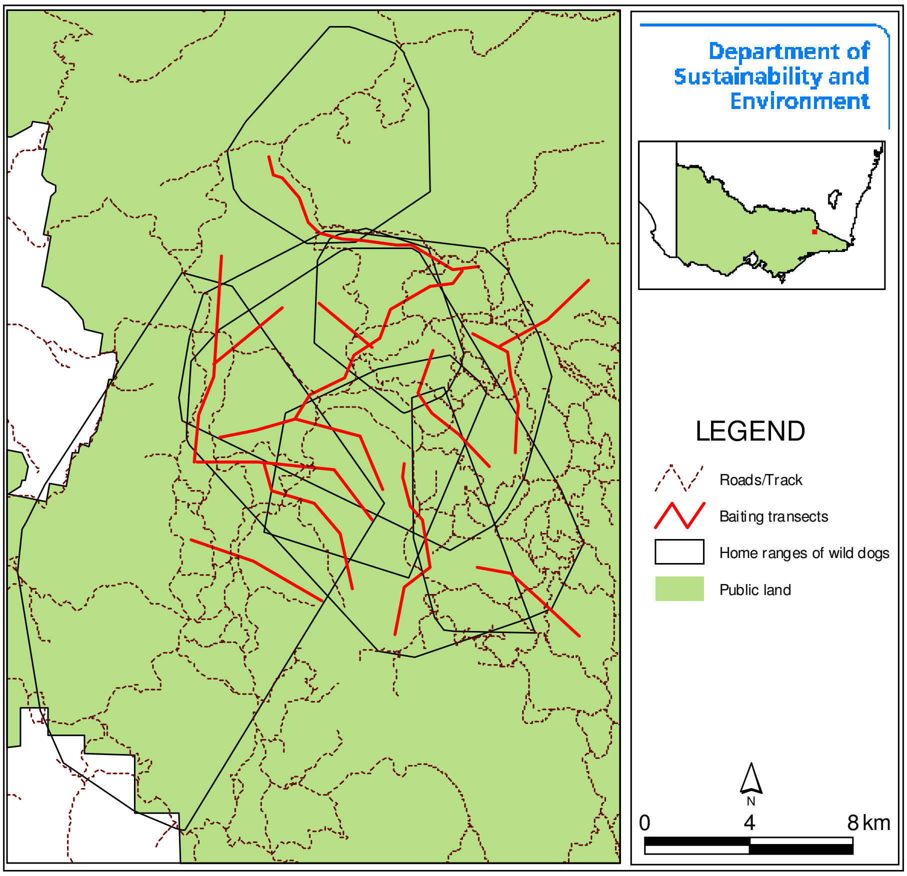

Figure 18. Location of aerial baiting transects and home ranges of wild dogs at Nunniong Plain, Gippsland, May 2007.

5.3.4 Fate of wild dogs

No wild dogs were killed during the aerial baiting phase of the trials. Four dogs were subsequently re-trapped and killed by DPI wild dog controllers. The majority of collars were also retrieved and analysis of home range and habitat selection undertaken (Robley et al. 2009).

5.4 Outcome

We planned and conducted an aerial baiting program and the status of spotted-tailed quoll established at a further three sites in Gippsland. The GPS location data provided significantly greater detail of wild dog movement and habitat use than previously available (Robley et al. 2009). No wild dogs were killed by aerial baiting during this trial. A contributing factor to this was the baits being under-dosed, because an incorrect dilution factor was applied to the aqueous solution by DPI officers. This fact was not discovered until October 2007 after this and the earlier north-eastern Victoria trial, when a selection of baits were sent for analysis to the Alan Fletcher Laboratory (QLD DPII) as part of another trial investigating the rate of decay of 1080 in predator meat baits.

Baits used in this trial were manufactured by staff from the Victorian Department of Primary Industries. Baits were made from 250 gm fresh meat injected with 0.15 ml of 1080 to provide the 4.5 mg/kg dose required for wild dog baits. The solution of 1080 was made from mixing powdered 1080 with water to produce the required dilution. Following advice (B. Parker, QLD DPI, pers. comm.) powdered 1080 product was replaced with a pre-prepared 1080 solution (30g/l 1080 concentrate). This solution also required mixing with water to produce the correct dilution. However, the dilution rates are different for powdered 1080 and the aqueous 1080, a fact not known by the DPI officers preparing the baits. The result was an over dilution by a factor of 10.

In searches for suitable sites for the Gippsland trial, spotted-tailed quolls were detected at two sites, but in numbers too low to provide robust results. It became apparent that assessing the safe use of aerial baiting through its impact on spotted-tailed quoll would be impractical, as the densities of this species were very low. It was agreed by the ABSCC that future trials would focus on the effectiveness of aerial baiting to reduce wild dog numbers only.

6 Assessing the safe and effective use of aerial baiting - Gippsland retrial

6.1 Introduction

A third trial was undertaken at two sites in Gippsland in November 2007 to assess the impact of aerial baiting on a known number of wild dogs. This repeat trial was undertaken at Nunniong Plain and at Cobungra to take advantage of the dogs already collared at these sites from the previous trial. Additional trapping was undertaken at both sites in an attempt to increase the number of wild dogs collared during this trial. Prior to undertaking toxic aerial baiting, the Cobungra site was surveyed for the presence of spotted-tailed quoll. The Nunniong Plain site had been surveyed for quolls in March 2007, and the ABSCC agreed that it was not necessary to resurvey that site.

6.2 Methods

6.2.1 Spotted-tailed quoll surveys

Surveys were conducted in October 2007 at Cobungra. Forty-nine collapsible wire cage traps were set out following the procedures outlined in section 3.2.2.

6.2.2 Capturing wild dogs

Trapping for wild dogs at Nunniong Plain and Cobungra was undertaken in October 2007 using the same methodology in section 4.2.2.

To supplement the existing number of wild dogs fitted with GPS-Argos data-logging collars, any wild dogs caught at Nunniong Plain or Cobungra were fitted with VHF transmitting only collars.

6.2.3 Bait preparation

Predator meat baits were prepared by the Department of Primary Industries as per revised operating procedures using aqueous 1080 solution (Keyideas 2007). Baits were 200 g fresh horse meat, injected with liquid 1080 solution to provide a dose of 4.5 mg/kg of 1080 poison per bait. Baits were dried on racks for 12 hours to form a ‘crust’ before being injected and then frozen. A sample of 10 baits was sent to the Alan Fletcher Laboratory, Queensland Department of Primary Industries and Fisheries, for assessment of the 1080 concentration prior to baiting.

6.2.4 Baiting technique

Baiting was undertaken following the same methods as in section 3.2.6.

6.2.5 Assessing the effectiveness of aerial baiting

Assessment of the effectiveness of aerial baiting was undertaken using the same methods as in section 3.2.7.

6.3 Results

6.3.1 Spotted-tailed quoll survey

Following 926 trap nights, no spotted-tailed quolls were captured during surveys at the Cobungra site. However, several possible quoll scats were collected during this work. Two of these were subsequently identified as belonging to spotted-tailed quolls, and as a result the ABSCC decided that the planned trial would not be undertaken on the Cobungra site.

6.3.2 Wild dog captures

Two females and one male were caught and collared at Nunniong Plain (Table 5). No wild dogs were captured at Cobungra.

Table 5. Details of wild dogs available at Nunniong Plain for the aerial baiting trial.

Location	Date captured and collared	Date collar dropped off	Sex	Weight (kg)	Approx. age (yrs)	Home range (km^2)	Purity
Nunniong	23/03/07	30/03/07	F	14.0	—	95	hybrid
Nunniong	26/03/07	19/12/07	M	18.0	4	59	hybrid
Nunniong	22/03/07	12/12/07	F	7.0	1	71	hybrid
Nunniong	20/03/07	14/11/07	F	13.0	1	36	hybrid
Nunniong	21/03/07	9/12/07	M	17.0	5	231	hybrid
Nunniong	25/03/07	14/11/07	M	18.5	—	156	hybrid
Nunniong*	10/10/07	—	M	20.0	2–3	—	hybrid
Nunniong*	13/10/07	—	F	17.0	4–6	—	hybrid
Nunniong*	14/10/07	—	F	14.0	1	—	hybrid

* dogs caught in October 2007 and fitted with VHF-only collars

6.3.3 Bait deployment

On 8 November 2007, 604 predator meat baits were dispensed from a helicopter along 80 km of bait line over the Nunniong Plain trial site, following the same route as the May 2007 flight (Figure 18). The baits contained an average of 4.69 mg of 1080 (range 3.22 – 6.55 mg/bait).

6.3.4 Fate of wild dogs

At the time of baiting nine wild dogs were present on site (six with GPS collars and three with VHF-only collars). The fate of the three VHF collared dogs is unknown as they were not able to be relocated after baiting, despite extensive searching.

Of the remaining six dogs, none conclusively died from aerial baiting. Two dead dogs were recovered. GPS locations indicate that one of these died 46 days after baiting; this was an old dog and most likely died from causes other than aerial poison baiting. The other was found two metres down a wombat hole. GPS data was last received on 14 November 2007, six days after baiting. It is likely that this animal died as a result of consuming poison bait. The collar was retrieved on 19 December, but the advanced state of decay of this animal prevented extraction of the RhodamineB biomarker which would indicate the presence of 1080.

6.4 Outcome

This was the third planned and implemented aerial baiting program, and it established the presence of spotted-tailed quoll at a third site in Gippsland. The additional GPS data enhanced the data collected in the previous trial.

Although all baits used in this trial were toxic at the time of deployment, only one dog was considered to have been killed by a bait. Three dogs (with VHF-only collars) could not be relocated, and their fate is unknown.

Given the lack of temporal and spatial replication and small sample size, it is not possible to draw any general conclusions about the effectiveness of aerial baiting other than to state that at that site, at that time, it was not effective in reducing the sample of collared wild dogs.

Factors that would have affected the result include bait density, availability of alternative food sources, the life of the bait (e.g. European Wasps, *Vespula germanica*, can quickly degrade baits), and the underlying density of foxes, which also take predator meat baits.

The only previous study to conclude that aerial baiting is effective was undertaken in New South Wales using a density of 40 baits per linear kilometre, replicated in each of three years (Fleming et al. 1996). Importantly their study indicated that between years, wild dogs were able to recover to comparable levels. Research is being undertaken by NSW DPI investigating the relative efficacy of different baiting rates (P. Fleming, pers. comm.).

6.4.1 Spotted-tailed Quoll population modelling

The results of our surveys for a population of spotted-tailed quoll revealed that this species is sparsely distributed and where present are in low densities. This finding is supported by other surveys undertaken in recent years in Victoria (Nelson 2007; Nelson and Belcher 2008; Nelson et al. 2008; Nelson et al. 2010). To gain some insight into the likely impact of aerial baiting on populations of spotted-tailed quoll, a model was developed to explore the likely impact of additional mortality on small populations (Todd and Robley 2006).

The purpose of this model was to investigate the potential impact of aerial baiting on a population of spotted-tailed quolls over 20 years. Investigations to date on the impact of aerial baiting have been conducted as one-off trials and are not able to predict the impact of sustained control over longer periods. The model was also intended to aid managers in making a decision on the likely impact of aerial baiting in Victoria. Dr Andrew Claridge, New South Wales Department of Conservation and Environment, supplied data used to construct the model, as there were insufficient data from Victoria to use in the modelling.

The risk of extinction of a population of 100 females over 20 years was modelled. In toxic aerial baiting trials conducted by the NSW Department of Environment and Conservation (DEC) in winter 2004, 31 radio-collared quolls were monitored following a routine aerial baiting program in Tuggolo State Forest and Nowendoc National Park, on the Northern Tablelands of NSW. One died from 1080 and a further five consumed toxic bait and survived. During late-autumn and winter of 2005 a trial was conducted in the Styx River State Forest and parts of Cunnawarra National Park on the Northern Tablelands. Fourteen radio-collared quolls were subjected to aerial baiting. Two died however there was no 1080 residual found, but Rhodomine B (RhB) dye injected into the baits was found in their whiskers. A further 11 individuals had RhB in their whiskers but survived. In 2005 a trail was conducted within the catchment of the Jacobs River in southern Kosciuszko National Park. Sixteen radio-collared quolls were exposed to aerial baiting. One quoll death was recorded, and it did not test positive to 1080. Of 18 whisker samples collected from live quolls after baiting, six (32 %) tested positive for RhB.

Concurrently with the DEC research, the Queensland Department of Natural Resources and Mines measured quoll mortality during surface baiting programs for wild dogs. In trials between 2002 and 2005 in southern Queensland, 76 radio-collared quolls were exposed to surface-laid baits. Two 1080-related deaths were recorded with an additional six radio-collared quolls dying from unknown causes.

In the model we removed one, two and three females per year from the population as additional mortality associated with aerial baiting operations. The risk of extinction for habitat that supports smaller populations was also modelled. Hence, a population of 25 females over 20 years with one, two and three females removed each year was also considered.

With the removal of an increased number of females, the average minimum population size moved closer to zero (i.e., extinction; Table 6), the increased number of removals is defined as added risk.

The percentage increase in added risk is the difference between the average minimum population size with no removals and that with one, two or three removals divided by the no removal estimate multiplied by 100.

Spotted-tailed quolls are highly fecund animals and, given the reported survival rate estimates, the associated growth rate estimate suggests their populations should be relatively robust. However, the populations face the usual risks associated with small population size. If resources are sufficient to support a larger female population then there is less likelihood of chance events driving the population to extinction. But if the female population is relatively small then the risk of extinction through chance events alone may be high.

As a starting point for discussing further research required for facilitating the management of spotted-tailed quolls, the model highlights several key knowledge gaps. Estimates of survival rates for spotted-tailed quolls from long-term investigations of marked animals would improve the understanding of population dynamics as well as inform management about possible key sensitivities. In circumstances of small female populations, an understanding of the role of dispersal is critical to comprehending how small populations persist. The preliminary modelling suggests that small populations may not persist under minor disturbance. On the other hand, in Victoria smaller populations may be the norm, so these populations would need to be highly connected with other populations in order to persist.

Table 6. Summary of outcomes of spotted-tailed quoll population model.

Model	Initial population	Time (yrs)	No. females lost to baiting	No. populations extinct from 1000 trials*	Est. min population size after 20 years	Increased risk (%)
1	100	20	—	2	55	—
2	100	20	1	29	47	15
3	100	20	2	114	37	33
4	100	20	3	291	27	51
5	25	20	—	115	10	—
6	25	20	1	624	4	59
7	25	20	2	929	0.75	93
8	25	20	3	988	0.1	99

* This is the number of populations that go extinct from 1000 interactions of a particular scenario.

7 Discussion

The objective of these trials was to provide information that would assist in deliberations about the reintroduction of aerial baiting for the control of wild dogs in Victoria. We undertook a series of trials designed to address four main aims:

1. the ability to place baits accurately from the air;
2. the relative fate of surface laid baits versus buried baits;
3. the risk posed by aerial baiting to non-target species, in particular spotted-tailed quoll;
4. the effectiveness of aerial baiting at killing wild dogs.

This study demonstrated that baits can be deployed with an average accuracy of 5.6 m ± 1 m in mountainous terrain, although it should be noted that some baits will fall greater than 10 m from the flight line. This study confirmed that surface-laid baits are more likely to be taken by non-target species, which has implications for the effectiveness of aerial baiting programs. It was established that spotted-tailed quolls are rare in the landscape and likely to occur at low densities. An additional project used this knowledge to investigate the risk of extinction faced by small populations from the loss of a small number of females. This clearly showed that for small, potentially isolated populations, even small increases in mortality can lead to significantly increased risk of extinction (Todd and Robley 2006). We also implemented three aerial baiting operations. While incorrect dilution of the aqueous 1080 nullified two of the three trials, and only a very low kill rate (11%) was achieved in the third trial, we increased our understanding of wild dog movement and habitat use significantly. This knowledge has been used in subsequent projects investigating the efficacy of ground-based baiting programs (Robley et al. 2009). This work showed that ground-based baiting can be effective. However, areas with limited track access can lessen the spatial distribution of baits, potentially reducing the likelihood that wild dogs will encounter effective baits.

The effectiveness of aerial baiting to control wild dogs and foxes using fixed-wing aircraft was first investigated in Western Australia between 1946 and 1953 using brisket fat and strychnine (Tomlinson 1954). This work concluded that aerial baiting was more cost-efficient than ground-based baiting but that it was not necessarily more effective at killing dogs because ‘Men operating on the ground had more time to observe tracks and signs and are able to place baits exactly where required’. However, the author noted that in inaccessible areas, aerial baiting is an effective tool for killing wild dogs. Factors such as time of year, weather, placement of baits and using aerial baiting in conjunction with ground-based activities all contribute to the success of wild dog control.

The effectiveness of aerial baiting at reducing wild dogs has been assessed by a number of other trials, with varying results. Newsome et al. (1972) investigated the effectiveness of aerial baiting around watering points in central Australia in 1968, and concluded that this campaign was a failure. The effectiveness of aerial baiting with fixed-wing aircraft and 1080-poisoned meat baits has been demonstrated to be an efficient and cost-effective method for controlling dingoes in the pastoral zone of north-western Western Australia (Thomson 1986). In three trials in 1980 and 1981, aerial baiting was shown to reduce the abundance of wild dogs by 100%, 63% and 62% (Thomson 1986). A similar trial in 1985 reduced the number of radio-collared wild dogs by 85% (Thomson and Marsack 1992). McIlroy (1986) assessed two surface-laid poison baiting operations in Kosciuszko National Park, New South Wales, in which nine wild dogs were radio-collared and baits were laid on the surface at bait stations along trails. Only two of the nine dogs were killed (a 22% kill rate). Thomson and Marsack (1992) also recorded a range of changes in the abundance of wild dogs (6–80% reductions) in the Nullarbor area as the result of aerial baiting with 1080-

poisoned baits. Bait type and the age and social status of the targeted dogs appeared to affect the efficacy of the baiting program (Thomson and Marsack 1992). Fleming et al. (1996) investigated the efficacy of aerial baiting with 1080 poison for the control of wild dogs in the temperate rangelands of north-eastern New South Wales from 1991 to 1993. Reductions of 66.3–84.5% in the abundance of wild dogs at the treatment site were found based on ln-transformed frequency corrected for sightability of signs. The indices of abundance measured prior to the annual baiting in 1992 and 1993 were similar, indicating that populations returned to their initial abundance within one year. Burrows et al. (2003) report that a single large scale aerial baiting (1600 km^2) using 40–60 g dried meat baits at 5 per km^2 for the control of both wild dogs and foxes resulted in almost complete removal of these species over a 15-month period.

In the trials where control failed (Newsome et al. 1972; McIlroy 1986), the authors suggested that bait type, seasonal conditions, the rapid loss of toxicity, the rapid rate of removal of baits by non-target species, particularly the Red Fox and birds, and the dogs' apparent preference for natural prey were reasons why there was no reduction in wild dogs.

Bait application rates in previous studies have been in the order of 40 baits/linear km but recent changes to the conditions for the use of 1080 restrict the application rate to 10 baits/linear km as used in this trial. It might be possible that this rate is too low for effective control.

If aerial baiting is to be reintroduced into Victoria, the following areas of investigation should be considered:

- In areas where spotted-tailed quolls are suspected or likely to occur, investigations to confirm their presence need to be conducted given the likely impact the loss of only few individuals could have on low density, fragmented populations which appear to characterise Victorian populations.
- Bait application rate. There is currently no information available to land managers on the comparative effectiveness of different baiting rates. However, NSW DPI is investigating aerial baiting rates between 10 and 40 baits per kilometre. Consideration should be given to implementing trials investigating rates between these two extremes to help inform best-practice management in Victoria.
- How best to integrate aerial baiting with ground-based baiting. The aim of placing baits should be to maximise the likelihood of wild dogs encountering bait using knowledge gained from these trials and subsequent work on movement and habitat use, including the timing and frequency of aerial baiting.
- Long-term monitoring of the costs and benefits of aerial baiting. This should include impacts on stock losses and the effect on native species predated by wild dogs and native species killed.
- The likely impact that wild dog baiting has on population levels of foxes and the potential flow-on effects to population levels of feral cats and the potential impact on native species.

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