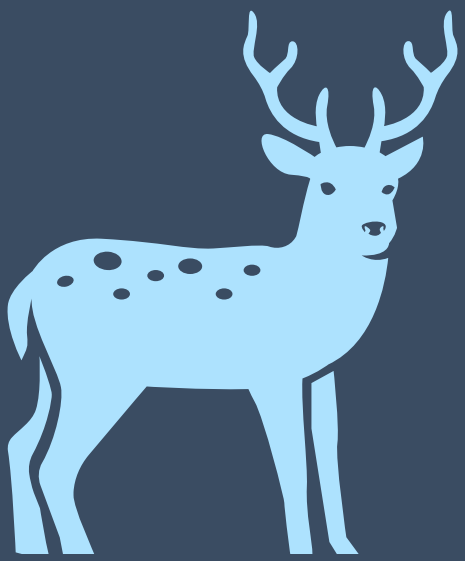
NSW GOVERNMENT | Department of Primary Industries

NSW Code of Practice and Standard Operating Procedures for the Effective and Humane Management of Feral Deer



www.dpi.nsw.gov.au

Published by the NSW Department of Primary Industries

NSW Code of Practice and Standard Operating Procedures for the Effective and Humane Management of Feral Deer; NSWDEER COP

First published March 2022

ISBN 978-1-76058-546-4

Citation

Sharp, T.M., Cope, H. & Saunders, G. (2022). New South Wales Code of Practice and Standard Operating Procedures for the Effective and Humane Management of Feral Deer. NSW Department of Primary Industries, Orange, NSW.

Acknowledgements

The NSW Codes of Practice and Standard Operating Procedures for vertebrate pests have been developed by the NSW Department of Primary Industries in collaboration with industry representatives and NSW government agencies. The documents have been endorsed by the NSW State Pest Animal Committee which comprises representatives from: Department of Primary Industries, Landcare NSW, Local Government NSW, Local Land Services, National Parks and Wildlife Service, Nature Conservation Council, NSW Farmers and RSPCA NSW.

www.dpi.nsw.gov.au

INT22/17910

Preface

This document (Code of Practice (COP) and relevant Standard Operating Procedures (SOPs)) provides current information and guidance to government agencies, land managers and pest animal controllers involved in the management of feral deer in NSW. The aim is for control programs to be conducted in a way that reduces the negative impacts of feral deer using the most humane, target-specific, economic and effective techniques available.

Previously published and endorsed COPs and SOPs [1] available via the PestSmart website (https://www.pestsmart.org.au/) can provide general guidance for national use, but some of the content may now be out-of-date. This revision of NSW-specific COPs and SOPs [2] has been developed to provide the most relevant and up-to-date information to support best practice pest animal management in NSW. Outdated information has been removed, while new information has been added to reflect the advancements and changes specific to feral deer management within NSW. For ease of use, the COP and SOPs for each species have been consolidated into one document: however, links are provided to allow printing of individual SOPs as required.

Contents

Preface 3
Introduction 5
Definitions and terms 5
Best practice in pest animal management 6
The NSW *Biosecurity Act 2015* and pest animal management 7
Animal welfare and humaneness 8
Deer management 9
Relevant legislation 15
Further information 16
References 16
Recommended reading 18
Standard Operating Procedures: 18
NSWDEER SOP1 Ground shooting of feral deer 19
Background 19
Application 19
Animal welfare implications 20
Workplace health and safety considerations 21
Equipment Required 22
Procedures 24

References 27
NSWDEER SOP2 Aerial shooting of feral deer 29
Background 29
Application 29
Animal welfare implications 30
Workplace health and safety considerations 31
Equipment required 32
Procedures 33
References 37
NSWDEER SOP3 Trapping of feral deer 39
Background 39
Application 39
Animal welfare implications 40
Workplace health and safety considerations 41
Equipment required 41
Procedures 42
References 45

Introduction

All pest animal management must aim to minimise individual animal suffering while at the same time optimising the population impact of a control program. This requires use of the most humane methods that will achieve the control program's aims. Consideration of animal suffering should occur regardless of the status given to a particular pest species or the extent of the damage or impact they create. While the ecological and economic rationales for the control of pests such as feral deer are frequently documented, of equal importance is an ethical framework under which these pests are controlled.

A **Code of Practice** (COP) provides overarching context and brings together the SOP procedures in context, and now in one document that specifies humane control options and their implementation. In this way, COPs encompass all aspects of controlling a pest animal species as determined by best practice principles, relevant biological information, guidance on choosing the most humane and appropriate control technique and how to most effectively implement management programs.

This COP provides state-wide guidance and is based on current knowledge and experience in the area of feral deer control. It will be revised as required to take into account advances in knowledge and development of new control techniques and strategies.

Standard Operating Procedures (SOPs) ensure that an ethical approach (including the recognition of, and attention to, the welfare of all animals directly or indirectly affected by control programs) is uniformly applied to each pest animal control option. The SOPs are written in a way that describes the procedures involved and animal welfare issues applicable for each control technique, thus acting as a detailed guide to support best practice control programs.

Definitions and terms

Best practice management – a structured, consistent and adaptive approach to the humane management of pest animals aimed at achieving enduring and cost-effective outcomes. 'Best practice' is defined as the agreed principles and specific techniques at a particular time following consideration of scientific information and accumulated experience [3].

Euthanasia – literally means a 'good death' and usually implies the ending of suffering for an individual; however, when used in regard to animals it usually refers to the means by which an animal is killed rather than the reason for killing it [4, 5].

Humane – refers to an absence of (or minimal) pain, suffering and distress (e.g., a relatively more humane euthanasia method will cause less pain, suffering and distress than a relatively less humane euthanasia method).

Humaneness – level of welfare impact or welfare cost (e.g., assessing level of humaneness is equivalent to assessing welfare impact or cost).

Humane killing – the killing of animals using relatively humane methods in certain situations (e.g., animals used in research or pest management) for reasons other than to reduce their suffering.

Humane vertebrate pest control – the development and selection of feasible control programs and techniques that avoid or minimise pain, suffering and distress to target and non-target animals [6].

Pest animal – (also referred to as vertebrate pest) native or introduced, wild or feral, non-human species of animal that is currently troublesome locally, or over a wide area, to one or more persons, either by being a health hazard, a general nuisance, or by destroying food, fibre, or natural resources [7]. Refer to Vertebrate Pesticide Manual [8] for relevant governance and legislation information as applied to the control of vertebrate pests.

Welfare – an animals' state as regards its attempts to cope with its environment [9]. Welfare includes the extent of any difficulty in coping or any failure to cope; it is a characteristic of an individual at a particular time and can range from very good to very poor. Pain and suffering are important aspects of poor welfare, whereas good welfare is present when the nutritional, environmental, health, behavioural and mental needs of animals are met. When welfare is good, suffering is absent [10].

Best practice in pest animal management

From an animal welfare perspective, it is highly desirable that pest animal control programs are efficient, effective and sustained so that pest populations are reduced to low levels and not allowed to recover, thereby avoiding the need for repeated large-scale killing. Over the last decade, the approach to managing pest animals has changed [3]. Rather than focussing on inputs, it is now realised that like most other aspects of agriculture or nature conservation, pest management needs to be carefully planned and coordinated with the aim of reducing to an acceptable level the damage due to pest animals i.e., the focus is on measurable economic and environmental outcomes. Pest animal control is just one aspect of an integrated approach to the management of production and natural resource systems and management of other factors may also be required to achieve the desired result. For example, for a lamb producer with limited resources, other factors influencing lamb production may include weed control, cover for lambs, ewe nutrition or rams that give a higher twinning rate. Unless pest animal control actions are well planned, collaborative and coordinated at the right temporal and spatial scales, individual control programs are unlikely to have long term benefits. When planning pest animal management, there are some important steps that should be considered (Braysher and Saunders, 2015 [11]):

1. Identify the trigger to undertake pest animal management. Is there a community or political pressure for action on pests and an expectation that pest animals should be controlled? Pest control is unlikely to be effective unless there is strong local or political will to take action and commit the necessary resources.
2. Identify the key group to take responsibility for bringing together those individuals and groups that have a key interest in dealing with the pest issue.
3. Identify the problem. In the past the pest was usually seen as the only problem. We now know that the situation is more complex. First, determine what the problem is. For example, it may be effects on native fauna, reduced levels of agricultural production, and complaints from neighbours or emotional stress from worrying about pest impacts. Several factors impact on each of these problems and control of pests are often only part of the solution.

4. Identify and describe the area of concern. Sometimes it helps to remove agency and property boundaries (nil tenure) so that the problem can be viewed without the tendency to point blame at individuals, groups or agencies. Property and agency boundaries can be added later once agreement is reached on the best approach.
5. Try to break the area into smaller management units for planning. These smaller units may be determined by water bodies, mountain ranges, fences, vegetation that is unsuitable for a particular pest or other suitable boundaries that managers can work to. While it is best to work to boundaries that restrict the movement of pests, this may not be practicable and jurisdictional boundaries, for example, the border of a Landcare group, may have to be used in combination with physical boundaries. Once the management units are identified:
    a. Identify as best you can, the pest animal distribution and abundance in each management unit.
    b. Estimate as far as is practicable, the damage caused by the pest or pests to production and to conservation.
    c. Gather and assess other relevant planning documents such as, recovery plans for threatened species and property management plans. Identify any key constraints that may prevent the plan being put into operation and identify all the key stakeholders.
    d. Develop the most appropriate pest management plans for each of the management units.

Implementing effective and humane pest animal control programs requires a basic understanding of the ecology and biology of the targeted pest, other species that may be affected directly (non-targets) or indirectly (e.g., prey species) by a control program. Managers should take the time to make themselves aware of such information by reading the recommended texts included in this document.

The NSW *Biosecurity Act 2015* and pest animal management

From 1 July 2018, the management of pest animals in NSW needs to account for the requirements and obligations under the NSW *Biosecurity Act 2015*. Everyone in NSW who deals with pest animals, including land managers (public and private), recreational land users, other community members and even visitors to the state must manage those pest animals where they present a risk to biosecurity in NSW.

There are some specific requirements relating to some pest species outlined under the Biosecurity Regulation 2017. For example, under the Biosecurity Regulation, it is illegal for a person to keep, move or release a feral pig, wild rabbit, feral deer or European red fox.

A number of documents are available to help land managers and other community members to understand which pest animals they must manage and how they can be managed. Central to these are the Regional Strategic Pest Animal Management Plans that set out the requirements for managing the impacts of pest animals.

Specific members of the Local Land Services' team can investigate if they suspect a person or organisation is not managing pests properly and are able to provide educational material outlining the biosecurity risks presented by the pest animals, and management actions that must be taken to manage the risk posed. If appropriate management action is not taken to

manage the pest animals, trained and authorised staff from Local Land Services can undertake enforcement action.

Animal welfare and humaneness

Pest animals continue to cause significant damage and risks to the environment, agricultural production and to public health. Each year hundreds of thousands of pest animals are trapped, poisoned, shot or otherwise destroyed because of the harm they cause [12]. For most people in today's society the management of pest animals is considered acceptable provided that such management is *humane* and *justified* [13]. However, some deficiencies need to be addressed, inhumane techniques replaced and new, more humane, alternatives developed. For further detail refer to RSPCA Policy E02 *Management of wild animals*.

The humaneness of an individual pest control technique is highly dependent on the way the technique is applied and on the skill of the operator involved. Attention to details such as timing and coordination of control, bait delivery, lethal dose rates, type or calibre of firearm and ammunition have significant effects on animal welfare and target outcomes of control programs. By standardising the way control methods are applied, many of the negative welfare impacts can be reduced or even prevented. This document (COP and SOPs) has been specifically developed to address this issue.

It also contains a summary of the results of humaneness assessments for all individual techniques included as SOPs. The full assessments can be found on the PestSmart website (https://www.pestsmart.org.au/). These assessments were carried out using a model developed by Sharp and Saunders (2008, 2011)[14, 15]. The model provides a practical, general means of assessment that can be applied to any control technique. The goal of humaneness assessment is to evaluate the impact of a control technique on individual animals and to use this assessment to determine which methods are more or less humane compared to others.

Assessment of humaneness using the Sharp and Saunders model is based on the five domain approach to welfare assessment as developed by Mellor and Reid (1994)[16]. According to this approach, potential or actual welfare compromise is identified in four physical or functional domains and one mental domain:

1: Nutrition – water or food deprivation, malnutrition.

2: Environmental – exposure to excessive heat or cold.

3: Health – disease or physical injury.

4: Behaviour – spatial or interactive restriction.

5: Mental or Affective State – includes impacts from the first four domains (e.g., thirst hunger, anxiety, fear, nausea, pain, boredom, depression, frustration, loneliness, distress) and any other cognitive awareness of external challenges leading to negative affective states.

When considering the humaneness or welfare impact of a control method, impacts are assessed in relation to nutrition, the animal's environment, its health or functional status, its behavioural needs and its overall mental status. As described by Sharp and Saunders (2008, 2011) [14,15] and Beausoleil and Mellor (2015)[17] when data is available, actual impacts in each of the four domains are evaluated using a range of quantitatively assessed changes in behaviour and physiology along with pathophysiological indicators of functional disruption.

Compromise in one or all of the physical domains is then used to infer potential negative affective impacts in the fifth domain. As welfare is generally considered to be a state within an animal that most directly relates to what the animal experiences, the overall impact of a control method on the animal's welfare generally reflects impacts in Domain 5. When the model is applied to a range of different methods, these can be compared, thus allowing an informed decision on control method choice based on relative humaneness.

Humaneness assessment using the Sharp and Saunders model follows a two-part process: Part A examines the impact of a control method on overall welfare and the duration of this impact; and Part B examines the effects of the killing method on welfare (so is only applied to lethal methods). For example, with live trapping followed by shooting, both Part A and Part B are applied, but with fertility control only Part A is applied.

In Part A, overall welfare impact is assessed by looking at the impacts in each of the five domains as described above. In Part B, the killing method is assessed by examining the level of suffering and the duration of suffering based on the time to insensibility based on the criteria described by Broom (1999)[9]. Matrices are then used to determine the score for each part and then the two scores are combined to obtain the overall humaneness score.

Deer management

Background

Australia has wild populations of six deer species: fallow deer (*Dama dama)*; red deer (*Cervus elaphus*); sambar deer (*Cervus unicolor*); rusa deer (*Cervus timorensis*); chital deer (*Axis axis*); and hog deer (*Axis porcinus*): all of which can be found in NSW. Population numbers are increasing due mostly to intrinsic growth. The feral deer population in NSW increased in distribution by around 30 % from 2005 to 2009 [18] and continues to increase. There is a recognised lack of knowledge on the general ecology of these species which is a hindrance to the ongoing development of management strategies. Further compounding this problem is that each species is different in terms of ecological parameters such as habitat preferences, reproduction, rates of increase, group size and movements [19].

Feral deer impacts can include changes to plant communities, competition with native wildlife, economic losses to crops, pastures and plantation trees, human safety and the knock-on effects of illegal hunting. They are also recognised as potential reservoirs and vectors of endemic and exotic diseases [18]. There is now clear evidence of the adverse economic and environmental impacts of feral deer in NSW [18]. Deer are considered a priority pest in NSW. However, they are also a recreational and commercial hunting resource [20]. From September 2019 a NSW Game Hunting License is no longer required when hunting feral deer on private lands. Deer remain a game animal for hunting on nominated public lands and require a NSW Restricted Game Hunting Licence (R-license) with associated hunting restrictions.

For further information please see:

- 2016 National Workshop on Deer Management Proceedings: https://pestsmart.org.au/resources/
- 2016 State-wide review of pest animal management final report: www.nrc.nsw.gov.au

- PestSmart: https://pestsmart.org.au/toolkits/feral-deer/
- 2019 Feral Deer in NSW; Primefact 1678: https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/854414/Feral-Deer-in-New-South-Wales.pdf

Primary and supplementary control techniques

Pest control programs must be cost-effective. The techniques used within a control program need to be complimentary to each other and lead to a maximum impact reduction, which often requires reducing pest animal densities to low levels over a large scale and maintaining this level of population suppression indefinitely. This leads to a situation where the need for ongoing control is minimised and rates of re-invasion reduced. Follow-up control programs, where the initial reduction is maximised, are also much cheaper to implement as the target population is relatively small. Control techniques can be seen as primary or supplementary based on the following general principles.

Primary techniques are those that can achieve rapid pest population knockdown over large areas in a cost-effective way. Supplementary techniques are generally only effective in helping to maintain pest population suppression once densities have already been reduced to low levels. For example, in the management of feral deer, shooting is a primary method of control and supplementary techniques are used as a follow-up, e.g., trapping. Regional variations can also occur within species with some techniques such as aerial shooting only being considered as a primary technique where visibility is good. For effective control, regionally appropriate selection of at least one primary control technique and one supplementary control technique should be utilised where possible to help satisfy general biosecurity duty requirements.

Spatial scale is also important. To achieve cost efficiencies and depending on the movement behaviour of the target pest, the area under control may need to be a collaboration of many adjoining land managers. This is particularly the case for highly mobile pest animals such as feral deer.

Poorly executed control programs can simply become sustained culling operations that do little to achieve long-term successful outcomes. This in turn can lead to sporadic implementation of crisis management programs where pest numbers have become unacceptable, but the outcome usually becomes sub-optimal. A rotation of primary and supplementary techniques can also be important. Pest animals can become familiar to a particular technique (e.g., spotlight aversion) that may require switching to another lethal method (e.g., aerial shooting). Another factor to consider is timing of control operations. Time of the year can mean targeting a biological weakness in the pest animal (e.g., a period of food and water stress). Alternatively, application of control can align with the need for the commodity to be protected when it is most vulnerable.

Deer management methods

Integrated management using a range of control techniques produces the best results, but a lack of reliable information on the costs and benefits of deer control is seen as a barrier to adoption of some techniques. The most commonly used feral deer control techniques in

NSW are ground and aerial shooting and to a lesser extent trapping and exclusion fencing. Other techniques that have been investigated or are proposed include repellents (including scare devices), fertility control and poison baiting. There has been minimal evaluation of the efficacy of deer management techniques in Australia. Further development of these and other control techniques is required [19, 20].

Cost-effectiveness, humaneness and efficacy for each control technique need to be evaluated in every program. A brief evaluation of the humaneness of control techniques follows:

Humaneness of control techniques

Shooting

Ground shooting

Shooting can be a humane control method when; it is carried out by competent, accurate and responsible shooters; the correct combination of firearm and ammunition and optimum shot placement are used; the target animal can be clearly seen and is within range; and all wounded animals are promptly located and euthanased humanely. Head shots are the preferred shot placement when prevailing conditions are appropriate, e.g., stillness of target[21].

Dependent young will experience significant negative welfare impacts if they are not euthanased quickly and humanely after their mother is shot. Shooting can also have negative effects on surviving animals in social groups.

Aerial shooting

All aerial shooting programs in NSW managed by Government agencies must adhere to the instructions and requirements of the NSW Feral Animal Aerial Shooting Team (FAAST) Manual [22]. Private or commercial operators that are not conducting shooting as part of a FAAST program must still adhere to all relevant regulatory and legislative requirements.

Aerial shooting of feral deer from a helicopter can be a humane control method when it is carried out by highly skilled and experienced shooters and pilots; the correct firearm, ammunition and shot placement is used; and wounded animals are promptly located and euthanased.

With shooting, initial shots to the chest do not render the animal instantaneously insensible and time to death is slower whereas a well-placed initial shot to the head to destroy the brain will result in instantaneous insensibility and a quicker death. However, with aerial shooting, chest shots are generally preferred for smaller species since the heart and lungs are the largest vital area and accurate shots to the head to destroy the brain can be difficult to achieve. This is particularly the case for species that move quickly and erratically. Head shots should only be attempted when conditions are ideal to avoid wounding. Shooting at other parts of the body (outside of head (brain) and chest (heart-lung) target zones) is unacceptable.

Compared with ground shooting, aerial shooting allows the delivery of multiple shots in quick succession to ensure a rapid death. There is also much better opportunity for rapid

follow-up shots for any injured animals. There must be a minimum of two shots per animal – one of which must be a chest shot.

Trapping

All traps have the potential to cause injury and some degree of suffering and distress so should only be used when no practical alternative exists. Clover traps can be used for trapping individual feral deer, and larger traps (corral and paddock) are used for trapping groups of deer. Animals caught in a cage trap are likely to experience significant injuries since they will make frantic attempts to escape. Importantly, non-target animals that are caught in cage traps can usually be released unharmed.

Clover traps are small (around 2 m by 1 m and 1.5 m high) and are constructed with a metal or wooden box frame with nylon netting sides and a door that slides closed when triggered by a trip cord. Corral traps are large (0.25 – 4ha) and can be permanent or portable constructions with hessian or shade cloth sides. The door is triggered either by remote device, trip wire or there is a one-way entrance. Drop net traps consist of a large square of nylon netting (10cm mesh) suspended on poles by a system of pulleys that release the net when a trigger mechanism is activated. Drop nets have not been widely used in Australia due to the largely forested habitats where deer are problematic.

As well as injuries, trapped animals can suffer from exposure, thirst, starvation, shock, capture myopathy and predation. Therefore, traps should be placed in a suitable area protected from extremes of weather and must be inspected at least once daily. Deer must have access to water and feed if they are to be held in large paddock traps for more than 24 hours. Trapped animals should be approached carefully and quietly to minimise panic, further stress and risk of injury. Feral deer to be euthanased must be destroyed as quickly and humanely as possible with a single rifle shot to the brain. If lactating females are caught in a trap, efforts should be made to find dependent fawns and kill them quickly and humanely. Non-target animals that are caught but not severely injured should be released at the trap site. If they are injured, but may respond to veterinary treatment, such treatment should be sought. Severely injured non-target animals must be destroyed quickly and humanely.

Exclusion fencing

The use of exclusion fencing is generally regarded as a humane, non-lethal alternative to lethal control methods. However, the high costs of establishing and maintaining deer-proof enclosures (including, if necessary, removal of deer from within the enclosure), mostly limits this technique to areas that have a significant and persistent deer problem or for the management of threatened species. Although exclusion fencing acts as a barrier to deer it can have negative effects on non-target species by altering dispersion and foraging patterns and causing entanglement and electrocution. It can also create a significant hazard to wildlife in the event of a bushfire [23]. Refer to the following RSPCA website for further perspectives on the humaneness of exclusion fencing:

https://kb.rspca.org.au/knowledge-base/what-are-the-risks-to-wildlife-associated-with-barrier-and-cluster-fencing/

For further information on pest exclusion fence design, please refer to sites such as:

https://www.wool.com/globalassets/wool/sheep/pest-animals/wild-dog-exclusion-fencing--australian-wool-innovation/kondinin-group-research-report---exclusion-fencing.pdf

https://www.wool.com/on-farm-research-and-development/sheep-health-welfare-and-productivity/pest-animals/wild-dog-exclusion-fencing/

Similar pest fence designs are also available from the web sites of commercial fencing manufacturers. Deer farming industry websites provide guidance on deer fence designs, including modifications to existing livestock fences:

https://www.deerfarming.com.au/wp-content/uploads/2016/11/DFH06-Fencing.pdf

Lethal baiting

No pesticides are currently approved for use in the control of deer in NSW. Recent research in New Zealand and Australia has identified a number of potential bait presentation techniques that may have future application for deer management. Prior to any approval or adoption of baiting as an additional control method the technique would be required to demonstrate a high level of target selectivity, be matched with an approved toxicant and produce consistent and humane results during approved field research trials.

Table 1: Humaneness, Efficacy, Cost-effectiveness and Target Specificity of Deer Control Methods

Control technique	Acceptability regarding humaneness* and Relative humaneness score (Part A [1-8], Part B [A-H]**)	Efficacy regarding population reduction	Cost-effectiveness	Target Specificity	Comments
Aerial shooting *Primary*	Acceptable Score: 4C (chest)	Effective	Relatively cost-effective. More cost-effective when deer density is high	Target specific	Suitable for extensive areas and inaccessible country. Most effective way of achieving quick, large scale culling if appropriately resourced.
Ground shooting *Primary*	Acceptable Score: 3A (head), 3D (chest)	Effective but only in low density areas	Relatively cost-effective at low densities	Target specific	Species differences in difficulty to locate and shoot. Labour intensive, only suitable for smaller scale operations.
Exclusion fencing *Supplementary*	Acceptable Score: N/A	Limited	Expensive	Can be in certain situations	Useful for protection of threatened species or high value crops. Expensive, therefore can be impractical for broad scale application.
Trapping (clover traps) *Supplementary*	Acceptable Score: N/A	Not effective	Not cost-effective.	May catch non-target animals	Variations in trap suitability between species. Not practical for large scale control, but can be used to remove problem animals in peri-urban settings.
Trapping (corral and paddock traps) *Supplementary*	Acceptable Score: N/A	Can be effective in certain situations	Can be cost-effective in certain situations	May catch non-target animals	Variations in trap suitability between species. Used to capture larger groups of animals.
Lethal baiting *Not available*	Acceptable Score: N/A	Unknown	Unknown	Depends on agent used	No products currently registered.

Footnotes for Table 1

* Acceptable methods are those that are relatively humane when used correctly in accordance with the applicable Standard Operating Procedure. Conditionally acceptable methods are those that, by the nature of the technique, may not be consistently humane. There may be a period of poor welfare before death.

Methods that are not acceptable and are considered to be inhumane – the welfare of the animal is very poor before death, often for a prolonged period

** From assessments conducted using a model to assess the relative humaneness of pest animal control methods (Sharp and Saunders 2011)[15]. Humaneness score (AB) consists of Part A - welfare impact prior to death, scale of 1 – 8, less suffering to more suffering and Part B - mode of death, scale of A – H, less suffering to more suffering. For assessment worksheets and matrix of relative humaneness scores see: https://pestsmart.org.au/toolkit-resource/feral-wild-deer-control-methods-humaneness-matrix/.

N/A = Humaneness score not available.

Control techniques are classified as primary (maximum effect), supplementary (follow-up) or 'not available'. In some situations, techniques can alternate between primary and supplementary.

Relevant legislation

All those involved in vertebrate pest control should familiarise themselves with relevant aspects of the appropriate federal and state legislation. The table below lists relevant legislation. This list is by no means exhaustive and was current at the time of writing.

Commonwealth	*Agricultural and Veterinary Chemicals Code Act 1994* *Environment Protection and Biodiversity Conservation Act 1999*
New South Wales	*Biodiversity Conservation Act 2016* *Biosecurity Act 2015* *Game and Feral Animal Control Act 2002* *Local Government Act 1993* *Local Land Services Act 2013* *National Parks and Wildlife Act 1974* *Pesticides Act 1999* *Prevention of Cruelty to Animals Act 1979*
Other relevant legislation	*Civil Aviation Act 1988 and Regulation 1998* *Civil Aviation (Carriers' Liability) Act 1967Firearms Act 1996* *Dangerous Goods (Road and Rail Transport) Act 2008* *Firearms Act 1996* *Work Health and Safety Act 2011*

Note: copies of the above legislation and relevant regulations may be obtained from federal and state publishing services.

Further information

Local Land Services	https://www.lls.nsw.gov.au/biosecurity/pestplan
NSW National Parks and Wildlife Service	https://www.environment.nsw.gov.au/topics/animals-and-plants/pest-animals-and-weeds/pest-animals
NSW Department of Primary Industries	https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests
NSW Environment Protection Authority	https://www.epa.nsw.gov.au/your-environment/pesticides/pesticides-nsw-overview/pesticide-control-orders
PestSmart Connect	https://www.pestsmart.org.au/

References

1. Sharp, T. & Saunders, G. (2011). *Humane pest animal control: codes of practice and standard operating procedures.* New South Wales Department of Primary Industries, Orange. Available at: https://pestsmart.org.au/
2. Sharp, T. & Saunders, G. (2005). *Humane pest animal control: codes of practice and standard operating procedures*. New South Wales Department of Primary Industries, Orange.
3. Braysher, M. (2017). *Managing Australia's Pest Animals: A Guide to Strategic Planning and Effective Management*. CSIRO Publishing, Melbourne.
4. Morton, D. B. (2010). Euthanasia. In *The encyclopedia of applied animal behaviour and welfare*. D. S. Mills and J. N. Marchant-Forde. CABI, Wallingford, UK**:** 232.
5. American Veterinary Medical Association (AVMA). (2020). *AVMA guidelines for the euthanasia of animals: 2020 edition*. American Veterinary Medical Association. Available at: https://www.avma.org/sites/default/files/2020-01/2020-Euthanasia-Final-1-17-20.pdf
6. RSPCA (2004). *A national approach towards humane vertebrate pest control*. Discussion paper arising from the proceedings of an RSPCA Australia/AWC/VPC joint workshop, August 4–5, Melbourne. RSPCA Australia, Canberra.
7. Koehler, J. W. (1964). *Opening remarks*. Proceedings of the 2nd Vertebrate Pest Control Conference. March 4 and 5, 1964, Anaheim, California.
8. Anon. (2018). *Vertebrate Pesticide Manual.* NSW Department of Primary Industries, Orange. Available at: https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests/publications/nsw-vertebrate-pesticide-manual
9. Broom, D. (1999). The welfare of vertebrate pests in relation to their management. Pp 309-329, in P. Cowan and C. Feare (eds.) *Advances in Vertebrate Pest Management*. Filander Verlag: Fürth.

10. Littin, K., Mellor, D., Warburton, B. & Eason, C. (2004). Animal welfare and ethical issues relevant to the humane control of vertebrate pests. *New Zealand Veterinary Journal,* 52: 1-10.

11. Braysher, M. & Saunders, G. (2015). *Best Practice Pest Animal Management*. NSW Department of Agriculture. Available at: https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests/publications/best-practice-pest-animal-mgt.

12. Olsen, P. (1998). *Australia's Pest Animals : New Solutions to Old Problems*. Bureau of Resource Sciences ; Canberra & Kangaroo Press, Sydney

13. Mellor, D. & Littin, K. (2004). Using science to support ethical decisions promoting humane livestock slaughter and vertebrate pest control. *Animal Welfare,* 13: 127-132.

14. Sharp, T. & Saunders, G. (2008). *A model for assessing the relative humaneness of pest animal control methods (first edition)*. Department of Agriculture, Fisheries and Forestry, Canberra.

15. Sharp, T. & Saunders, G. (2011). *A model for assessing the relative humaneness of pest animal control methods (second edition)*. Department of Agriculture, Fisheries and Forestry, Canberra, ACT.

16. Mellor, D. & Reid, C. (1994). Concepts of animal well-being and predicting the impact of procedures on experimental animals. . Pp. 3-18, in R. Baker, G. Jenkin, & D.J. Mellor (eds.) *Improving the Well-being of Animals in the Research Environment*. Australian and New Zealand Council for the Care of Animals in Research and Teaching. Glen Osmond, South Australia

17. Beausoleil, N. & Mellor, D. (2015) Advantages and limitations of the Five Domains model for assessing welfare impacts associated with vertebrate pest control. *New Zealand Veterinary Journal*, 63: 37-43.

18. Natural Resources Commission (2016). *Shared problem, shared solutions - State-wide review of pest animal management final report.* NSW Government, Sydney. Available at: https://www.nrc.nsw.gov.au

19. Forsyth, D., Pople, T., Page, B., Moriarty, A., Ramsey, D., Parkes, J., Wiebkin, A., & Lane, C. (eds.) (2017). *2016 National Wild Deer Management Workshop Proceedings*, Adelaide. Invasive Animals CRC, Canberra.

20. Davis, N.E., Bennett, A., Forsyth, D., Bowman, D., Lefroy, E., Woods, S., Woolnough, A., West, P., Hampton, J., & Johnson, C. (2016). A systematic review of the impacts and management of introduced deer (family Cervidae) in Australia. *Wildlife Research,* 43: 515-532.

21. DeNicola, A.J., Miller, D.S., DeNicola, V.L., Meyer, R.E., Gambino, J.M. (2019). Assessment of humaneness using gunshot targeting the brain and cervical spine for cervid depopulation under field conditions. *Plos One,* 14: e0213200.

22. Office of Environment and Heritage (2019 Draft). *NSW Feral Animal Aerial Shooting Team (FAAST) Manual*. OEH Sydney.

23. Long, K. & Robley, A. (2004). *Cost effective feral animal exclusion fencing for areas of high conservation value in Australia*. Australian Government, Department of the Environment and Heritage, Canberra.

Recommended reading

Bengsen, A.J., Forsyth, D.M., Harris, S., Latham, A.D., McLeod, S.R., and Pople, A. (2020). A systematic review of ground-based shooting to control overabundant mammal populations. *Wildlife Research,* 47: 197-207.

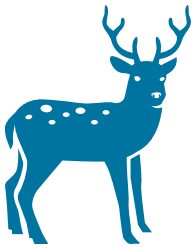
Hampton, J.O., Finch, N.A., Watter, K., Amos, M., Pople, T., Moriarty, A., Jacotine, A., Panther, D., McGhie, C., Davies, C., Mitchell, J., Forsyth, D.M. (2018). A review of methods used to capture and restrain introduced wild deer in Australia. *Australian Mammalogy,* 41: 1-11.

Jackson, S.M., Bengsen, A., Forsyth, D.M. and Comte, S. (2021). *A review of the methods used to trap wild deer in New South Wales and Queensland*. Vertebrate Pest Research Unit. Department of Primary Industries, Orange, New South Wales.

McLeod, S.R. (2009). *Proceedings of the National Feral Deer Management Workshop, Canberra*. Invasive Animals CRC, Canberra.

Standard Operating Procedures:

- Ground shooting of feral deer (NSWDEER SOP1)
- Aerial shooting of feral deer (NSWDEER SOP2)
- Trapping of feral deer (NSWDEER SOP3)



NSWDEER SOP1
Ground shooting of feral deer

Background

Ground shooting of feral deer is undertaken as part of culling programs in national parks, reserves and private land. It is carried out by government vertebrate pest control officers, landholders and professional shooters. Such shooting is usually done at night from a vehicle or foot, with the aid of spotlights or thermal imaging/night vision scopes. It is best suited to accessible areas where deer numbers are low and where the impact of deer is greatest. It is also effective when used intensively as part of a coordinated program.

Shooting can be a humane method of killing feral deer when it is carried out by experienced, skilled shooters, the animal can be clearly seen and is within range, the correct firearm, ammunition and shot placement is used, and wounded animals are promptly located and killed.

This standard operating procedure (SOP) is a guide only - it does not replace or override the relevant NSW or federal legislation. The SOP should only be used subject to the applicable legal requirements (including WHS) operating in the relevant jurisdiction.

Individual SOPs should be read in conjunction with the overarching Code of Practice for that species to help ensure that the most appropriate control techniques are selected and that they are deployed in a strategic way, usually in combination with other control techniques, to achieve rapid and sustained reduction of pest animal populations and impacts.

Application

- Ground shooting should only be used in a strategic manner. Where deer are widely distributed, a coordinated program is required for effective control.
- Control programs are conducted in national parks, reserves and private land as part of long-term control strategies for reducing negative impacts on native flora, fauna, urban areas and agricultural enterprises.
- Although time consuming and labour intensive, a well-planned and coordinated ground shooting program is considered an effective means for reducing lower density deer populations.
- Ground shooting as a means of population control is not suitable in inaccessible or rough terrain where sighting of target animals and accurate shooting is difficult or when wounded animals cannot easily be followed up and killed, in these circumstances aerial shooting may be the preferred technique.

- Shooting of feral deer should only be performed by skilled operators who have the necessary ability and experience with firearms and who hold the appropriate licences and accreditation.
- Storage and transportation of firearms and ammunition must comply with relevant legislative requirements. (*See Firearms Act 1996*, Firearms Regulation 2017).

Animal welfare implications

Target animals

- The humaneness of shooting as a control technique depends almost entirely on the skill and judgement of the shooter. If properly carried out, it can be a humane method of killing deer.
- Shooting must be done with the appropriate firearms and ammunition and in a manner that aims to cause rapid insensibility and a quick death.
- When shooting an animal, it must be clearly visible and able to be killed with a single shot due to the difficulty of follow-up shots from the ground, particularly in difficult terrain. A solid rest or support should be utilised to ensure accurate shot placement.
- Only head (brain) or chest (heart-lung) shots must be used. A well-placed shot to the head to destroy the brain will result in instantaneous insensibility and a quicker death compared to a well-placed shot to the chest. Chest shots to destroy the heart can present challenges for accurate placement and may not always result in rapid death. For this reason, under ideal conditions, head shots are preferred over chest shots, however in some situations (e.g., where close approach is not possible; the head is obstructed or cannot be targeted; the animal is already wounded; or a second 'follow-up' shot can be quickly taken), because the chest is a larger target, a chest shot may be the most suitable option. Shooting at other parts of the body is unacceptable.
- Correctly placed head shots cause brain function to cease and insensibility will be immediate. Death from a shot to the chest is due to massive tissue damage and haemorrhage from major blood vessels. Insensibility will occur sometime after, from a few seconds to a minute or more. If a shot stops the heart functioning, the animal will lose consciousness very rapidly.
- The shooter must be certain that each animal or defined group of animals is dead by physical inspection before another is targeted.
- Herd flight response is a limiting factor for humane killing of deer. To keep stress to a minimum, options that can be employed are:
  - shooting on moonless nights with the aid of spotlights or thermal/night vision equipment
  - a red filter fixed over the spotlight may reduce the amount of light seen by the deer
  - rifles with sound suppressors attached that may also reduce animal disturbance and allow multiple deer to be targeted in some circumstances.
- All species apart from Sambar and Hog deer tend to be found in groups. When possible, all deer in a group should be killed before any further groups are targeted.

- Wounded deer must be located and killed as quickly and humanely as possible with a second shot, preferably directed to the head. If left, wounded animals can suffer from pain and the disabling effects of the injury (including sickness due to infection). Note that some deer can run considerable distances even when severely injured so they may be difficult to locate. Use of a thermal device significantly enhances the ability to locate carcasses.
- Female deer will often hide newly born young until they are old enough to be mobile. If lactating females are inadvertently shot, all reasonable efforts should be made to find dependent young and kill them quickly and humanely with a shot to the brain. Behavioural cues such as vocalising, travelling in a different direction or grazing away from the herd can be useful to determine if females have hidden calves/fawns nearby. This will vary depending upon the species of deer:
  - *Rusa* – calves may be born at any time of year but there is a peak in March to April.
  - *Fallow* – fawns are usually born in November or December.
  - *Red* – breeding is regular, calves are born from late November to December.
  - *Sambar* – calves may be born at any time of year but there is a peak in May and June.
  - *Chital* – breeding is not sharply defined; calves are observed in April and May and from September to November.
  - *Hog* – irregular breeding, fawns are more frequently seen between August and October.

Non-target animals

- Shooting is relatively target specific and does not usually impact other species. However, there is always a risk of injuring or killing non-target animals, including livestock, if shots are taken at movement, colour, shape or sound.
- Only shoot at the target animal once it has been positively identified and never shoot over the top of hills or ridges.
- Shooting should be used with caution around lambing paddocks as it may disturb the lambing flock and cause mismothering. Also avoid paddocks containing sensitive livestock, e.g., horses, farmed deer. They are easily frightened by spotlights and gunshots and may injure themselves by running into fences and other obstacles.

Workplace health and safety considerations

- Firearms are hazardous. Everyone should stand well behind the shooter when an animal is being shot. The line of fire must be chosen to prevent accidents or injury from stray bullets or ricochets.
- Shooting from a vehicle is potentially dangerous. An agreed safety procedure between the shooter and others in the vehicle must be in place to ensure that people do not enter the field of fire or disturb the taking of a shot.
- Firearm users must strictly observe all relevant safety guidelines relating to firearm ownership, possession and use.

- Firearms must be securely stored in a compartment that meets state legal requirements. Ammunition must be stored in a locked container separate from firearms.
- The shooter and others in the immediate vicinity should wear adequate hearing protection to prevent irreversible hearing damage, and safety glasses to protect eyes from gases, metal fragments and other particles.
- Care must be taken when handling deer carcasses as they may carry diseases such as Q-fever, salmonellosis, toxoplasmosis and yersiniosis that can affect humans and other animals. Routinely wash hands and other skin surfaces contaminated with blood and other body fluids. Carcasses can be heavy, so care must be taken when lifting/dragging.

Equipment Required

Firearms and ammunition

- Large calibre, high powered centrefire rifles fitted with a telescopic sight must be used.
- The calibre of rifle used will depend on the size and species of deer
- The minimum firearm and ammunition requirements for the ground shooting of *small deer* (hog, fallow, chital), are:
  - calibre: .243 inches
  - bullet weight: 80 grain
  - muzzle energy: 1819 ft-lbs
- Examples of acceptable firearm and ammunition combinations with maximum shooting distances for *small deer* (hog, fallow, chital) are included in the table below:

Cartridge	Bullet weight (gr)	Muzzle velocity (ft/sec)	Muzzle energy (ft-lbs)	Maximum distance (metres)
.243	80	3200	1819	200
25-06 Rem	90	3350	2243	200
.308 Win	150	2820	2649	200

Source: https://press.hornady.com/assets/pcthumbs/tmp/1410995911-2019-Standard-Ballistics-Chart.pdf

- The minimum firearm and ammunition requirements for the ground shooting of *large deer* (red, rusa, and sambar) are:
  - calibre: .308 inches
  - bullet weight: 150 grain
  - muzzle energy: 2649 ft-lbs

- Examples of acceptable firearm and ammunition combinations with maximum shooting distances for *large deer* (red, rusa, sambar and wapiti) are included in the table below:

Cartridge	Bullet weight (gr)	Muzzle velocity (ft/sec)	Muzzle energy (ft-lbs)	Maximum distance (metres)
.308 Winchester	150	2820	2649	200
.300 Win Mag	150	3275	3572	200

Source: https://press.hornady.com/assets/pcthumbs/tmp/1410995911-2019-Standard-Ballistics-Chart.pdf

- Ammunition must expand and should be heavily constructed, controlled expansion or bonded core projectiles.
- An appropriate sound suppressor fitted to the rifle (where allowed by a special permit) may assist in certain situations.
- Shotguns are NOT recommended for use on deer. If they must be used in an emergency situation, rifled slugs are to be used as ammunition.
- The accuracy and precision of firearms should be tested against inanimate targets prior to the commencement of any shooting operation.

Other equipment

- If shooting at night:
  - a handheld spotlight, or a helmet or headband mounted 12-volt spotlight
  - thermal/night vision monocular and scopes
  - spotlight fitted with red filter.
- Lockable firearm box.
- Lockable ammunition box.
- Personal protective equipment (hearing and eye protection).
- First Aid kit.
- Appropriate maps identifying access trails and land tenure.
- Communication devices (e.g., 2-way radios / mobile or satellite phones) are recommended for safety reasons.

Procedures

- Deer must NOT be shot from a moving vehicle as this can significantly detract from the shooters' accuracy.
- It is recommended that during daylight hours shooters familiarise themselves with the shooting zone and the terrain they are to cover at night. Take note of potential hazards or risks and also any landmarks that may help with navigation.
- Be aware that the spotlight only illuminates a small portion of the danger zone and only a fraction of the projectile's range. If possible, a thermal device should always be used to assess any potential risks before a shot is fired.
- Ensure you are in a firm, safe and stable position before taking a shot.

Target animal and shot placement

- The objective is to fire at the closest range practicable in order to reduce the risk of non-lethal wounding. Accuracy with a single shot is important to achieve an immediate humane death.
- A deer should only be shot at when:
  - it is stationary and can be clearly seen and recognised
  - it is within the effective range of the firearm and ammunition being used
  - a humane kill is probable. If in doubt, do NOT shoot.
- Ensure there are no other deer behind the target animal that may be wounded by the shot passing through the target.
- Although deer are comparatively large animals, the vital areas targeted for clean killing are small. Shooters should be highly skilled and experienced at shooting and be able to accurately judge distance, wind direction and speed and have a thorough knowledge of the firearm and ammunition being used.
- Where specialist equipment such as thermal and/or night vision equipment is used for control programs, shooters must be familiar and competent with the operation and use of equipment prior to operations being undertaken.
- The shooter must aim either at the head, to destroy the major centres at the back of the brain near the spinal cord or, at the chest, to destroy the heart, lungs and greater blood vessels. This can be achieved by one of the following methods (see also Figure 1).

Head Shots

Frontal position (front view)

- This is the preferred method for fawns/calves. The firearm is aimed at the middle of the forehead at the crossing point of two imaginary lines drawn from the eyes to the tops of the opposite ears. The bullet should be directed horizontally into the skull. In stags this point is found between, and sometimes just behind, the antlers.

Temporal position (side view)

- This method is preferred for mature/older animals. The firearm should be aimed at the side of the head so that the bullet enters the skull at a point midway between the eye and the base of the ear on the same side of the head.

Rear of the head

- This method is preferred for mature/older animals that cannot be approached from the side. The firearm should be aimed at the back of the head at a point just behind the base of the antlers and directed towards the animals' muzzle.

Chest Shots

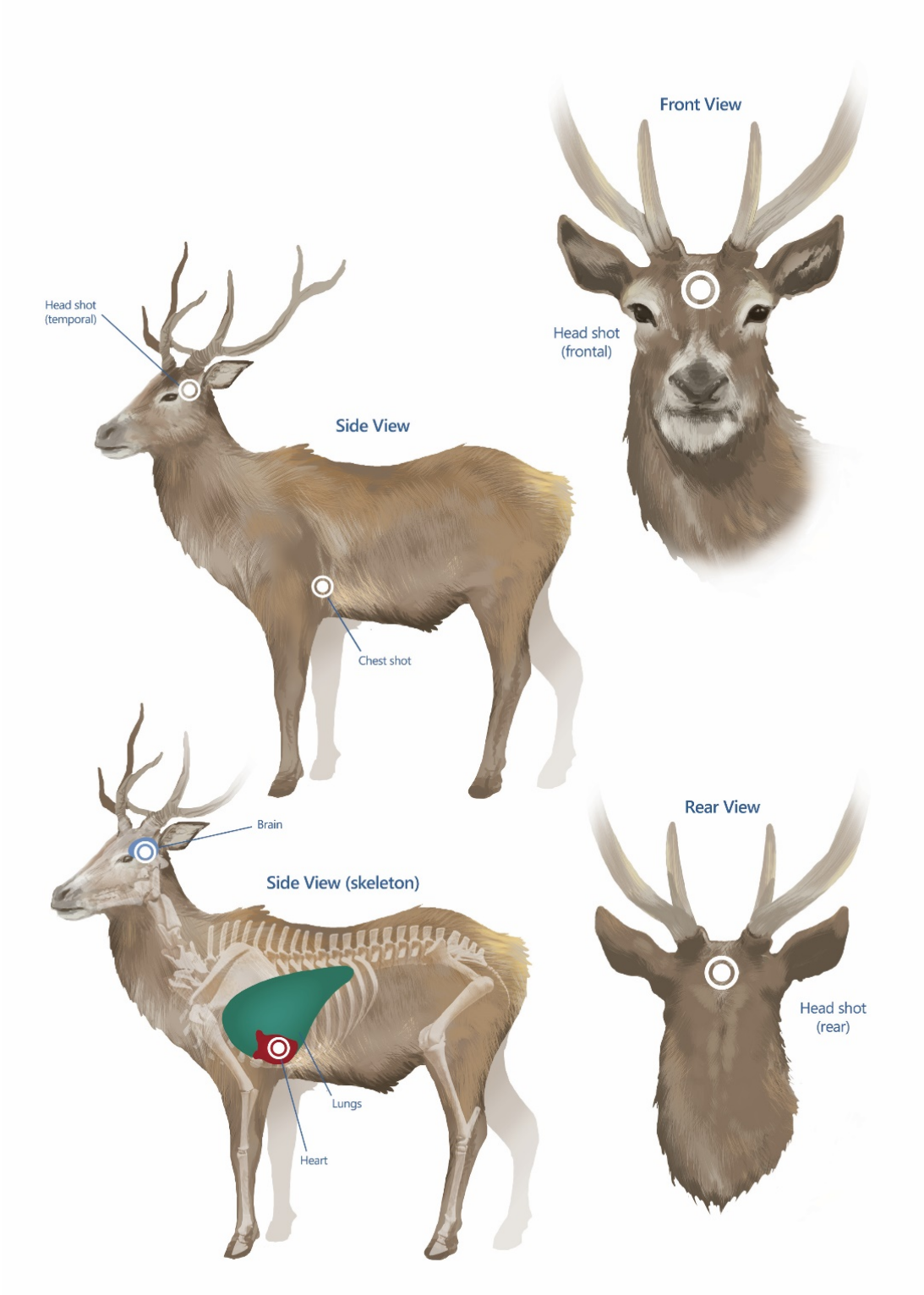
Side view

- The firearm is aimed horizontally at the centre of a line encircling the minimum girth of the animal's chest, immediately behind the forelegs. The shot should be taken slightly to the rear of the shoulder blade (scapula). This angle is taken because the scapula provides partial protection of the heart from a direct side-on shot.

Front view

- The firearm is aimed horizontally at the point midway between the forelegs and immediately below the base of the throat. Frontal chests shots should only be taken when the animal is in the head high position.
- Shooting of individuals should stop when the flight response of the herd limits further accurate shooting.
- Where possible fawns/calves and juveniles should be shot before shooting mature deer.
- The target animals in a group should be checked to ensure they are dead before moving on to the next group of animals. *Always approach the animal from the dorsal (or spinal) side to prevent injury from the involuntary kicking legs.* Death of shot animals can be confirmed by observing a combination of the following:
  - no heartbeat
  - no breathing
  - no corneal reflex (no blinking when the eyeball is touched)
  - no response to a painful stimulus (e.g., a pinch of the ear tip).
- If death cannot be verified, a second shot to the head should be taken immediately.
- If the carcasses are to be donated or sold for secondary use e.g., for feeding large carnivores at zoos, wildlife parks etc., they should be exsanguinated or 'bled-out' (carotid arteries and jugular veins cut) as soon as possible following shooting.

Figure 1: Shot placement for ground shooting of feral deer.



Note that shooting an animal from above or below the horizontal level as depicted here will influence the direction of the bullet through the body. Adjustment to the point of aim on the external surface of the body may need to be made to ensure that the angled bullet path causes extensive (and therefore fatal) damage to the main organs in the target areas.

References

Aebischer, N.J., Wheatley, C.J., & Rose, H.R. (2014). Factors associated with shooting accuracy and wounding rate of four managed wild deer species in the UK, based on anonymous field records from deer stalkers. *PLoS One 9:* e109698.

American Veterinary Medical Association (AVMA). (2020). *AVMA guidelines for the euthanasia of animals: 2020 edition.* American Veterinary Medical Association. Available at: https://www.avma.org/sites/default/files/2020-01/2020-Euthanasia-Final-1-17-20.pdf

American Veterinary Medical Association (AVMA). (2016). *AVMA Guidelines for the Humane Slaughter of Animals*. Available at: https://www.avma.org/sites/default/files/resources/Humane-Slaughter-Guidelines.pdf

Anon. (2016). *Deer Stalking Code of Practice*. Available at: https://basc.org.uk/cop/deer-stalking/

Anon. (2002). *Deer Management Plan for Royal National Park and NPWS Reserves in the Sydney South Region.* NSW National Parks and Wildlife Service, Sutherland.

Anon. (2001). *Australian Deer Association Inc. National Code of Conduct*. Available at: https://www.austdeer.com.au/code_conduct

Bengsen, A.J., Forsyth, D.M., Harris, S., Latham, A.D., McLeod, S.R., and Pople, A. (2020). A systematic review of ground-based shooting to control overabundant mammal populations. *Wildlife Research,* 47: 197-207.

Cockram, M.S., D.J. Shaw, E. Milne, R. Bryce, C. McClean, & M.J. Daniels. (2011). Comparison of effects of different methods of culling red deer (*Cervus elaphus*) by shooting on behaviour and post-mortem measurements of blood chemistry, muscle glycogen and carcase characteristics. *Animal Welfare* 20: 211-224.

DeNicola, A. J., Miller, D. S., DeNicola, V. L., Meyer, R. E., & Gambino, J. M. (2019). Assessment of humaneness using gunshot targeting the brain and cervical spine for cervid depopulation under field conditions. *PloS One* 14: e0213200.

Finnie, J. (1997). Traumatic head injury in ruminant livestock. *Australian Veterinary Journal,* 75: 204–208.

Gregory, N. (2004). *Physiology and behaviour of animal suffering*. Oxford, UK: Blackwell

Lambooij, B. & Algers, B. (2016). Mechanical stunning and killing methods. In: Verlade A, Raj M (eds) *Animal Welfare at Slaughter*. Sheffield, U.K: 5M Publishing.

Lewis, A. R., Pinchin, A. M. & Kestin, S. C. (1997). Welfare implications of the night shooting of wild impala (*Aepyceros malampus*). *Animal Welfare* 6: 123-131.

McLeod, S. (ed.) Proce*edings of the National Feral Deer Management Workshop – Canberra November 2005*. Invasive Animals Cooperative Research Centre, Canberra

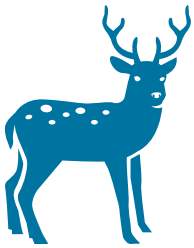
Scottish Natural Heritage (2008). *Best Practice Guidance on the Management of Wild Deer in Scotland.* Wild Deer Best Practice (WDBP), Inverness, Scotland. Available at: https://www.bestpracticeguides.org.uk/

Smith, G. (1999). *A guide to hunting and shooting in Australia*. Regency Publishing, South Australia.

Stokke, S., Arnemo, J. M., Brainerd, S., Söderberg, A., Kraabøl, M., & Ytrehus, B. (2018). Defining animal welfare standards in hunting: body mass determines thresholds for incapacitation time and flight distance. *Scientific Reports,* 8: 13786.

Urquhart, K. A. & McKendrick, I. J. (2003). Survey of permanent wound tracts in the carcases of culled wild red deer in Scotland. *Veterinary Record,* 152: 497-501.

Woods, J., Shearer, J.K. & Hill, J. (2010). Recommended On-farm Euthanasia Practices. Pp 186-213 in: Grandin T (ed.) *Improving Animal Welfare: A Practical Approach*. CABI, Wallingford, Oxfordshire, U.K.



NSWDEER SOP2
Aerial shooting of feral deer

Background

Aerial shooting of feral deer from a helicopter is used in extensive or otherwise inaccessible areas. It is an effective and relatively cost-effective method of quickly reducing feral deer populations. Teams involved in shooting from a helicopter require (at minimum) a shooter (seated immediately behind the pilot), an observer and the pilot. The observer or navigator primarily looks for and reports hazards plus keeps the helicopter within the approved shooting area, identifies target animals for the pilot, and records locations, species and animals killed. The pilot aligns the helicopter for the optimum shot, advises the shooter when to shoot and can also confirm kills and advise on requirements of additional shots for humaneness purposes.

Aerial shooting is a humane method of killing feral deer when it is carried out by experienced and skilled shooters and pilots, the animal can be clearly seen and is within range, the correct firearm, ammunition and shot placement is used, and wounded animals can be promptly located and killed.

This standard operating procedure (SOP) is a guide only; it does not replace or override the relevant legislation that applies in NSW. The SOP should only be used subject to the applicable legal requirements (including WHS) operating in the relevant jurisdiction.

Individual SOPs should be read in conjunction with the overarching Code of Practice for that species to help ensure that the most appropriate control techniques are selected and that they are deployed in a strategic way, usually in combination with other control techniques, to achieve rapid and sustained reduction of pest animal populations and impacts.

Application

- All aerial shooting programs conducted by Government Agencies - National Parks and Wildlife Service (NPWS) or Local Lands Services (LLS) - in NSW must be planned and implemented under the NSW Feral Animal Aerial Shooting Team (FAAST) framework and in accordance with the procedures of the NSW FAAST Manual.
- Private or commercial operators in NSW that are not conducting shooting as part of a FAAST program must still adhere to all relevant regulatory and legislative requirements.
- Shooting of feral deer should only be performed by competent, trained personnel who have been tested and accredited for suitability to the task and marksmanship and who hold the appropriate licences and accreditation (e.g., accredited through the FAAST training course or other approved competency, e.g., AHCPMG311 – Use firearms for pest control activities from aircraft, AHCPMG304 – Use firearms to humanely destroy animals).

- Aerial shooting should only be used in a strategic manner as part of a coordinated program designed to achieve sustained effective control. A shooting operations plan must be prepared and approved by the relevant agency for each FAAST aerial shooting program.
- Aerial shooting is a cost-effective method where deer density is high. Costs per animal increases greatly as deer numbers decrease. Also, deer learn to avoid helicopters, so successive shoots can become less effective.
- Aerial shooting is effectively used to control deer in inaccessible or rough terrain. In areas of heavy cover (e.g., vegetated creek lines, woodlands and forest), effectiveness is limited since deer might be concealed and difficult to locate from the air.
- For safety reasons, shooting from a helicopter must not be undertaken in adverse weather conditions (e.g., strong wind, rain, low cloud, hot days that cause unpredictable thermals).
- Operators (including helicopters, pilots, shooters and navigators) must hold the appropriate licences and permits and be skilled and experienced in aerial shooting operations. Where managed by Government Agencies they must also be approved by FAAST.
- Helicopter operators must have approval from the Civil Aviation Safety Authority to undertake aerial shooting operations (carriage and discharge of firearms in an aircraft).
- Aerial shooting should comply with all relevant federal and state legislation, policy and guidelines.
- Storage use and transportation of firearms and ammunition must comply with relevant legislative requirements.

Animal welfare implications

Target animals

- The humaneness of aerial shooting as a control technique depends on the skill and judgement of both the shooter and the pilot. If properly done, it can be a humane method of killing feral deer.
- Only chest (heart-lung) or head (brain) shots must be used. The initial chest (heart-lung) shot, or head (brain) shot (taken only when conditions are favourable for accurate shot placement) must be followed up with a further accurate heart-lung shot once the animal has collapsed. This deliberate 'overkill' policy is aimed at ensuring a quick death given the difficulty in confirming death from the air.
- Death from shots to the chest is due to massive tissue damage and haemorrhage from major blood vessels. Insensibility will occur sometime after the shot, ranging from a few seconds to a minute or more. If a shot stops the heart functioning, the animal will lose consciousness very rapidly. Correctly placed initial head shots cause brain function to cease and insensibility will be immediate.
- Shooting must be conducted in a manner that maximises its effect thus causing rapid death. This requires the use of appropriate firearms and ammunition.

- A target animal can only be shot when:
  - it is clearly visible and recognised
  - it is within effective range of shooter and the firearm and ammunition being used
  - a humane kill is probable. If in doubt do NOT shoot.
- The pilot must offer the shooter the best opportunities for a humane kill. This includes maintaining a stable shooting platform and to ensure that the helicopter is always aligned so that the shooter can maintain accuracy and to avoid shots to unacceptable parts of the body e.g., spine or neck shots. Aerial shooting should not be carried out if the nature of the terrain reduces accuracy resulting in too many wounding shots and prevents the humane and prompt despatch of wounded animals.
- To minimise the animal welfare implications of leaving dependent fawns to die, where possible they should be targeted first.
- If lactating females are shot, reasonable efforts should be made to find dependent young and kill them quickly and humanely.
- Aerial shooting programs by their nature must be highly accountable. Apart from maintaining absolute animal welfare standards, records should be kept of number and location of animals killed, hours flown, ammunition used and fly-back procedures.

Non-target animals

- Shooting is relatively target specific and does not usually impact on other species. However, there is always a risk of injuring or killing non-target animals, including livestock, if shots are taken before an animal has been positively identified.
- Sensitive livestock such as horses, free range poultry and farmed deer are easily frightened by gunshots, helicopter rotor noise, wind etc. and may injure themselves by running into fences and other obstacles. Avoid shooting in areas where these livestock occur or organise the removal of them from the area prior to the shooting program.

Workplace health and safety considerations

- The potentially hazardous nature of aerial shooting requires that safety protocols be strictly followed. Each team member must be aware of and trained in all aspects of helicopter and firearm safety.
- The helicopter pilot must perform a thorough pre-flight briefing with all personnel to establish communication protocols between the shooter and the pilot including pre-shot manoeuvre, commands for firing and emergency procedures.
- Shooting from a helicopter can be hazardous, particularly in areas of rugged topography. The combination of low-level flight, close proximity to obstacles (trees, rocks, and wires) and the use of firearms makes this task extremely hazardous.
- It is essential that ejected ammunition cases do not interfere with the safe operations of the helicopter. It might be necessary to fit a deflector plate (mandatory for FAAST operations) to the firearm to ensure shells are ejected safely.
- Firearm users must strictly observe all relevant safety guidelines relating to firearm ownership, possession and use.

- When not in use, firearms must be securely stored in a compartment that meets state legal requirements. Ammunition must be stored in a locked container separate from firearms.
- Adequate hearing protection should be worn by the shooter and others in the immediate vicinity of the shooter. Repeated exposure to firearm noise can cause irreversible hearing damage.
- Safety glasses are recommended to protect the eyes from gases, metal fragments and other particles.
- Refer to the current version of the FAAST Manual for further details on workplace health and safety requirements.

Equipment required

Firearms and ammunition

- Firearms should be:
  - Reliable, well maintained and capable of good accuracy
  - Fitted with a red dot scope with zero magnification
  - Rifles should be semi-automatic .308 calibre.
- Ammunition:
  - Chital deer: Hollow point, 130gn -135gn
  - Fallow deer: Hollow point, 130gn -135gn
  - Rusa deer: Hollow point, 130gn -135gn
  - Red deer: Hollow point, 130gn -135gn
  - Sambar deer: Protected point, strongly constructed (e.g. bonded core): 130-150gn; 150-180gn for larger individuals.
- Firearm and ammunition combinations for rifles with maximum shooting distances are included in the table below:

Cartridge	Bullet weight (gr)	Muzzle velocity (ft/sec)	Muzzle energy (ft-lbs)	Maximum distance (metres)*
.308 Winchester	130	3050	2685	70
.308 Winchester	135	3000	2699	70
.308 Winchester	150	2820	2648	70
.308 Winchester	180	2620	2743	70

Source:

https://winchester.com/Products/Ammunition/Rifle/Power-Max-Bonded

https://www.federalpremium.com/rifle/american-eagle/american-eagle-varmint-and-predator/11-AE308130VP.html

https://www.osaaustralia.com.au/products/ammunition/centrefire-rifle/308-win/osa-ammo-308win-135gr-sierra-20-pack/

*With aerial shooting, most shots are taken at 20 to 50 metres and the maximum range would be about 70 metres

- Specifying ammunition based on species alone rather than individual body mass is problematic. Shooters should select ammunition (from those specified) that best suits their situation, and which is justifiable on animal welfare grounds. This may particularly apply to situations where multiple species are being controlled in the one operation.
- To provide a backup in case of firearm/ammunition malfunction, at least two functioning firearms must be carried by shooters at all times.
- The accuracy and precision of firearms should be tested against inanimate targets before any shooting operation.

Aircraft

- Aircraft used for aerial shooting should be manoeuvrable, fast and responsive to allow quick follow-up of any wounded animals.
- The FAAST governance structure has compiled a list of helicopter operators, aircraft and pilots who are approved for FAAST operations. Only helicopter operators and aircraft deemed appropriate to the particular task will be selected for FAAST operations. Approved operators can be sourced through the State Air Desk (LLS) or the through the Flight Operations Unit (NPWS).
- GPS (global positioning systems) and computer mapping equipment with appropriate software must be used to assist in the accurate recording of information (e.g., where animals are shot) and to eliminate the risk of shooting in off-target areas.

Other equipment

- Flight helmet (with intercom).
- Fire-resistant flight suit.
- Safety harness.
- Other personal protective equipment including lace-up boots, gloves and appropriate eye and hearing protection.
- Survival kit (including a first aid kit).
- Emergency locating beacon.
- Lockable firearm box.
- Lockable ammunition box.
- Refer to the current FAAST Manual for further information.

Procedures

- Shooters must not shoot at an animal unless they are confident of a clean kill without unnecessary pain, distress or suffering. Only chest (heart-lung) or head/brain shots must be used. Shooting at other parts of the body is unacceptable.
- Wounded animals can suffer from pain and the disabling effects of the injury (including sickness due to infection). The cost of ammunition and extra flying time must not deter operators from applying fly-back procedures.

- Where target animals are encountered in a group, they should typically be shot from the back of the group first (the last one shot is furthest away from the helicopter). This may not always be possible, e.g., when an animal breaks away from a group. In this case the shooter and pilot need to communicate so they focus on the same animal.
- Each animal must be shot at least twice with at least one bullet placed in the heart/lung and before shooting further animals. The only exemption to two shots is when the heart/lung is completely destroyed after the first shot, as may be the case with smaller animals.
- The shooter must shoot an animal more than twice in the following circumstances:
  - where directed by the pilot or if the shooter considers it necessary
  - until a bullet is placed in the heart/lung of the animal
  - if the animal doesn't appear dead (signs of life could include attempting to lift its head, any coordinated body movement, eye blinking or breathing).
- Each animal shot must be considered dead by the shooter and pilot, and verbally announced as a 'kill' by the pilot before shooting further animals. This procedure allows for both the shooter and pilot to make a judgement of each animal shot being dead, by the animal exhibiting no sign of life and/or by observing the placement of a bullet into the heart/lung.
- A flyback procedure is required after shooting a group of animals and must be applied at all times. The procedure is as follows:
  - fly back over each animal of the group shot
  - hover over each animal long enough to assess that the animal doesn't exhibit any sign of life
  - where there is any doubt by the shooter or pilot that the animal is dead or that there is a bullet in the heart/lung, the shooter is to shoot further bullet/s into the heart/lung of the animal.
- When large groups of animals are encountered or when groups are encountered in heavy vegetation, the shooter and pilot must consider the ability to conduct an effective flyback procedure. If an effective flyback is likely to be hampered by continuing to shoot further animals in a group or when animals already shot are unlikely to be found, shooting should temporarily cease, and a flyback conducted over animals already shot.
- The best time to shoot deer is when they are most active and away from cover; that is, in the early morning, late afternoon and evening. During winter months and on cooler, overcast days deer will be more active during daylight hours.
- Target deer should be mustered away from watercourses and areas of dense vegetation before being shot, as wounded animals will be difficult to locate if they go down in these locations.
- Once a target is sighted and has been positively identified, the pilot should position the helicopter as close as is safe to the target animal to permit the shooter the best opportunity for a humane kill.
- The pilot should aim to provide a shooting platform that is as stable as possible.

Target animal and shot placement

Aiming points for head and chest shots are as follows (See also Figure 2)

Chest Shot

Side view

- The firearm is aimed at the centre of a line encircling the minimum girth of the animal's chest, immediately behind the forelegs. The shot should be taken slightly to the rear of the shoulder blade (scapula). This angle is taken because the scapula and humerus provide partial protection of the heart from a direct side-on shot.

Head Shots

Poll position (rear view)

- When aerial shooting, most head shots will be taken at this position as animals are running away from the helicopter. The firearm should be aimed at the back of the head at a point between the base of the ears and directed towards the mouth.

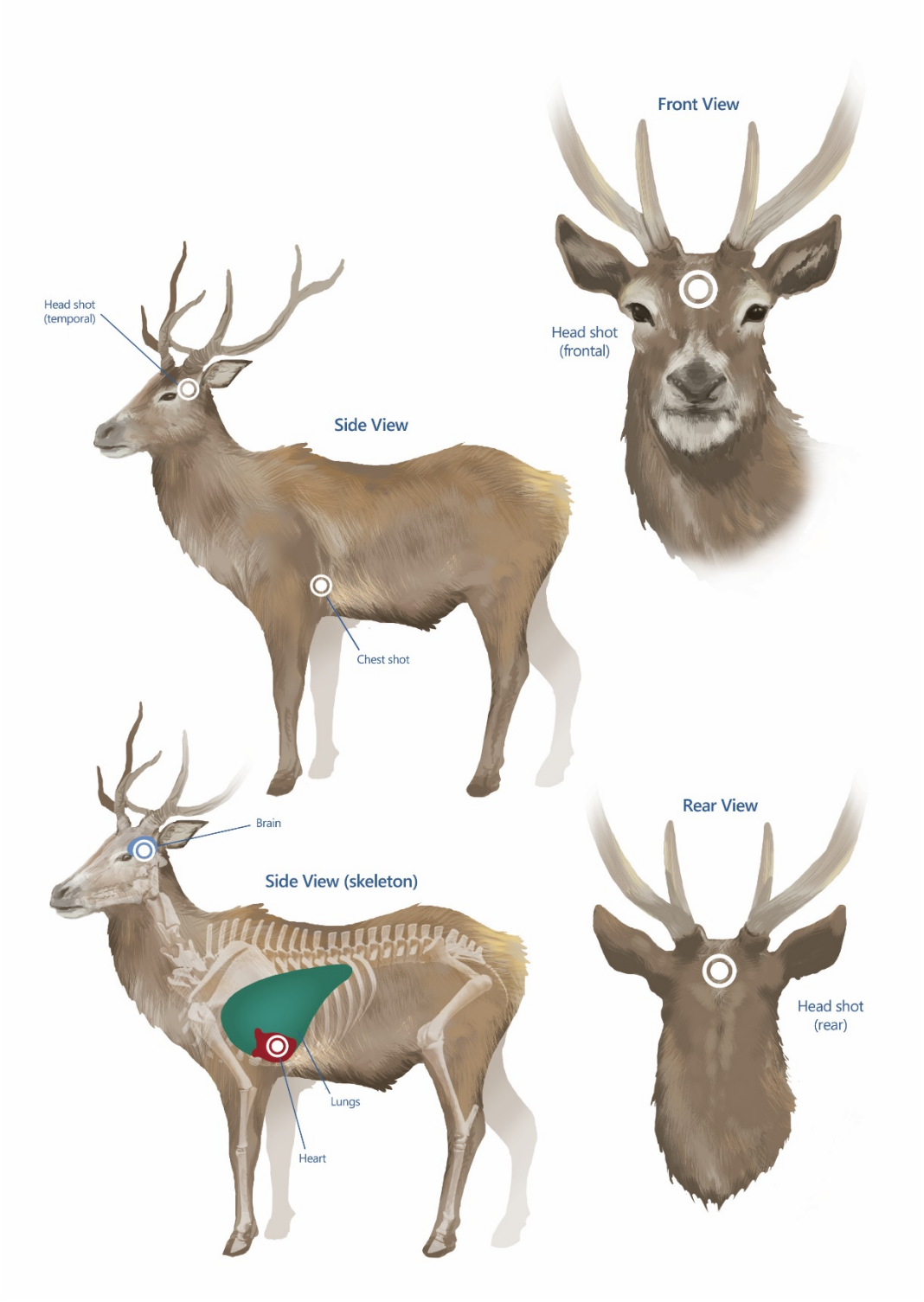
Temporal position (side view)

- This shot is occasionally used where a second shot needs to be delivered to an injured animal that is lying on its side. The deer is shot from the side so that the bullet enters the skull at a point midway between the eye and the base of the ear.

Frontal position (front view)

- This position is occasionally used when an animal faces the shooter. It should not be used for larger adult deer due to the heavier bone structure of the front of the skull. The shot is directed at a point of intersection of lines taken from the base of each ear to the opposite eye.

Figure 2: Shot placement for aerial shooting of deer.



Note that shooting an animal from above or below the horizontal level as depicted here will influence the direction of the bullet through the body. Adjustment to the point of aim on the external surface of the body may need to be made to ensure that the angled bullet path causes extensive (and therefore fatal) damage to the main organs in the target areas.

References

Aebischer, N.J., Wheatley, C.J., & Rose, H.R. (2014). Factors associated with shooting accuracy and wounding rate of four managed wild deer species in the UK, based on anonymous field records from deer stalkers. *PLoS One,* 9: e109698.

American Veterinary Medical Association (AVMA). (2020). *AVMA guidelines for the euthanasia of animals: 2020 edition.* American Veterinary Medical Association. Available at: https://www.avma.org/sites/default/files/2020-01/2020-Euthanasia-Final-1-17-20.pdf

American Veterinary Medical Association (AVMA). (2016). *AVMA Guidelines for the Humane Slaughter of Animals: 2016 Edition*. Available at: https://www.avma.org/sites/default/files/resources/Humane-Slaughter-Guidelines.pdf

Anon. (2016). *Deer Stalking Code of Practice*. Available at: https://basc.org.uk/cop/deer-stalking/

Anon. (2002). *Deer Management Plan for Royal National Park and NPWS Reserves in the Sydney South Region.* NSW National Parks and Wildlife Service, Sutherland.

Anon. (2001). *Australian Deer Association Inc. National Code of Conduct*. Available at: https://www.austdeer.com.au/code_conduct

Cockram, M.S., D.J. Shaw, E. Milne, R. Bryce, C. McClean, & M.J. Daniels. (2011). Comparison of effects of different methods of culling red deer (*Cervus elaphus*) by shooting on behaviour and post-mortem measurements of blood chemistry, muscle glycogen and carcase characteristics. *Animal Welfare* 20: 211-224.

DeNicola, A. J., Miller, D. S., DeNicola, V. L., Meyer, R. E., & Gambino, J. M. (2019). Assessment of humaneness using gunshot targeting the brain and cervical spine for cervid depopulation under field conditions. *PloS One*, 14: e0213200.

Finnie, J. (1997). Traumatic head injury in ruminant livestock. *Australian Veterinary Journal*, 75: 204–208.

Gregory, N. (2004). *Physiology and behaviour of animal suffering*. Oxford, UK: Blackwell.

Lambooij, B. & Algers, B. (2016). Mechanical stunning and killing methods. In: Verlade A, Raj M (eds.) *Animal Welfare at Slaughter*. Sheffield, U.K: 5M Publishing.

Lewis, A. R., Pinchin, A. M. & Kestin, S. C. (1997). Welfare implications of the night shooting of wild impala (*Aepyceros malampus*). *Animal Welfare,* 6: 123-131.

McLeod, S. (ed.) Proce*edings of the National Feral Deer Management Workshop – Canberra November 2005*. Invasive Animals Cooperative Research Centre, Canberra

Office of Environment and Heritage (2019 Draft). *NSW Feral Animal Aerial Shooting Team (FAAST) Manual*. OEH Sydney.

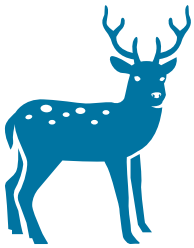
Scottish Natural Heritage (2008). *Best Practice Guidance on the Management of Wild Deer in Scotland.* Wild Deer Best Practice (WDBP), Inverness, Scotland. Available at: https://www.bestpracticeguides.org.uk/

Smith, G. (1999). *A guide to hunting and shooting in Australia*. Regency Publishing, South Australia.

Stokke, S., Arnemo, J. M., Brainerd, S., Söderberg, A., Kraabøl, M., & Ytrehus, B. (2018). Defining animal welfare standards in hunting: body mass determines thresholds for incapacitation time and flight distance. *Scientific Reports, 8*: 13786.

Urquhart, K. A. & McKendrick, I. J. (2003). Survey of permanent wound tracts in the carcases of culled wild red deer in Scotland. *Veterinary Record,* 152: 497-501.

Woods, J., Shearer, J.K. & Hill, J. (2010). Recommended On-farm Euthanasia Practices. Pp 186-213 in: Grandin T (ed.) *Improving Animal Welfare: A Practical Approach*. CABI, Wallingford, Oxfordshire, U.K



NSWDEER SOP3
Trapping of feral deer

Background

Capture and euthanasia of feral deer may be used for management purposes. Clover or box traps are used to capture individual deer, and larger paddock, corral or 'enclosure' traps are used for groups of deer.

Although trapping is considered to be an ineffective tool for large areas, it may be useful in urban/residential areas where feral deer are becoming a nuisance or traffic hazard, or where populations have already been reduced and individuals need to be targeted.

This standard operating procedure (SOP) is a guide only; it does not replace or override the relevant legislation that applies in NSW. The SOP should only be used subject to the applicable legal requirements (including WHS) operating in the relevant jurisdiction.

Individual SOPs should be read in conjunction with the overarching Code of Practice for that species to help ensure that the most appropriate control techniques are selected and that they are deployed in a strategic way, usually in combination with other control techniques, to achieve rapid and sustained reduction of pest animal populations and impacts.

Application

- Trapping is time-consuming and labour intensive and is therefore an inefficient method for large-scale feral deer management in Australia. It can be effective in controlling problem individuals in urban and semi-urban areas.
- Some individuals may be particularly trap-shy and therefore reluctant to enter the trap. Also, if food sources are readily available, deer may not be hungry enough to approach a baited trap.
- Traps have the potential to cause significant suffering and distress so should only be used when there is no suitable alternative.
- Selection of appropriate traps, trap sites and trap size will maximise chance of capture and minimise the distress caused to target and non-target animals.
- Every effort must be made to avoid target and non-target deaths from factors such as exposure or shock.
- Traps must be used in accordance with relevant NSW legislation (*Prevention of Cruelty to Animals Act 1979*).
- Shooting of captured feral deer should only be performed by skilled operators who have the necessary experience with firearms and who hold the appropriate licences and

accreditation. Storage and transportation of firearms and ammunition must comply with relevant legislation requirements.

Animal welfare implications

Target animals

- Feral deer are likely to suffer distress and potential capture myopathy from being confined in a cage trap. They can sometimes also be injured while trying to escape, leading to facial, leg and antler injuries. If multiple deer are caught in the same clover trap this increases the likelihood of receiving injuries.
- Traps must be inspected daily to prevent suffering and possible death from exposure, dehydration, starvation and/or shock. Risk of injury and capture myopathy increases with increased time spent in the trap.
- Where possible, trapping should be avoided when adverse weather conditions threaten the welfare of trapped animals.
- Corral traps should have hessian or shade cloth on the walls to create a visual barrier. This will help to minimise injuries caused by animals jumping into the sides of the trap.
- Smaller traps must be set up at sites where vegetation can provide shade and shelter. Where large paddock traps are used, access to water, feed and shelter must be provided if deer are to be held for more than 24 hours.
- Captured animals must be approached carefully and quietly to reduce panic, further stress and risk of injury.
- Trapped feral deer must be killed as quickly and humanely as possible (if euthanasia is the intended outcome).
- If lactating females without their young are caught in a trap and killed, reasonable efforts should be made to find dependent fawns and kill them quickly and humanely.

Non-target animals

- Traps are not target specific, therefore other species may be caught (depending on the trap mechanism and size of the animal).
- Traps must not be set near areas that are regularly frequented by non-target species.
- Live non-target animals caught in traps must be examined for injuries and signs of illness or distress and dealt with as follows:
    - Animals that are unharmed or have only received minimal injuries such as minor cuts or abrasions should be immediately released at the site of capture.
    - Animals that have more severe injuries or are suffering from thermal stress should receive appropriate attention. An animal suffering from thermal stress can initially be placed in a suitable quiet holding area that provides warmth or shade to allow recovery before release. Animals with treatable injuries that cannot be immediately released or those failing to recover from thermal stress should be presented to a veterinarian or a registered wildlife carer for treatment.

- Animals that have injuries that are untreatable, or which would compromise their survival in the wild should be euthanased using a technique that is suitable for the species. For more information on euthanasia techniques refer to *GEN001 Methods of Euthanasia.*

Workplace health and safety considerations

- Trapped feral deer can be dangerous to handle. They will be nervous and agitated and can inflict serious injury with their large bodies and legs. If these deer are killed whilst still in the cage, there should be no need to handle them directly.
- Firearms are hazardous. All people should stand well behind the shooter when a deer is being shot. The line of fire must be chosen to prevent accidents or injury from stray bullets or ricochets.
- Firearm users must strictly observe all relevant safety guidelines relating to firearm ownership, possession and use.
- Firearms must be securely stored in a compartment that meets state legal requirements. Ammunition must be stored in a locked container separate from firearms.
- The shooter and others in the immediate vicinity should wear adequate hearing protection to prevent irreversible hearing damage, and safety glasses to protect eyes from gases, metal fragments and other particles.
- Care must be taken when handling live deer and carcases as they may carry diseases such as Q-fever, salmonellosis, toxoplasmosis and yersiniosis that can affect humans and other animals. Routinely wash hands after handling all carcasses.

Equipment required

Traps

- Corral traps may be permanent or portable designs constructed at commonly used feeding sites, water points or trails. Trap gates can be triggered remotely, by trip-wire, or there may be a one-way entrance. In NSW, corral traps have been used to trap fallow and rusa deer.
- Clover traps are designed for capturing individual deer. They are small traps, around 2 m long x 1 m wide x 1.5 m high, with a metal or wooden frame covered in nylon mesh to minimise injuries, and a trip wire that triggers a sliding door to close the trap. In NSW, clover traps have been used to trap rusa deer.
- Paddock traps are large paddock scale enclosures where feed, water and cover are provided. Trap gates can be triggered remotely, by trip wire, or there may be a one-way entrance. Larger trap sizes give deer enough room to move away from people entering the trap, allow for effective handling and will also reduce the pressure on the fences.

Lures/baits

- Bait is required to attract deer into a trap, and may consist of feeds such as lucerne hay, Rhodes grass hay, corn or barley, or could be a water source.

- Attractiveness and palatability of the bait will vary with season and location.

Firearms and ammunition

- Smaller calibre rifles such as .22 magnum rimfire with hollow or soft-point ammunition are adequate for euthanasia of deer at short range (within 5 metres). If shooting animals from a greater distance, refer to *NSWDEER SOP1 Ground shooting of feral deer* for more detailed information.

Procedures

Selection of trap sites

- Traps should be set in areas where deer are known to be active. Camera traps could be used to establish the areas with most deer traffic and least non-target activity.
- The location of all trap sites must be accurately recorded. This information should be readily available to others in case the trapper is unable to return to check the traps.
- Do not place traps in areas where they may be interfered with/damaged by large stock or humans.

Placing and setting the trap

- For a period of time prior to trapping, traps should be left open with free feed inside to attract deer and allow them to acclimatise to entering the trap. This should increase the probability of captures and potentially decrease the stress perceived by captured animals.
- Before setting each trap ensure that it is functioning properly.
- The trap should be firmly staked to the ground or be heavy enough to prevent deer or some other animal from tipping it over and injuring itself, and/or releasing the trap door.
- Place free feed inside the trap in a suitable position in relation to the trap door mechanism.
- It is preferable to set traps at the end of each day and check early each morning. When traps are open during the day there is a greater risk of birds, such as magpies and currawongs, entering and triggering the trap. If traps need to be left open during the day, they should be checked again in late afternoon and not set on excessively hot days.
- Traps should be checked twice per day during peak fawning periods, and at least once per day at all other times.

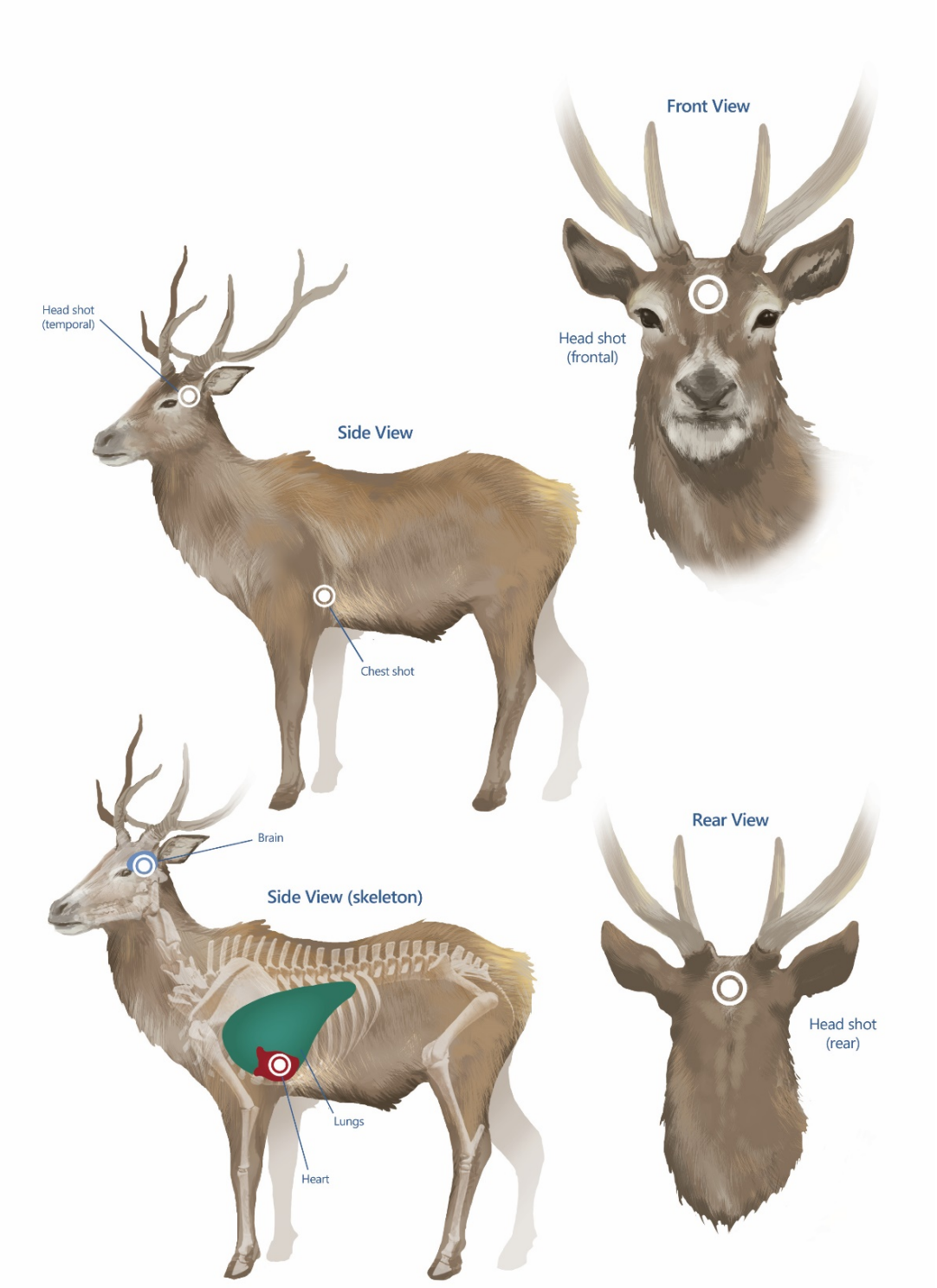
Euthanasia of trapped feral deer

Shooting

- Trapped feral deer can be euthanased by shooting whilst still held in the trap.
- It can be difficult to shoot feral deer humanely as they become very nervous and agitated when restrained and in the presence of people. Unnecessary people should keep away from the area. The shooter should approach the animal in a calm and quiet manner.

- Never fire when the deer is moving its head, be patient and wait until the deer is motionless before shooting. Accuracy is important to achieve a humane death. One shot to the head should ensure instantaneous loss of consciousness and rapid death without resumption of consciousness.
- To maximise the impact of the shot and to minimise the risk of misdirection the range should be as short as possible i.e., 5 to 20 cm from the head. See Figure 3 for shot placement diagrams.
- Where deer are contained within large paddock traps shooting should be undertaken at night as per *NSWDEER SOP1 Ground shooting of feral deer*.

Figure 3 Shot placement for ground shooting of feral deer



Note that shooting an animal from above or below the horizontal level as depicted here will influence the direction of the bullet through the body. Adjustment to the point of aim on the external surface of the body may need to be made to ensure that the angled bullet path causes extensive (and therefore fatal) damage to the main organs in the target areas.

References

Aebischer, N. J., Wheatley, C. J., & Rose, H. R. (2014). Factors associated with shooting accuracy and wounding rate of four managed wild deer species in the UK, based on anonymous field records from deer stalkers. *PLoS One,* 9: e109698.

American Veterinary Medical Association (AVMA). (2020). *AVMA guidelines for the euthanasia of animals: 2020 edition.* American Veterinary Medical Association. Available at: https://www.avma.org/sites/default/files/2020-01/2020-Euthanasia-Final-1-17-20.pdf

American Veterinary Medical Association (AVMA). (2016). *AVMA Guidelines for the Humane Slaughter of Animals*: 2016 Edition. Available at: https://www.avma.org/sites/default/files/resources/Humane-Slaughter-Guidelines.pdf

Anon. (2002). *Deer Management Plan for Royal National Park and NPWS Reserves in the Sydney South Region.* NSW National Parks and Wildlife Service, Sutherland.

Anon. (2001). *Australian Deer Association Inc. National Code of Conduct.* Available at: https://www.austdeer.com.au/code_conduct

Bergvall, U.A., Jäderberg, L. & Kjellander, P., (2017). The use of box-traps for wild roe deer: behaviour, injuries and recaptures. *European Journal of Wildlife Research,* 63: 67.

Cockram, M.S., Shaw, D.J., Milne, E., Bryce, R., McClean, C. & Daniels, M.J. (2011). Comparison of effects of different methods of culling red deer (*Cervus elaphus*) by shooting on behaviour and post-mortem measurements of blood chemistry, muscle glycogen and carcase characteristics. *Animal Welfare,* 20: 211-224.

DelGiudice, G.D., Mangipane, B.A., Sampson, B.A. & Kochanny, C.O. (2001). Chemical immobilization, body temperature, and post-release mortality of white-tailed deer captured by Clover trap and net-gun. *Wildlife Society Bulletin,* 29: 1147-1157.

DeNicola, A. J., Miller, D. S., DeNicola, V. L., Meyer, R. E., & Gambino, J. M. (2019). Assessment of humaneness using gunshot targeting the brain and cervical spine for cervid depopulation under field conditions. *PloS One*, 14: e0213200.

Finnie, J. (1997). Traumatic head injury in ruminant livestock. *Australian Veterinary Journal*, 75: 204–208.

Forsyth D, Pople T, Page B, Moriarty A, Ramsey D, Parkes J, Wiebkin A, & Lane C (eds.) (2017). *2016 National Wild Deer Management Workshop Proceedings, Adelaide, 17-18 November 2016*. Invasive Animals Cooperative Research Centre, Canberra, Australia.

Gregory, N. (2004). *Physiology and behaviour of animal suffering*. Oxford, UK: Blackwell

Hampton, J.O., Finch, N.A., Watter, K., Amos, M., Pople, T., Moriarty, A., Jacotine, A., Panther, D., McGhie, C., Davies, C. & Mitchell, J. (2019). A review of methods used to capture and restrain introduced wild deer in Australia. *Australian Mammalogy,* 41: 1-11.

Haulton, S.M., Porter, W.F. & Rudolph, B.A. (2001). Evaluating 4 methods to capture white-tailed deer. *Wildlife Society Bulletin,* 29: 255-264.

Jackson, S.M., Bengsen, A., Forsyth, D.M. and Comte, S. (2021). *A review of the methods used to trap wild deer in New South Wales and Queensland*. Vertebrate Pest Research Unit. Department of Primary Industries, Orange, New South Wales.

Lambooij, B. & Algers, B. (2016). Mechanical stunning and killing methods. In: Verlade A, Raj M (eds.) *Animal Welfare at Slaughter*. Sheffield, U.K: 5M Publishing.

McLeod S (2009) *Proceedings of the National Feral Deer Management Workshop, Canberra, November 2005,* Invasive Animals Cooperative Research Centre, Canberra.

Scottish Natural Heritage (2008). *Best Practice Guidance on the Management of Wild Deer in Scotland*. Wild Deer Best Practice (WDBP), Inverness, Scotland. Available at: https://www.bestpracticeguides.org.uk/

Smith, G. (1999). *A Guide to Hunting & Shooting in Australia*. Regency Publishing, South Australia.

Stokke, S., Arnemo, J. M., Brainerd, S., Söderberg, A., Kraabøl, M., & Ytrehus, B. (2018). Defining animal welfare standards in hunting: body mass determines thresholds for incapacitation time and flight distance. *Scientific Reports*, 8: 13786.

Thompson, M.J., Henderson, R.E., Lemke, T.O. & Sterling, B.A., 1989. Evaluation of a collapsible clover trap for elk. *Wildlife Society Bulletin17*: 287-290.

Urquhart, K. A. and McKendrick, I. J. (2003). Survey of permanent wound tracts in the carcases of culled wild red deer in Scotland. *Veterinary Record,* 152: 497-50

Woods, J., Shearer, J.K. & Hill, J. (2010). Recommended On-farm Euthanasia Practices. Pp 186-213 in: Grandin T (ed.) *Improving Animal Welfare: A Practical Approach*. CABI, Wallingford, Oxfordshire, U.K.