

Animal welfare and procedure compliance for non-commercial kangaroo shooting: Australian Capital Territory, 2015



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1. Introduction

Peri-urban populations of eastern grey kangaroos (*Macropus giganteus*) in the Australian Capital Territory (ACT) reach high densities and have been subjected to ongoing reduction programs (ACT Parks, Conservation and Lands 2010). To date, reduction of kangaroo populations deemed overabundant has been largely achieved by non-commercial or “damage-mitigation” professional shooting (Department of Environment and Heritage 2008). The use of shooting as a management tool for the reduction of kangaroo population densities is described in the ACT Kangaroo Management Plan (ACT Parks, Conservation and Lands 2010). Under the ACT Kangaroo Management Plan, all kangaroo shooting programs are required to be conducted in accordance with the *National code of practice for the humane shooting of kangaroos and wallabies for non-commercial purposes* (hereafter ‘the COP’; Department of Environment and Heritage 2008). The COP sets a minimum standard of humane conduct for persons undertaking the non-commercial culling of kangaroos.

The 2015 peri-urban ACT Government kangaroo conservation cull was conducted with the intent of strict adherence to the standards outlined in the COP. To facilitate compliance with the COP and to allow transparent demonstration of animal welfare outcomes, an independent animal welfare audit was conducted. A veterinarian, independent of the shooting program (i.e. not a member of the shooting team or an employee of the managing agency) collected ante-mortem (before death) and post-mortem (after death) data from a representative sample of shot animals. The independence of the observer from the shooting team and the managing agency was considered important to provide an unbiased assessment of the program to stakeholders and the general public. The importance of independent observers for the transparent quantification of animal welfare parameters has been recognised for many contentious wildlife management programs (Daoust and Caraguel 2012; Greene *et al.* 2013; Hampton *et al.* 2014).

2. Methodology

Methodology for the independent animal welfare audit was largely derived from peer-reviewed studies of animal welfare outcomes in wildlife shooting programs (Lewis *et al.* 1997; Hampton *et al.* 2015). Methods were also adapted from non peer-reviewed studies that have assessed similar night shooting methods (Department for Environment, Food and Rural Affairs 2013) and those that have studied kangaroo shooting specifically (ACT Parks and Conservation Service 2013; McLeod and Sharp 2014). An independent animal welfare audit of damage-mitigation kangaroo shooting in the ACT was undertaken in 2013 (ACT Parks and Conservation Service 2013), and the methods used there were adapted to reduce selection bias resulting from shooter selection of animals to be assessed (see Hampton *et al.* 2015). Procedure-based measures were used to assess protocol compliance and animal-based measures (see Whytt *et al.* 2003) were used to assess animal welfare outcomes.

2.1. Study area

Shooting events were observed on five nights in June 2015. Shooting events were observed in four reserves: Mount Painter Nature Reserve, The Pinnacle Nature Reserve, Mulanggari Grasslands Nature reserve, and Wanniasa Hills Nature Reserve.

2.2. Shooting configuration observations

The COP specifies that shooters should aim so as to hit adult kangaroos in the brain and that juvenile 'young-at-foot' animals should be shot so as to be hit in the brain or heart. The COP specifies that a rifle of minimum .204 Ruger® centrefire calibre should be used. The COP specifies that immediately after shooting of adult kangaroos, pouches of shot females should be checked for the presence of live pouch young, and if detected, they should be euthanased with blunt cranial trauma or decapitation. The independent observer recorded the specifications of all equipment used and documented procedures followed by the shooting team.

A customised four-wheel drive buggy vehicle (without a windscreen) was the platform for a shooter, driver and observer. A driver drove the vehicle slowly (5–10 km/h), with the observer sitting on a bench seat between the shooter and the driver. The observer used thermal imaging observation methods developed for the study of European badger (*Meles meles*) shooting techniques in the United Kingdom (Department for Environment, Food and Rural Affairs 2013). A Guide IR® 518C monocular thermal imager (Wuhan Guide Infrared Inc., Wuhan, China) was used to observe all shooting events.

The vehicle was stopped when a stationary kangaroo was sighted and estimated to be within the maximum shooting distance specified by the COP (i.e. <200 metres). Shooting was not to be undertaken from a moving vehicle, nor targeting moving or non-standing animals. Following the COP, the shooter shot at the cranium (brain) as the sole target anatomical zone for adult kangaroos and the brain or thorax as target anatomical zones for sub-adults (young-at-foot). A .223 Remington® calibre bolt-action rifle was used to fire 55 grain soft-point ammunition, as per the COP. The rifle was fitted with a telescopic scope as per the COP. Spotlights (white light illumination) are used for many kangaroo shooting methods (McLeod and Sharp 2014) but were not used in this program. Further specifications of the shooting equipment or configuration have not been published in order to protect the intellectual property and anonymity of the shooting team. Animals were searched for after shooting using limited white light illumination. Searching for shot animals was abandoned on one occasion when protestors were observed to be present in the immediate vicinity.

2.3. Ante-mortem observations

2.3.1. Kangaroo shooting

From each shooting event, the observer recorded the following data as per Hampton *et al.* (2015): the number of shots fired at each animal, whether shots hit animals, the apparent time to insensibility for shot animals, whether shot animals died or escaped wounded, and whether or not killed animals were found. As soon as possible after shooting a cohort of animals, the animals were approached to confirm death, check for the presence of pouch young and assess ballistic pathology (bullet wound injuries).

When adult female kangaroos were shot, any pouch young present were required to be euthanased according to the COP. To assess this component of kangaroo shooting, observation methodology was largely derived from a study of animal welfare outcomes in commercial kangaroo shooting (McLeod and Sharp 2014). It has been argued that unfurred pouch young do not meet the scientific criteria for sentience, or the capacity to suffer, prior to the age of fur development and eye opening, due to limited brain

development. For a discussion of neurological development and the onset of sentience in marsupials, see McLeod and Sharp (2014).

2.3.2. Pouch young euthanasia

From each pouch young euthanasia event, the observer recorded the following data as per McLeod and Sharp (2014): the number of pouch young present, the age class of pouch young (furred or unfurred), euthanasia method (blunt trauma or decapitation), duration from pouch removal to euthanasia being applied (for furred animals), and the number of blows struck to each animal (as per Daoust *et al.* 2013).

2.4. Post-mortem observations

Adult kangaroos were subjected to post-mortem examination immediately following collection and euthanasia of pouch young, if present. The observer recorded the age of each animal (adult or sub-adult), the sex of the animal, and bullet wound tract locations. Locations of bullet wounds in the carcass were recorded following the methodology of Urquhart and McKendrick (2003). The pouches of adult female kangaroos were inspected for the presence of pouch young undetected by the shooting team, and the number of lactating mammary glands was recorded.

3. Results

Observations were made for a total of 141 kangaroos that were shot at over five nights and four field sites. By field site, the shooting of animals was observed at Mount Painter Nature Reserve ($n=39$), Mount Pinnacle Nature Reserve ($n=70$), Mulanggari Grasslands Nature reserve ($n=6$), and Wanniasa Hills Nature Reserve ($n=26$).

3.1. Shooting configuration

The firearm and ammunition used by the shooting team are described in 2.2 (above), and complied with the COP. On all shooting nights observed, the firearm was confirmed to be zeroed at approximately 75 m prior to use, as per the COP. During kangaroo shooting, shots were only taken when there was a known earthen backstop created through the relative topographic elevation of the shooting position, as per standard practice with peri-urban shooting (see DeNicola and Williams 2008).

Table 1. Summary of ante-mortem data (as per Hampton *et al.* 2015) collected during non-commercial shooting of eastern grey kangaroos (*Macropus giganteus*) in the Australian Capital Territory, June 2015.

Category	Sample size (<i>n</i>)
Number of animals shot at	141
Number of animals hit	139
Number of animals rendered immediately insensible	136
Number of animals found	134
Number of animals presumed killed but not found during observations	5
Number of animals killed with multiple shots	2
Number of animals escaping unwounded	2
Number of animals killed with a single shot but not rendered immediately insensible	1
Number of animals escaping wounded	0

3.2. Ante-mortem data

All kangaroos were stationary and standing prior to shooting, and estimated to be within 120 metres of the shooter when shot. The outcomes for 141 animals that were shot at are shown in Table 1, as per Hampton *et al.* (2015). A total of 143 shots were fired, with two shots observed to miss animals entirely and two animals (1% of shot animals) being shot twice. A total of three animals were observed to not be rendered immediately insensible by shooting; two kangaroos were shot twice after being observed to be sensible (conscious) and mobile following the first shot, and one sub-adult animal (young-at-foot) was shot once (thorax shot) but was not rendered immediately insensible (5 second duration to insensibility). The shooting team performed repeat shots on both animals that were not killed by the first shot before subsequent animals were targeted. All other shot animals (98%; $n=136$) were rendered immediately insensible from the first shot, based on observation. The shooting team confirmed the sex of all animals that were found, and inspected the pouches of all female kangaroos that were found for pouch young, after animals were moved to the shooting vehicle.

Table 2. Summary of demographic post-mortem information for eastern grey kangaroos (*Macropus giganteus*) subjected to non-commercial shooting in the Australian Capital Territory, June 2015.

Category	Sample size (<i>n</i>)
Adult females with pouch young shot	66
Adult females without pouch young shot	6
Adult males shot	45
Sub-adult females shot	10
Sub-adult males shot	7
Unfurred pouch young euthanased	57
Furred pouch young euthanased	9
Kangaroos presumed killed but not found during observations	5

3.3. Post-mortem examination

3.3.1. Shot animals

Of the 139 kangaroos that were shot, 134 kangaroos were found by the shooting team and available for post-mortem examination, with five animals (4%) not found by the shooting team during the observation period. Reasons for not finding shot animals included the presence of protestors limiting access to shooting sites and limited illumination being used during searching. The animals that were not found were observed to have been shot in the cranium, inducing immediate insensibility, and were presumed to have been killed. The sex ratio of the shot animals that were found was female-biased (61:39). The demographic breakdown of the animals shot by age and sex is shown in Table 2. Sub-adult animals (undeveloped testicles in males and undeveloped mammary glands in females) represented 12% of animals shot ($n=17$).

The majority of examined animals (98%; $n=131$) were killed by a single shot that resulted in ballistic pathology to the brain as per the COP. One animal, a sub-adult (young-at-foot) was shot once in the thorax, as recommended by the COP. Of the two animals that were shot twice, one was initially shot in the shoulder, and subsequently in the thorax, and the other animal was initially shot in the eye socket and subsequently in the thorax. The COP specifies that animals not fatally injured by an initial shot should be shot in the thorax.

3.3.2. Pouch young

A total of 72 adult female kangaroos were inspected for the presence of pouch young. Of these adult female animals, 92% ($n=66$) had one pouch young present while 8% ($n=6$) did not have pouch young present. No adult females were found with more than one pouch young, but 7% ($n=5$) had an elongated mammary gland ('long teat'; McLeod and Sharp 2014) in addition to having a pouch young.

Of pouch young detected ($n=66$), 57 (86%) were unfurred and nine (14%) were furred (Table 2). The majority of pouch young (92%) were euthanased via blunt trauma ($n=61$) with the remaining 8% ($n=5$) euthanased via decapitation. All pouch young euthanased via decapitation were unfurred. These pouch young were decapitated using the thumb and forefinger method described by McLeod and Sharp (2014), or were first stunned via blunt trauma, and were subsequently decapitated using the thumb and forefinger method. Pouch young euthanased via blunt trauma had their craniums swung into inanimate metallic parts of the shooting vehicle (as per McLeod and Sharp 2014), and a mean of 2.8 total blows (range 1–7) were struck. The mean duration from pouch removal to a euthanasia method being applied was 3 seconds.

The shooting team was observed to check all euthanased pouch young to confirm death immediately after euthanasia procedures had been performed. Pouch young were checked for the presence of a corneal reflex (where appropriate; furred animals), body movement, breathing or heartbeat, as per the COP. No pouch young were detected by the independent observer that were alive after euthanasia procedures had been performed. No adult female kangaroos were observed with pouch young remaining in their pouch after the shooting team had performed checking and euthanasia procedures.

The shooting of non-target species was not observed.

4. Discussion

4.1. Compliance with the code of practice

The shooting team was observed to be compliant with all aspects of the COP relating to the firearm and ammunition used. Additionally, the shooting team was compliant in the targeting of animals, ensuring that non-target species were avoided. The majority of adult animals shot displayed ballistic pathology to the brain and fracturing of the calvarium (upper portion of the skull; Daoust and Caraguel 2012). One sub-adult animal was shot in the thorax and two adult animals were shot outside of the cranium or thorax before being killed by a subsequent shot to the thorax, as allowed under the COP.

The majority of female kangaroos shot had pouch young, but few were obvious via remote observation, with the majority of pouch young (86%) being unfurred. The shooting of female kangaroos with obvious pouch young or young-at-foot in this context is allowed under the COP as the shooting program was conducted for management and/or ecological reasons, being a damage mitigation program. All young-at-foot that were obviously paired with an adult kangaroo were shot, as specified by the COP. The COP states that shot female kangaroos should be thoroughly examined for pouch young 'immediately' after shooting, however the shooting team could not locate five kangaroos during independent observations. All found kangaroos were moved to the location of the vehicle before being checked, such that physical euthanasia methods involving the shooting vehicle could be

used, as described by McLeod and Sharp (2014). Small, unfurred pouch young were decapitated using the thumb and forefinger method (McLeod and Sharp 2014) rather than a sharp blade, as per the COP.

4.2. Animal welfare outcomes

The percentage of kangaroos rendered immediately insensible (98%) was higher than for other published studies of night shooting (e.g. 93%, Lewis *et al.* 1997; 60%, Hampton *et al.* 2015). A minority of animals were not rendered immediately insensible by shooting, but either had a brief duration from shooting to insensibility (one sub-adult animal), or were subsequently killed in accordance with procedures specified by the COP (two adult animals). The non-fatal wounding and escape of animals occurs in many shooting methods (Department for Environment, Food and Rural Affairs 2013; Aebischer *et al.* 2014; Hampton *et al.* 2015). There were no kangaroos observed to be non-fatally wounded in this study. For comparison, McLeod and Sharp (2014) reported an incidence of 0.3% for non-fatal wounding of kangaroos subjected to commercial shooting.

The fact that five kangaroos were killed but not found during independent observations is a concern for animal welfare as the shooting team was unable to approach animals to ensure death and euthanase pouch young, if present. The presence of protestors at the field site hindered search efforts. Traditional night shooting methods use spotlights (white light) for the identification of target animals and finding of shot animals (Lewis *et al.* 1997; McLeod and Sharp 2014; Hampton *et al.* 2015). Spotlights were not used for the shooting method observed and the reduced illumination may have also hindered search efforts. Improved strategies for searching for shot animals should be considered to improve future welfare outcomes. There is currently no standard tool or implement recommended for blunt trauma euthanasia of furred pouch young under the COP, and parts of the shooting vehicle were used in this program. Repeated blows were used, as per standard practice for ensuring animals are rendered insensible (Daoust *et al.* 2013). Selection of tools for blunt trauma euthanasia has been demonstrated to be important for animal welfare outcomes in other species (e.g. grey seals (*Halichoerus grypus*); Daoust *et al.* 2013). A recent study of pouch young euthanasia in commercial kangaroo shooting has also concluded that improved blunt trauma methods should be explored (see Sharp *et al.* 2015).

For the five adult female kangaroos that had an elongated teat, it is likely they were, or had recently been, suckling a young-at-foot. It has been demonstrated that kangaroo young-at-foot are not dependent on maternal nutrition from the age of permanent pouch emergence, and it is unknown how long it takes for elongated teats to shorten after a young-at-foot is weaned (McLeod and Sharp 2014). For these reasons, it is difficult to extrapolate animal welfare implications from the presence of an elongated teat in a shot adult female kangaroo, beyond the presumption that the female is, or has recently been, suckling a young-at-foot. The assumption that these teats suggest the presence of a 'dependent' young-at-foot is questionable.

5. Conclusions

Independent assessment of this non-commercial kangaroo shooting program indicated that the COP was complied with in almost all aspects. The failure of the shooting team to find and inspect all shot animals immediately after shooting was one important area of non-compliance. The shooting team made reasonable efforts to avoid this however were constrained by the operating environment not allowing the use of white light, and the presence of protestors. This finding suggests that search methods for shot kangaroos should be improved. The refinement of euthanasia methods for older (furred) pouch young remains an area where animal welfare outcomes could also be improved.

6. Recommendations

In order to improve animal welfare outcomes for non-commercial kangaroo shooting, and to ensure compliance with the COP, the following recommendations are made:

1. Improved search methods for shot animals, that are compatible with the operating environment, should be developed
2. Field practices should be reviewed for the euthanasia of furred pouch young

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