

A model for assessing the relative humaneness of pest animal control methods

Second edition June 2011

by Trudy Sharp and Glen Saunders

Vertebrate Pest Research Unit – Industry & Investment NSW

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Preface to the Second Edition

This second edition has been updated and revised to include minor modifications and improvements to the model for assessing the relative humaneness of pest animal control methods. Some of the examples in the impact scales have been modified and notes have been added to the worksheet to clarify some aspects of the assessment process.

This edition also contains a summary of the project which applied the model to commonly used control methods. Completed assessments for a range of species and techniques are included as well as 'humaneness matrices' which provide a simplified overview of the relative humaneness of all the methods for each species.

Thus, Section 1 contains a review of humaneness assessment and a summary of the project to **develop** the model whilst Section 2 describes the process undertaken to **assess** the humaneness of commonly used invasive animal techniques.

Information in this publication has been summarised below to provide a quick overview of the process to develop and apply the model and we have also addressed some of the issues encountered along the way:

Background to the Assessment model

A workshop hosted by RSPCA Australia, the Animal Welfare Science Centre and the Vertebrate Pests Committee (VPC) was held in 2003 in Melbourne. It was attended by representatives from government (State and Commonwealth), animal welfare and veterinary organisations e.g. Australian Veterinary Association (AVA), RSPCA and pest animal control organisations e.g. Livestock Health and

Pest Authorities as well as producer bodies e.g. Cattle Council, Australian Wool Innovation, Victorian Farmers Federation.

The workshop examined solutions for achieving humane pest animal control and identified a major weakness in the consideration of animal welfare. While the workshop participants indicated there was a will to include consideration of animal welfare in control strategies and in the registration of new control products, a process to do this in an objective, science based way was lacking. This lack of animal welfare consideration was viewed as posing a general threat to ongoing pest animal control operations.

With the financial support of the Department of Agriculture, Fisheries and Forestry under the Australian Animal Welfare Strategy (AAWS), a project to develop a process for assessing the relative humaneness of pest animal control methods was offered to tender in 2007. Under the management of a steering group formed from members of the AAWS Wild Animals Working Group, the NSW (I&I) Vertebrate Pest Research Unit was commissioned to develop a suitable model for humaneness assessment.

Development of an Assessment Model

Creating a suitable, workable model proved to be difficult due to the variety of control techniques used, the wide range of pest animals targeted, and the inclusion of both lethal and non-lethal methods. The final aim therefore became to produce a practical, general model of humaneness assessment that can be applied to any pest control method.

The assessment of overall welfare impact is based on five domains:

- 1: Thirst/hunger/malnutrition
- 2: Environmental challenge
- 3: Injury/disease/functional impairment
- 4: Behavioural/interactive restriction
- 5: Anxiety/fear/pain/distress

The model was not designed to provide an absolute measure of humaneness but will allow a judgement to be made about the impact of a specific control method on the target animal. When the model is applied to a range of different methods, these can be compared and a decision can be made on the choice of method that is informed by an understanding of the relative humaneness of each method being considered.

It was clear from the initial tender that the development of an assessment process would require significant stakeholder input and agreement for it to have a wide uptake and ultimate impact. As part of the consultation process a workshop to consider a first draft of the humaneness model was held in April 2008 and was again attended by representatives from various State/Territory and Commonwealth governments (including the CSIRO and APVMA), and non-governmental organizations such as RSPCA, Animals Australia, NSW Farmers and AVA. At the workshop it was agreed that the model was acceptable and would be workable with some minor modifications. The modified model was published in 2008.

Discussions on how the model should be used were also undertaken at the workshop with the majority of stakeholders expressing their support for its application to currently used control methods (those for which Standard Operating Procedures had been written). There was general agreement that a panel of experts with knowledge and experience in animal welfare and invasive animal management should determine the priority methods for assessment, complete the assessments using the

humaneness model and then disseminate the results to a wider audience. It is anticipated that the information gained will improve best practice management of invasive animal species by enabling humaneness to be considered alongside efficacy, cost-effectiveness, practicality, target specificity, operator safety etc. when determining the most appropriate method for managing the impact of an invasive animal.

The Assessment Process

In 2009, a project was funded by the Australian Pest Animal Research Program (APARP) formerly known as the Australian Pest Animal Management Program (APAMP) and the Australian Animal Welfare Strategy (AAWS) through the Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF) to identify and coordinate a suitable panel, who would then apply the model to a selection of currently used invasive animal methods.

The objectives of the Humaneness Assessment Panel were to:

- Produce a priority list of methods to be assessed.
- Identify other suitable advisors with expertise and experience in particular invasive animal species and their management. These 'species experts' will be invited to attend meetings of the panel and participate in the humaneness assessments for their species of interest.
- Review current information and perform humaneness assessments using the model as a framework.
- Identify where there is a need to develop more humane methods or to expedite the introduction of more humane methods.
- Identify areas where there are gaps in knowledge regarding the welfare impact of control methods. These gaps will be

discussed in the final project report and also reported to the AAWS research group and the VPC Animal Welfare technical group.

- Report any problems, suggested changes or other issues with the current Standard Operating Procedures for the Humane Control of Pest Animals to the Vertebrate Pest Research Unit, NSW Dept. Industry and Investment so that modifications can be made when the SOPs are reviewed.
- Provide suggestions, where appropriate, for improving the assessment model.
- Release the results of the humaneness assessments so they can be placed on a suitable website e.g. feral.org.au or DAFF AAWS (website yet to be established).
- Seek endorsement of the assessments by the National Vertebrate Pest Committee.
- At the end of the project's tenure, make recommendations on the requirement for, and composition of future panels to conduct further assessments and/or to periodically review completed assessments to take into account new research.

The Humaneness Assessment Panel was based on expertise and independence and comprised of:

Dr Glen Saunders

Research Leader
Vertebrate Pest Research Unit, Industry and Investment NSW

Dr Bidda Jones

Chief Scientist
RSPCA Australia

Mr Chris Lane

Program Coordinator, Invasive Animals
Cooperative Research Centre
Vertebrate Pest Research Unit, Industry and Investment NSW

Mr Jason Neville

Senior Ranger, Pest Management, Western Rivers Region
DECC - Parks and Wildlife Group

Ms Trudy Sharp

Project Officer
Vertebrate Pest Research Unit, Industry and Investment NSW

Dr Andrew Fisher

Associate Professor in Production Animal Management and Welfare
Faculty of Veterinary Science, University of Melbourne

Dr Frank Keenan

A/Manager, Land Protection Policy
Biosecurity Queensland

Dr Andrew Braid

Veterinarian
CSIRO Sustainable Ecosystems, Agricultural Landscapes Program

Additional members were co-opted for their specific species or technique expertise. No techniques were assessed without this additional expertise being available.

Further information on the panel members and invited species experts are included in Section 2. The Assessment Panel's proceedings were recorded and reported to AAWS and APAMP in the project's final reports.

Issues

Some concerns were expressed over the implementation of the process for assessing the relative humaneness of pest animal control methods, under what circumstances it might be applied and how it might threaten the use of existing pest animal control strategies. In relation to some of these concerns the following points are relevant:

- There is a worldwide trend towards ethical and moral concern for welfare of animals

regardless of their status. This trend cannot be ignored.

- The ranking process is an enabler not an inhibitor; it provides support to control techniques through evidence based, objective assessment.
- When selecting the most appropriate pest control techniques to apply in the field, welfare is just one of the issues to be considered. This is made clear in the documentation around the model.
- Control techniques are relatively easy to assess on the basis of efficacy, cost/benefit, target specificity etc. but nothing was previously in place to assess humaneness.
- The development of a humaneness assessment for a particular control technique is not linked to a decision on the need to implement control; this is a given.
- Application of the model provides transparency to the community and is independent of the end-users which is to their advantage.
- The use of the model and the assessment results provides a means of encouraging development of more humane techniques.
- The consultation process involved in this process was extensive. No groups were deliberately excluded.

Glen Saunders and Trudy Sharp

June 2011

Contents

Preface to the Second Edition	3
Section I – Developing a model for assessing the relative humaneness of pest animal control methods.....	9
Foreword	11
Acknowledgements	12
Executive Summary	13
Membership and project steering group	14
Scope and approach.....	14
Part A: Review of humaneness assessment.....	17
1. Introduction	17
2. What is humaneness?	17
a. Defining humaneness	17
b. Why do we need to assess the relative humaneness of pest animal control methods?	18
3. Defining animal welfare	19
4. Assessment of animal welfare	19
a. How is welfare assessed?	19
b. Assessment of laboratory animal welfare	21
c. Assessment of production animal welfare	24
d. Assessment of welfare of free-living wild animals	25
5. Application of welfare/humaneness assessment: some examples relevant to pest animal control	26
a. Assessment of humaneness of traps	26
b. Assessment of humaneness of poisons	28
c. Humaneness of rodent pest control	30
d. Humaneness of wombat destruction techniques	30
e. Assessment of lethal methods for badger control	30
f. The assessment of welfare of hunted deer	31
g. Assessment of humaneness of feral pig control techniques used in Australia.....	32
6. Can we achieve overall assessment of humaneness of pest animal control methods?.....	33
7. The role of 'best practice' and guidelines for the use of pest control methods.....	33
8. Criteria for assessing overall suitability of a control method - how will humaneness fit in?.....	34
9. Summary	35
Part B: A model for assessing the humaneness of pest animal control methods.....	37
1. Introduction.....	37
2. Overview of Mellor and Reid's model.....	37
3. Proposed model for the assessment of relative humaneness of pest animal control techniques	39
4. Advantages and disadvantages of this model	40
5. The humaneness assessment model.....	41
6. References.....	53

Section 2 – Assessing the humaneness of commonly used invasive animal control methods	57
1. Project Information	58
2. Acknowledgments	58
3. Executive summary	59
4. Background to the project.....	60
5. Project aims and objectives.....	60
6. Methodology.....	61
7. The humaneness panel	61
8. Panel meetings	67
9. Invasive animal control methods assessed.....	67
10. Suggested changes to model.....	68
11. Gaps in knowledge.....	68
12. Outputs of humaneness assessment project.....	69
13. References.....	70
14. Appendices	71
Appendix 1: Feral donkey ground shooting worksheet.....	72
Appendix 2: Feral cat cage trapping (without transport) worksheet	77
Appendix 3: Feral cat cage trapping (with transport) worksheet.....	80
Appendix 4: Feral camel mustering worksheet.....	83
Appendix 5: Feral goat aerial shooting worksheet.....	85
Appendix 6: Feral goat trapping worksheet.....	90
Appendix 7: Feral horse aerial shooting worksheet.....	92
Appendix 8: Fox 1080 baiting worksheet	96
Appendix 9: Pest bird net trapping worksheet.....	99
Appendix 10: Rabbit warren destruction by explosives worksheet	105
Appendix 11: Wild dog trapping with padded jaw traps worksheet.....	108
Appendix 12: Humaneness matrices.....	114



Section I - Developing a model for assessing the
relative humaneness of pest animal control methods

Foreword

Consideration of animal welfare in the management of invasive animals is essential to ensure that control techniques are performed humanely. For this reason, a workshop hosted by RSPCA Australia, the Animal Welfare Science Centre and the Vertebrate Pests Committee was held in 2003 in Melbourne, Australia. The workshop examined solutions for achieving humane invasive animal control and identified a major stumbling block in the consideration of animal welfare. While the workshop participants indicated there was a will to include animal welfare in control strategies and in the registration of new control products, what was lacking was an accepted way to do this. In other words, to properly consider humaneness in invasive animal management, we needed to have a reliable and practical method of assessing it.

After further thought and discussion, and with the financial support of the Department of Agriculture, Fisheries and Forestry under the Australian Animal Welfare Strategy (AAWS), a project to develop a model for assessing the relative humaneness of pest animal control methods commenced in April 2007. Under the management of a steering group formed from members of the AAWS Wild Animals Working Group, Trudy Sharp and Glen Saunders, from the NSW Department of Primary Industries Vertebrate Pest Research Unit, were commissioned to develop the model. It was clear that the model would require significant stakeholder input and agreement for it to have any chance of a wide uptake and ultimate impact. The project included broad consultation and the direct involvement of a range of stakeholders, with the goal of achieving the eventual endorsement of those individuals and groups.

Creating a suitable, workable model proved to be a difficult process due to the variety of control techniques used, the wide range of pest animals targeted, and the inclusion of both lethal and non-lethal methods. The final aim therefore was to produce a practical, general model of assessment that can be applied to any pest control method.

The model does not give an absolute measure of humaneness: it is designed to allow a judgement to be made about the impact of a specific control method on the target animal. When the model is applied to a range of different methods, these can be compared and a decision can be made on the choice of method that is informed by an understanding of the relative humaneness of each method being considered.

The model presented here provides a reliable, functional and accepted method that enables humaneness to be considered as an integral part of planning invasive animal control. The next step is for those involved in the decision making process, including government agencies, registration authorities and land managers, to ensure its uptake and application.

I commend the model to you.

Bidda Jones

Leader, Project Steering Committee
Chief Scientist, RSPCA Australia
2008

Acknowledgements

We would like to acknowledge the input and guidance of the project steering group with special thanks to Dr Bidda Jones and Ms Kristy McPhillips for their invaluable support and assistance. We would also like to thank the numerous stakeholders who provided useful comments throughout the project and also Professor David Mellor for his suggestions on improving the humaneness model. This project has been funded by the Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF) under the Australian Animal Welfare Strategy (AAWS).

Executive Summary

Pest animals such as rabbits, feral pigs, foxes, wild dogs and feral cats continue to cause significant environmental damage and agricultural losses in Australia despite improvements in control methods and the development of new techniques. Each year hundreds of thousands of pest animals are trapped, poisoned, shot or otherwise destroyed because of the harm they cause (Olsen 1998). Historically, pest animal control has focused on killing as many pests as cheaply as possible. For most people in today's society the management of pest animals is acceptable provided that such management is *humane* (Mellor and Littin 2004) and *justified*. However, many of the methods used to control pest animals in Australia are far from being humane. There is a pressing need to improve the humaneness of control programs and to develop a process that enables the most humane methods to be identified.

The 'humaneness' of a pest animal control method refers to the overall welfare impact that the method has on an individual animal. A relatively more humane method will have less impact than a relatively less humane method. The development of a system to assess the relative humaneness of control techniques was identified as a priority at a joint workshop held by RSPCA Australia, the Animal Welfare Science Centre and the Vertebrate Pests Committee in 2003 (Humane Vertebrate Pest Control Working Group 2004). Information from such a system could be used to assist decision makers in the development, planning and implementation stages of pest animal control programs along with other factors such as efficacy, cost-effectiveness, practicality, target specificity and operator safety.

Included in this report is a review of current information relating to the assessment of humaneness and welfare impact. It examines the assessment of welfare in laboratory animals, production animals and wild animals and also

summarises methods used to determine the welfare impact of some pest animal control methods. Based on this review, it was apparent that although there are some systems for assessing humaneness for specific *classes* of control methods (i.e. injury scoring for restraining traps, comparison of poisons), there are none that could be applied to the full range of pest animal control techniques used in Australia. A model was therefore developed to achieve this aim.

The model presented in this report examines the *negative impacts* that a control method has on an animal's welfare and, if a lethal method, *how the animal is killed*. There are two parts: Part A examines the impact of a method on overall welfare and the duration of this impact; Part B examines the intensity of suffering and duration of suffering of the killing technique. In Part A, overall welfare impact is assessed by looking at the impact in each of five 'domains', originally described by Mellor and Reid (1994) to examine the impact of scientific procedures on experimental animals. Domain 1 is water deprivation, food deprivation and malnutrition; Domain 2 is environmental challenge; Domain 3 is injury, disease, functional impairment; Domain 4 is behavioural, interactive restriction; and Domain 5 is anxiety, fear, pain and distress. The degree of impact in each domain is rated on a five-step scale – no impact, mild, moderate, severe or extreme impact. The overall impact is the rating given to Domain 5 since this represents the outcome of the impacts in the other four domains (and also includes external influences, such as the presence of humans). 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). Matrices are used to determine the score for each part and then the two scores are combined to obtain the overall humaneness score.

The main advantage of this model is that it provides a systematic, comprehensive and transparent process that helps to generate consensus among diverse stakeholders regarding the humaneness of control methods. Also, the *relative* humaneness of different techniques can be compared based on the score obtained. Although it cannot achieve a purely objective and precise assessment, this model allows us to *grade* humaneness using the available scientific information and informed judgement

The humaneness model has received widespread support with the majority of stakeholders indicating that it is effective and practical. Consultation with relevant stakeholders has also indicated that they support the application of the model by an expert panel to currently used control techniques and that the assessments be disseminated to a wider audience.

Membership of the project steering group

The project steering group included representatives from the AAWS Animals in the Wild Working Group:

- Bidda Jones, RSPCA Australia
- Chris Buller, Invasive Animals CRC
- Frank Keenan, Department of Primary Industries and Fisheries, Queensland
- Maxine Cooper, Australian Capital Territory (ACT) Government
- Kristy McPhillips, Australian Department of Agriculture, Fisheries and Forestry (DAFF)
- Tony Peacock, Invasive Animals CRC
- Quentin Hart, Bureau of Rural Sciences

And also:

- Kate Littin, New Zealand Ministry of Agriculture and Forestry

Scope and approach

The objectives of this project were to:

Phase 1:

- Undertake a desktop review and evaluation of existing literature (i.e. studies, articles, documents, codes of practice, standard operating procedures etc.) relating to the assessment of humaneness of pest animal control methods. Information obtained from this review will be used to develop a humaneness ranking model that contains key welfare assessment principles. The purpose of the model is to allow the relative humaneness of control methods to be taken into consideration during the development, planning and implementation stages of pest animal control programs.
- Submit the draft model via a scoping document to the steering group for approval.

Phase 2:

- With the assistance of the steering group, identify key stakeholders with an interest or involvement in the use of pest animal control techniques (i.e. APVMA; farmers; animal welfare organisations; land managers - government and non-government; and the community).
- Circulate the scoping document to identified stakeholders to obtain feedback.
- Collate all comments received from stakeholders and incorporate these comments into a new draft of the scoping document. Submit new draft of scoping document to the steering group for approval.

Phase 3:

- Circulate the second draft of the scoping document to stakeholders.
- Identify main points of agreement/difference and prepare agenda for stakeholder meeting based on these points.
- Organise a face-to-face meeting of key stakeholders with the aim to reach consensus on the proposed ranking of humaneness model.
- Prepare a report of the meeting and prepare a final version of the ranking of humaneness model. Submit final report to steering group, who will submit to high level stakeholders e.g. National Resource Management Ministerial Council (NRMMC), Primary Industries Ministerial Council (PIMC), Australian Pesticides and Veterinary Medicines Authority (APVMA) for endorsement.

- A workshop to discuss the proposed model for assessing the relative humaneness of pest animal control methods was held on Wednesday 9th April, 2008. Twenty-seven invited participants, including members of the project steering group, attended the workshop including representatives from State/Territory and Commonwealth governments (except ACT) as well as the CSIRO, Australian Pesticides and Veterinary Medicine Authority (APVMA), Animals Australia, NSW Farmers, Australian Veterinary Association and Massey University, New Zealand. A report summarising the outcomes of the workshop was prepared and comments and suggestions were incorporated into a final version of the humaneness model.
- A final report that incorporates the literature review and the model for assessing humaneness was submitted.

The outcomes of the project were:

- A teleconference involving members of the steering group and consultant was held on 31 May, 2007. The aim was to discuss the proposed approach and to receive some initial feedback on the consultancy.
- A desktop review of literature relating to the assessment of humaneness and a draft humaneness ranking model was prepared and circulated to members of the steering group on 10 August, 2007. Comments and suggestions were incorporated into a second draft and this was circulated to stakeholders with an interest or involvement in pest animal control on 22 November, 2007.
- A discussion paper was prepared which included a summary of the 36 comments received from stakeholders and also formed the basis of the agenda for a workshop to discuss and refine the proposed humaneness model.



Part A: Review of humaneness assessment

A1. Introduction

Pest animals continue to be a significant problem in Australia despite improvements in pest animal control methods and the development of new techniques. Each year hundreds of thousands of foxes, rabbits, kangaroos, goats, pigs, mice, cats, rats and birds are trapped, poisoned, shot or otherwise destroyed because of the agricultural losses and the environmental harm they cause (Olsen 1998). Methods used in the management of pest animals include:

- lethal methods such as shooting, poisoning, gassing, introduction or encouragement of specific disease, capturing an animal using a trap, snare or net and then killing it, destruction of burrows containing animals using explosives or ripping; and
- non-lethal methods such as exclusion fencing, repellents and deterrents, fertility control, harbour removal, live capture and release of animal (Sharp and Saunders 2005).

The main aim of pest management is not to kill large numbers of pest animals but to reduce pest animal damage and to promote sustainable production and/or the conservation of biodiversity (Olsen 1998). To achieve this aim, a strategic approach to pest animal management is recommended (Braysher 1993). This involves the use of scientifically based procedures that are humane, cost-effective and integrated with ecologically sustainable land management. Over the years there has been much research looking at the economic and ecological elements of

pest management, but only recently has there been an interest in assessing the impact that control methods have on animal welfare (see Littin and O'Connor 2002; Mason and Littin 2003; Morris *et al.* 2003; O'Connor *et al.* 2003; Jones 2003a; Littin 2004; Mellor and Littin 2004; Littin and Mellor 2005). A commonly held view in today's society is that the use and management of animals by humans is acceptable provided that such use and management is *humane* (Mellor and Littin 2004) and *justified*. This review will firstly define the concept of humaneness and how it relates to animal welfare. It will then summarise some of the current approaches to the assessment of humaneness/welfare in a range of different animal types and specific situations.

A2. What is humaneness?

A 2a Defining humaneness

To assess humaneness objectively we need to define it; this is not an easy task. Most dictionaries classify the word 'humane' as an adjective that describes a particularly human quality e.g. 'marked by compassion, sympathy or consideration for human or animals' (Merriam-Webster's Collegiate dictionary); 'having or showing compassion or benevolence' (Oxford Dictionary); and 'having a disposition to treat other human beings or animals with kindness' (Webster's Dictionary). Yet in documents relating to the treatment of animals, the word humane is used to mean causing minimum pain and suffering, most often in relation to killing methods. For example, the

RSPCA Australia policy on humane killing states that to achieve a humane death 'an animal must be killed instantly or instantaneously rendered insensible to pain until death supervenes' (Jones 2003b). Broom (1999) uses the term 'humane killing' to refer to instances where the welfare of the animal is not poor just prior to the initiation of the killing procedure and the procedure itself results in insensibility to pain and distress within a few seconds. Jones (p9, 2003b) describes both aspects of the word when she states that "the humaneness of a killing method can be measured either by the absence of pain, suffering or distress experienced by the animal, or by the relative level of compassion and kindness exhibited by humans".

The term *humane* can be confusing and it often attracts controversy whenever it is used. In 1997, The International Standards Organisation process to adopt internationally agreed *humane* trapping standards was stopped because an agreement on the definition of the term humane could not be reached (Harrop 1998). Rather, it was agreed to work on 'trap testing methodology standards' instead of 'humane trapping standards'. In 1999, The International Whaling Commission (IWC) removed the word *humane* from the title "Working Group on Welfare Considerations of Whale Killing Methods" and the related "Workshop of Whale Killing Methods" because a number of countries objected to the very subjective nature of the term and its failure to reflect differences in cultural and traditional backgrounds (Gillespie 2003). In the Codes of Practice for Humane Pest Animal Control (Sharp and Saunders 2005) *humane* was defined as:

"causing the minimum pain, suffering and distress possible. To be humane is to show consideration, empathy and sympathy for an animal, an avoidance of (unnecessary) stress, and the demonstration of compassion and tenderness towards our fellow creatures" (Australian Veterinary Association 1997).

In a recent review by stakeholders, a decision was made to delete this definition as it was considered to be an inappropriate starting

point for defining methods of pest animal control (Braid and Buller 2007).

A definition of humane that may be more relevant to pest animal control is "a desire to avoid the infliction of unnecessary pain upon wild animals" (Gillespie 2003). As such, when animals are to be legitimately killed, it must be done in a way that causes minimum pain and reduces the time to death wherever possible. Humane vertebrate pest control (HVPC) has been defined as "the development and selection of feasible control programs and techniques that avoid or minimise pain, suffering and distress to target and non-target animals" (Humane Vertebrate Pest Control Working Group 2004). A totally humane pest animal control method would therefore not cause any pain, suffering or distress.

Therefore, in the case of pest animal control, humaneness should not only refer to a killing method but should also extend to what happens to the animal prior to killing or to the effects of non-lethal methods used for pest animal control (e.g. live traps, exclusion fencing, deterrents). When we talk of the 'humaneness' of a control method, we are really talking about the overall impact that a control method has on an individual animal, and when we talk about impact, we really mean the impact on that animal's welfare. A relatively more humane method will therefore have less negative impact on an animal's welfare than a relatively less humane method. There is no one pest control method that does not have some sort of impact on an animal, therefore to compare humaneness of methods we have to compare these impacts.

A 2b Why do we need to assess the relative humaneness of pest animal control methods?

Pest animal control operations can cause a range of negative impacts on both target and non-target animals, resulting in harm and suffering. To reduce animal suffering, the most humane methods that are useable in any given situation must be employed. In order to use the most



Feral goats (*Capra hircus*) (photo by NSW Department of Primary Industries)

humane control method, we need to be able to evaluate the humaneness of a technique. To assess humaneness, we need to assess what harms are being done to an animal and how bad each harm is with respect to intensity and duration (Mellor and Littin 2004). The concept of 'relative humaneness' refers to the degree to which a technique causes pain, suffering or distress. Evaluating which methods are more or less humane enables us to choose the most humane method for a particular situation. If we are to choose the method that causes the least suffering and distress, it is essential that we are at least able to recognise adverse effects and in some cases be able to quantify these effects.

A3. Defining animal welfare

The term 'animal welfare' is often used in scientific literature, legislation, public statements and general discussion. However, the concept of animal welfare is often difficult to define and is subject to continuing debate. Dawkins (2006) states that "good animal welfare" involves physical health and positive emotions, such as pleasure and contentment. "Poor welfare" comes not only from ill-health, injury and disease but also from negative emotions such as frustration or fear, which we call suffering. Broom (1996) states that the welfare of an individual is its state as regards its attempts to cope with its environment. It is a characteristic of an animal, not something given by humans and it will vary on a continuum

from very good to very poor. He argues that welfare should be defined in such a way that it can be readily related to other concepts such as: needs, freedoms, happiness, coping, control, predictability, feelings, suffering, pain, anxiety, fear, boredom, stress and health. Scott et al. (2003) define welfare as a complex construct that combines both subjective and objective aspects of the conditions of life for animals. Fraser (1993) prefers to use the term 'well-being' to refer to the state of the animal and uses 'animal welfare' to refer to the broader concept that includes social and ethical issues. In this review, the term 'animal welfare' will allude to a complex construct that includes both objective and subjective aspects of the physical and mental well-being of animals.

A4. Assessment of animal welfare

A 4a How is welfare assessed?

A key issue in the assessment of welfare is that it should consider what matters to animals from their point of view (Bracke *et al.* 2002). The general methods for assessing welfare involve the use of:

- direct indicators of poor welfare;
- tests of avoidance;
- tests of positive preference;

- measures of ability to carry out normal behaviour and other biological functions; and
- direct indicators of good behaviour (Broom 2007).

A large number of objective measures of welfare can be used in an attempt to determine the welfare state of an animal. A summary of these are included in Box 1:

Box 1: Measures of welfare (from Broom 2007)

- physiological and behavioural indicators of pleasure;
- extent to which strongly preferred behaviours can be shown;
- variety of normal behaviours shown or suppressed;
- extent to which normal physiological processes and anatomical development are possible;
- extent of behavioural aversion shown;
- physiological and behavioural attempts to cope;
- immunosuppression;
- disease and body damage prevalence;
- behaviour pathology;
- brain changes;
- body damage prevalence;
- reduced ability to grow or breed; and
- reduced life expectancy.

Although there exists a multitude of different welfare measures it is generally agreed that there is no one single measure or standard welfare 'thermometer' that can be used by itself to tell us the state of an animal (Mason and Mendl 1993; Bracke et al. 1999a; Dawkins 2004). Therefore,

a number of indicators from a variety of areas (i.e. health, physiology and behaviour) are required to get an overall picture of an animal's welfare. A common strategy for assessing welfare involves constructing lists of the most important welfare indicators as determined by consensus of expert opinion (e.g. Whay et al. 2003; Rousing et al. 2007). Some assessment protocols also use a weighting process with the most important indicators attracting a higher weight. An overall welfare score is obtained by summing the weighted scores for each of the indicators (Bracke et al. 1999a; Bracke et al. 2002; Bracke 2006).

Another approach to assessment of welfare relies more heavily on behavioural observations to capture both the physical and mental aspects of welfare. Dawkins (2004) argues that, instead of constructing lists of many different welfare indicators, welfare assessment should be directed at answering two key questions: (1) *Are the animals healthy?*; and, (2) *Do they have what they want?* Answers to these questions summarise what most people need to know about animal welfare and guide the process of collecting the most relevant evidence. Observing an animal's behaviour can be a less intrusive way of assessing welfare and avoids some of the difficulties associated with the interpretation of physiological parameters.

A more subjective approach to assessing welfare is to evaluate an animal's 'Quality of Life' (QoL) (see Scott et al. 2003; Broom 2007; Kirkwood 2007; Scott et al. 2007). QoL has been defined as:

"the subjective and dynamic evaluation by the individual of its circumstances (internal and external) and the extent to which these meet its expectations (that may be innate or learned and that may or may not include anticipation of future events), which results in, or includes, an affective (emotional) response to those circumstances (the evaluation may be a conscious or an unconscious process, with a complexity appropriate to the cognitive capacity of the individual)" (Scott et al. 2007).

Some argue that QoL is essentially the same as welfare, the difference being that welfare is considered over the short-term or long-term, whereas QoL refers to the characteristic of an individual over a time-scale longer than a few days (Broom 2007). A QoL approach has been used to develop a number of health-related quality of life instruments to assess acute and chronic pain in dogs and has also been generalised to farm animal welfare (Scott *et al.* 2003).

One of the main problems associated with the assessment of welfare is that our interpretation of the many objective welfare measures involves subjective judgements which are in turn influenced by the nature and extent of our concern for the animal under consideration (Mason and Mendl 1993). Also, although the mental state of an animal is an important aspect of its welfare; recognising and assessing this is far from easy. Measurement of animal welfare is always going to be a difficult process. Although we have a range of objective physiological and behavioural changes that can indicate poor welfare, these measures can be difficult to interpret. It can sometimes be very difficult to know if an animal is suffering because we do not have access to its state of mind and so do not know what it is actually feeling. What we can do though is scientifically collect evidence from which we can make inferences about its welfare state (much like a doctor who uses signs and symptoms to make a judgement about a disease) (Mason and Mendl 1993).

A 4b Assessment of laboratory animal welfare

A major concern about the use of animals in research and testing is the potential for scientific procedures to cause pain, suffering or distress (Hawkins 2002). The 'three R's' concept of replacement, reduction and refinement, first proposed by Russell and Birch in their book, 'Principles of Humane Animal Experimentation' have been incorporated into the national legislation of many countries and have become widely

accepted by the scientific community (Buchanan-Smith *et al.* 2005). Replacement involves using non-animal alternatives where available, whilst reduction involves reducing the number of animals used for procedures. Refinement of scientific procedures involves minimising any pain or suffering that might be experienced by animals. To assist with achieving refinement, a number of techniques have been developed for animal monitoring and to aid the recognition of discomfort, pain and distress. These include score sheets (e.g. Mertens and Rulicke 1999; van der Meer *et al.* 2001), clinical observation sheets, severity scales (Mellor and Reid 1994) and harm-benefit analysis.

A survey of scientific establishments was recently undertaken in the UK to evaluate how pain, suffering and distress are recognised in laboratory animals (Hawkins 2002; 2003). It was found that *clinical observation sheets* are widely used to note simple objective measures such as body weight and for logging inspection times and any observed adverse effects. Also used are *score sheets* which were originally suggested by Morton and Griffiths (1985). The principle behind score sheets is that observations of clinical signs are used as a way of determining the degree to which an animal's physiology and mental state has deviated from normal, and then using these changes to make an assessment of the severity of the adverse effects (Morton 1998). It is assumed that those making the assessment will have a good knowledge of the animal's normal behaviour and physiology. Score sheets are usually made up specifically for each scientific procedure and for each species. They list key clinical signs and behaviours that are associated with discomfort, pain and distress along with objective measures of health and/or development such as body weight. These criteria are assigned numerical scores so that an overall or total score can be produced that represents the overall adverse welfare effects. More recently the score sheet has evolved to use *binary* scoring, whereby the clinical signs are marked as simply present or absent, rather than using numerical scores. Other techniques for assessing animal

well-being and recording observations included data management systems, phenotype assessment protocols and visual analogue scales.

Hawkins (2002) points out that the main problem with the assessment of laboratory animal welfare is that it is still largely a subjective exercise. There are few, if any, specific, objective behavioural indicators of pain, suffering and distress and the systems that are currently in use are heavily reliant on subjective criteria. The author concludes that binary score sheets appear to be the most effective way of assessing animals and recording observations and can be a useful tool for improving objectivity and consistency in many situations.

Harm-benefit analysis is a major feature of the ethical review that animal ethics committees undertake when they consider applications to conduct research, teaching and testing procedures on live animals (Mellor 2004). The harm-benefit analysis examines the balance between the expected severity of the welfare compromise and the expected benefits of the procedure. To assist in the comprehensive assessment of the harms caused by scientific procedures, Mellor and Reid (1994) have developed a *severity scale* based on the UK Farm Animal Welfare Council's 'Five Freedoms'. This approach is based on the notion that an animal's welfare is good when its nutritional, environmental, health, behavioural and mental needs are met. The following five domains of potential animal welfare are identified:

- Domain 1 is food deprivation/water deprivation/malnutrition¹;
- Domain 2 is environmental challenge;
- Domain 3 is disease/injury/functional impairment;
- Domain 4 is behavioural restriction; and
- Domain 5 is anxiety/fear/distress.

¹ This domain was originally named thirst/hunger/malnutrition but was re-named after realising that thirst and hunger should properly be located in Domain 5

Research proposals are examined systematically in all domains, and the degree of welfare compromise in each is rated on a 5-step non-numerical scale (O, A, B, C, X). Anxiety/fear/pain/distress arising from compromise in domain 1-4 is cumulated in to domain 5. The overall rating is commonly that given to domain 5, but if the score for this domain is low or unknown, it is given to the highest rating in the other domains. The major advantage of this system for assessing the impact on welfare is that it encourages systematic consideration of all sources of possible compromise (Bayvel 2000). This wider consideration allows more accurate assessment of the severity of impact and thereby improves the validity and efficiency of a harm-benefit analysis. Another advantage is that it predicts welfare compromise in advance and therefore can prevent it. Concerns have been raised, however, about the potential for a lack of consistency in the way the scale is applied. Because qualitative terms such as mild, moderate, short-term etc. are used in the grading system, any assessment or prediction of impact will require a subjective judgement of what these terms actually mean in a specific situation. It has also been suggested that the purpose of the scale is not well understood by some people using it with the result being that the category descriptors and examples are seen as prescriptive requirements rather than the guidelines they were intended to be (Mellor *et al.* 2005). When assessing individual cases, the authors of the scale have stressed the importance of applying a degree of judgement when determining the anticipated impact. The categories and guidelines are meant to be flexible and should not be seen as definitive or precise descriptors of impacts (Mellor and Reid 1994).

The severity scale developed by Mellor and Reid has been used in New Zealand since 1997 to assess and record the level of animal welfare compromise imposed by research, testing and teaching. The data from these assessments are required by law to be submitted to the NZ Ministry of Agriculture and Forestry in an annual return. Recently, a review was undertaken to

examine the operation and effectiveness of the scale and the extent to which it fulfils the purpose for which it was devised (Mellor *et al.* 2005). Recommended revisions outlined in the review included the following:

- the name of the categorisation system should be the “impact scale” rather than the “severity scale”. The word *impact* should replace the words *severity* and *suffering* to acknowledge that while there will always be an impact, suffering does not always occur;
- the current 5-step non-numerical scale should be enlarged to include a sixth category (labelled Z) which includes procedures that should not be carried out under any circumstances;
- an exhaustive list of manipulations with recommended gradings is not advisable, because it will inevitably not be comprehensive and because it tends to be viewed in a rigid manner;
- in the tables containing category descriptors and examples, terms such as mild, moderate, severe, short-term and long-term are deliberately not defined further as interpretation will depend on the species being used, the details of its biology and the circumstances surrounding the manipulations involved. This underlines the importance of the tables and examples being used as indicative rather than definitive. Judgement must be exercised by the researchers and AEC members and this judgement must be informed by consultation with experts in the biology and behaviour of the particular species; and
- a provisional score with respect to mental state should be established first as the ultimate measure of impact. The impacts from the other four physical domains, as contributors to that ultimate measure, are then checked to ensure that no factor has been missed nor the impact with regard to mental state over- or under-estimated.



Common carp (*Cyprinus carpio*) (photo by John Gasparotto)

A number of other countries (e.g. Canada, Finland, The Netherlands, New Zealand, Switzerland and the United Kingdom) have also adopted the use of ‘harm scales’ as public policy. In these countries it is a mandatory requirement that investigators assess and record the severity of harm done to animals in biomedical research, typically according to categories of minor, moderate, or severe levels of invasiveness. Along with providing essential information to those involved in evaluating the justification of scientific procedures, the use of harm scales and other scoring systems for assessment of adverse states in laboratory animals promotes the application of the three R’s, with data from the Netherlands demonstrating a reduction in the severity of laboratory animal procedures (Orlans 2000). The use of severity scales can help to define clear upper limits on animal suffering which can assist in implementing humane end-points and can also identify procedures that cause the most animal suffering and target these as priorities for application of the three R’s (Smith and Jennings 2004).

A discussion group organised to consider the appropriateness and usefulness of the severity categorisation system of scientific procedures in the UK have come up with a number of suggestions that could be equally applicable to the assessment of severity of impact of pest animal control methods (Smith and Jennings 2004). The group suggested that a severity assessment should:

- focus on the individual animal;
- be assessed from the animal’s point of view as far as possible; and

- adopt a 'holistic' approach, in which there is an attempt to consider all factors that can potentially influence well-being including psychological effects (e.g. anxiety, fear, boredom), physical effects, duration of effects as well as wider factors such as transport and husbandry.

The group also suggested that guidance on assessment of animal suffering and how to assign severity categories should:

- cover all classes of vertebrates and protected invertebrate species, as well as their protected developmental stages;
- encompass a wide range of different kinds of adverse effects (including their duration), protocols and techniques;
- as far as possible be based on empirical evidence; and
- include detailed worked examples to illustrate the application of severity categories in practice, particularly at their boundaries.

The group noted that it is particularly difficult to assign severity categories when adverse effects are uncertain or unpredictable.

A 4c Assessment of production animal welfare

A number of approaches to the assessment of animal welfare in production animals have been reported in the literature, with most taking an integrated approach. 'Overall welfare assessment' aims to assess welfare based on knowledge of the biological needs of animals and usually involves combining a number of weighted, welfare-relevant attributes or criteria to produce an overall welfare score (Bracke *et al.* 1999a).

Scott *et al.* (2001) describe a methodological framework for the development of a composite animal welfare scale based on a number of individual welfare-related items. This involves the use of a scaling procedure to combine separate

items to create a single welfare measure. The technique follows psychometric and metrological principles for scale creation that were originally developed in the fields of human medicine and psychology. The stages in creating such a welfare assessment framework are:

1. *Identification of the items to be included in the composite scale.* These would be key components of animal health and disease, behaviour and husbandry as well as more subjective factors which would help to assess the animal's quality of life. The items to be included would be identified by surveying individuals involved in the farming area of interest (e.g. farmers, veterinary surgeons, animal welfare scientists). Once the items are listed, individuals are asked to rank the terms they associate with good welfare. The list is then reduced to a smaller list of items containing expressions relating to disease, management practices and behaviour.
2. *Construction of a composite welfare index.* A scaling technique is used to allow for weighting of the items to reflect the level of welfare associated with them. Expert judgement (gathered from a large body of experts) would be used to assign the relative weights. After weighting, the individual items are combined to form a single composite measure.
3. *Testing.* The resulting composite index must be validated and its reliability assessed by repeated use with multiple observers under a number of experimental conditions. Amendments to the draft welfare index may be necessary following this testing stage.

A similar, although more complex, approach has been used to construct a system for overall welfare assessment in pregnant sows (Bracke *et al.* 2002). This model is implemented in a computer-based decision support system that takes a description of a housing and management system as input and produces a welfare score as output. The welfare status of pregnant sows is assessed in relation to their housing and management

system based on available scientific knowledge. The model contains 37 attributes such as 'space per pen', 'exposure to cold', 'handling and fear', 'resting comfort' and 'social stability' that describe the welfare relevant properties of housing and management systems. These attributes are linked to statements of need and scientific statements about the various welfare performance criteria. Weighting factors that represent the relative importance of the attributes are derived from the scientific statements. The welfare score is calculated as the weighted average score and is expressed as a value between 0 and 10. The advantage of this system is that it quantifies pregnant-sow welfare using a systematic and transparent procedure that covers all reasoning steps from selection of attributes to the determination of overall welfare status. It also has the flexibility to incorporate new insights about welfare assessment when they become available (Bracke *et al.* 2002).

The animal needs index (ANI) is an instrument for assessing and grading livestock housing with respect to the well-being of the animals (Bartussek 1999). It considers five components of the animal's environment: (1) the possibility of mobility; (2) social contact with members of the same species; (3) condition of the floors on which animals are lying, standing and walking; (4) stable climate (including ventilation, light and noise; and (5) the intensity of human care. Conditions that are considered to improve animal welfare are given more points and the overall sum of the points gives the ANI-value. The values have been graded into different categories of good or poor welfare. The ANI is used in actual policy decision making in Austria, mainly in controlling organic farming and in connection with animal welfare legislation (Bartussek 1999; Bracke *et al.* 1999b). For a detailed review of the overall assessment of farm animal welfare refer to Botreau *et al.* (2007a) and Botreau *et al.* (2007b).

A 4d Assessment of welfare of free-living wild animals

In considering the impact of human activities and human-induced environmental changes on the welfare of free-living wild animals, Kirkwood *et al.* (1994) proposed that at the simplest level, the scale and severity of harm can be evaluated by considering the following four factors:

1. The number of animals affected.
2. The cause and nature of harm.
3. The duration of harm.
4. The capacity of the animal to suffer.

These parameters should then be used to produce a summary that allows comparisons between cases. The summary should include the following components:

1. A description of the cause.
2. A description of the effect, based on observations or inferred knowledge about the cause.
3. Judgement of the levels of stress and/or pain caused.
4. A description of the magnitude of the problem (based on the numbers affected and mean duration of harm).

The authors warn that the process of allocating a score to reflect the severity of harm to welfare should be used with great caution due to a number of difficulties with this approach. They maintain that compiling a summary that includes the four components described above would provide the most useful picture of welfare impact caused by human activities. With regard to animal suffering, the authors take the view that although all mammals and birds have the capacity to suffer the unpleasant sensations of pain or stress, there is insufficient information to grade this suffering.

Jordan (2005) states that science-based welfare assessment in wild animals can be difficult because species react differently to pain, stress and fear. Since physiological examination is not possible in the wild, reliance must therefore be placed on a detailed knowledge of normal animal behaviour as well as situations that cause poor welfare.

With regard to the welfare of pest animals, Broom (1999) suggests that during evaluation of a pest control procedure, the *extent* of poor welfare can be multiplied by the *duration* of poor welfare to get an estimate of the severity of the problem. To evaluate the effects of killing methods on welfare two kinds of measurement are required. These are:

1. The severity of any poor welfare before death.
2. The duration of the period during which the poor welfare continues.

Broom (1999) advocates using a cost-benefit approach with the adverse effects of the pest being compared with the extent of poor welfare of the pest animals that a control method would cause.

Animal welfare research has not historically focused on pest animals or their management, and for many methods of pest control their impact on welfare is not known (Littin and Mellor 2005). A number of reviews of animal welfare issues arising from the use of pest animal control methods have suggested approaches for their assessment (e.g. Sainsbury *et al.* 1995; Gregory 2003; Littin *et al.* 2004; Mellor and Littin 2004; Littin and Mellor 2005). But whilst current guidelines for assessing humaneness tend to focus on leg-hold traps and poisons, there is a need to evaluate the welfare impact of a wider range of methods. The next section is a summary of some science-based comparisons of humaneness or acceptability conducted on a range of pest animal management methods.

A5. Application of welfare/ humaneness assessment: some examples relevant to pest animal control

A 5a Assessment of humaneness of traps

The humaneness of *restraining traps* (i.e. leg-hold and cage traps) is most often assessed by identifying the physical trauma caused by the trap to the captured animal. A number of studies have used an injury scoring or rating system to quantify the extent of injury caused by the trap and to compare the severity of injuries caused by different types of trap (Kreeger *et al.* 1990; Meek *et al.* 1995; Hubert *et al.* 1996; Fleming *et al.* 1998; Woodroffe *et al.* 2005). Some studies have also documented the physiological (e.g. elevation of heart rate, body temperature, cortisol, muscle enzymes, bilirubin, neutrophils etc.) and/or behavioural (e.g. changes in activity levels, digging, pacing, chewing on trap) responses to trapping (Jacobsen *et al.* 1978; Kreeger *et al.* 1990; White *et al.* 1991; Schutz *et al.* 2006). However, to date there is no objective scoring system for restraining traps that integrates physical injuries with behavioural and physiological responses, at least in part because interpreting such responses is not straightforward (Powell and Proulx 2003).

The humaneness of traps that are designed to kill an animal (*kill traps*) is usually evaluated on the basis of the time it takes for the trap to render an animal insensible to pain, most often measured by the loss of palpebral (blinking) reflex (Warburton *et al.* 2000). Many studies have used this criterion to assess the killing performance of traps and to determine if they are acceptably humane (Warburton and Hall 1995; Warburton and Orchard 1996; Warburton *et al.* 2000; Warburton and Poutu 2002; Poutu and Warburton 2003). It has been argued that setting the performance criteria for killing traps is easier than setting performance criteria for restraining traps, because time to insensibility

and death are relatively easy to define objectively compared with the injury, pain, anxiety and stress that may be experienced by restrained animals (Powell and Proulx 2003). In a review of trapping methods used in Europe and North America, the welfare performance of killing traps was evaluated using the additional criteria of likelihood of escape of injured animals, percentage of mis-strikes, trap selectivity, as well as time to unconsciousness (Iossa *et al.* 2007).

The International Organisation for Standardisation (ISO) has developed standards for the performance evaluation of traps for killing and restraining mammals (Warburton 1995; International Organisation for Standardisation (ISO) 1999a; 1999b; Harris *et al.* 2005). The ISO standards are considered to be the best currently available criteria for assessing the humaneness of restraining traps, although they have been criticised because they do not assess pain, physiological stress and long term-impact of some injuries, nor do they give guidelines as to how to avoid capture of non-target species (Harris *et al.* 2005). Another major criticism of the ISO standards is that the assessment of traps in an artificial setting is not likely to create the range of conditions and individual animal behaviour that is likely to occur in field situations. This could lead to traps failing in the field and poor welfare of trapped animals.

In New Zealand, the National Animal Welfare Advisory Committee has produced guidelines for assessing the welfare of restraining and kill traps used for mammals based on the ISO standards (NAWAC 2000). The aim of the NAWAC guidelines is to standardise the testing of welfare performance of traps, to improve the efficiency and selectivity of traps and also to encourage the development of new and existing traps to make them more effective and to reduce the extent of injuries and animal suffering. Traps are tested and assigned to one of two welfare performance classes (A or B) or if they do not pass the criteria, they are failed.

To assess the welfare performance of *restraining trap* systems the guidelines confine the measurement of predicted clinical impact on the

well-being of a trapped animal to observations of physical trauma or injury received. Thirty-five descriptions of trauma type are graded from 1 = no identifiable trauma, through to 35 = death. Trauma type is also more broadly classified into four classes i.e. mild, moderate, moderately severe and severe. This system is used to classify the overall trauma class e.g. if an animal receives 1 x mild trauma it is classified overall as mild, if it receives 1 x moderate or 3 x mild traumas, it is classified overall as moderate, if it receives 1 x moderately severe trauma, 2 x moderate traumas or 5 x mild traumas etc. it is classified overall as moderately severe, and so on. The guidelines stipulate what proportion of trapped animals is allowed to have trauma exceeding certain categories for a trap to pass the performance test. For *killing traps*, the time to loss of corneal reflexes is used as the assessment criterion. For a trap to pass the test, stipulated proportions of trapped animals must be rendered irreversibly unconscious within 3 minutes to be classified as welfare performance Class A; or within 5 minutes to be classified as welfare performance class B.

The NZ NAWAC guidelines do not attempt to use any measures of psychological and physiological distress because “insufficient information exists on what physiological parameters to measure and, for any one parameter, what levels could be considered as the minimum” (p1, NAWAC 2000). Annex A of the guidelines however does provide a description of the types of physical injuries that traps can inflict and attempts to predict how these injuries might bring about a negative impact on the welfare of the animal e.g.

“Major subcutaneous soft tissue maceration or erosion – covers a large area of soft tissue, perhaps half or full width of a limb, and possibly the entire thickness of the soft tissue. This will cause immediate pain and dysfunction of the affected body part. The animal might use the affected limb during flight, although it is likely to favour the limb. It will cause restriction in movement which may particularly affect hunting by predators, but will heal well with scar formation.” (p18, NAWAC 2000).

There has been some criticism of the injury scoring of restraining traps because a quantitative injury score is not a direct measurement of an injury level (Engeman *et al.* 1997). It is argued that application of a scoring system requires decisions on several levels of increasing abstraction from the actual physical injuries. Also, inconsistencies in scoring of injuries can occur between observers and there can also be different general perceptions of what levels of injuries are unacceptable and how frequently they can occur before a trap type is considered unacceptable.

Although there are some disadvantages, the current scoring or rating systems used for the assessment of trap humaneness does provide a systematic and objective way of evaluating the physical trauma caused by trapping systems, and these should be continued to be used in future trap evaluation (Harris *et al.* 2005). However, there are many other factors that need to be considered if an overall humaneness assessment is going to be made. These include:

- *Restraint time* – the extent of injuries and distress experienced by an animal caught in a foothold trap (or any live trap) is also influenced by the length of time spent in the trap. Longer restraint time is also a major factor in the development of dehydration or exposure and may also cause stress by disrupting natural behaviour and motivational systems (Schutz *et al.* 2006).
- *Method of euthanasia* – consideration must also be given to the method of euthanasia that will be used to kill the trapped animal (Harris *et al.* 2005). The benefits of having a relatively humane trapping system to capture an animal are countered if the method subsequently used for killing it is relatively less humane.
- *Effects of exposure or dehydration* – trapping systems that provide shelter from adverse weather conditions and food/water are likely to be more humane than those that don't.

- *Anxiety/fear/stress* – physical injury and pain will obviously have a negative effect on the animal, but so too will anxiety caused by confinement/restraint and physical exertion related to struggling (Marks *et al.* 2004). White *et al.* (1991) found that although foxes caught in a box traps and padded leg-hold traps had no physical injury, they still had evidence of a 'classical stress response' (indicated by, amongst other things, elevated levels of blood adrenocorticotropin and cortisol) compared to control foxes. This stress response was more dramatic in the leg-hold trap caught foxes. Psychogenic factors (e.g. fear, surprise) and differences in the intensity of exertion (e.g. pacing for box trapped foxes and digging for foothold trapped foxes) were thought to be responsible for the increased stress and for differences in response between trap methods.
- *Pain* – some injuries may only receive a low or medium injury score but are capable of causing severe pain (e.g. sternal fractures, rib fractures, permanent tooth fracture with exposure of pulp cavity).
- *Long-term impact of injuries* – animals that escape a trap may sustain damage/injuries that can have serious long-term effects on welfare e.g. tooth damage or claw loss may result in an inability to catch prey, leg injuries could cause limping that result in predation, mouth injuries may prevent eating.

A problem with the last three of these factors is that they are rather difficult to assess.

A 5b Assessment of humaneness of poisons

Whilst the humaneness assessment of traps currently relies on measures of physical injury or time to insensibility, the assessment of humaneness of toxic agents uses a wider set of criteria that includes behavioural, biochemical and pathological indicators. In the UK, the Food and Environmental Protection Act 1985 requires that methods for

controlling Pests should be humane and that they must be assessed for humaneness before they are registered for use (Pesticide Safety Directorate 1997; 2001). A UK MAFF working group, established to provide criteria for assessing humaneness, concluded that pain, distress and suffering could not be measured objectively but that a subjective assessment of humaneness was possible based on physiological and behavioural data, knowledge of the mode of action and reports of post mortem findings. They also added that the *duration* of severe symptoms can also be used as a major determinant in assessing humaneness since the degree of distress, pain and/or suffering will be increased if an animal is distressed for a longer period (Pesticide Safety Directorate 1997). An approach to humaneness testing, as developed by the above working group, involved two stages. A literature search in stage one and a testing programme involving the target species for stage two (Pesticide Safety Directorate 2001). Based on the assumption that conditions that cause pain or distress in humans would also do so in animals, information relating to the toxin should be gathered from human cases of exposure to the toxin as well as effects seen in target species or related species. Information that is required for assessment includes (Pesticide Safety Directorate 2001):

- details of the compound, dose, method and time of administration or exposure;
- age, sex, and species of the test animal;
- the time at which overt signs of toxicity first occur (including frequency of observations);
- the nature, severity and duration of signs observed;
- time to insensibility;
- time to death; and
- results of any post mortem examinations.

Eason and Wickstrom (2001) suggest that the humaneness of poisons is dependent on the duration of the distress or pain that animals

experience during three stages of toxicosis described as:

- an initial lag phase until the onset of clinical signs;
- a period of sickness behaviour when animals are most likely to experience pain; and
- a final phase preceding death when animals may be unconscious.

In New Zealand, guidelines have been developed to assess the relative humaneness of poisons used for pest species (Littin and O'Connor 2002). The guidelines set out a five-step process that enables the comparison of type, degree and duration of welfare compromise between toxins. The key welfare assessment principles identified in these guidelines were gained using information from the literature and also from previous research that examined the behavioural, biochemical and pathological changes in possums after poisoning with cyanide, 1080, phosphorus, cholecalciferol and brodifacoum. The authors examined two ways of assessing the relative humaneness of poisons. One approach involves creating a single grade or score that considers the number of animals affected as well as the duration and degree of suffering. Grades or scores can then be used to compare different poisons. The other approach involves listing and comparing several features of the method so that knowledgeable experts can then consider all of the relevant information and make an assessment on which poison is more humane. Because of a range of problems associated with assigning an overall numerical score, the authors recommended the approach of listing and thorough expert opinion to compare the appropriate features of each poison. They concluded that the welfare impact of vertebrate poisons can be assessed by the following five-step process:

1. Consider the capacity of the animal to suffer;
2. Anticipate likely effects of the poison.
3. Determine the type, intensity and duration of effects, and the percentage of animals affected.

4. Determine the degree of welfare compromise caused by each effect.

5. Assess the humaneness of the poison.

This process has been used to make assessments of the relative humaneness of the five main possum poisons used in New Zealand (O'Connor *et al.* 2003) with cyanide being identified as the most humane and brodifacoum the least humane.

A 5c Humaneness of rodent pest control

In a review by Mason and Littin (2003), the humaneness of rodent pest control methods used in the UK and USA was assessed based on the following criteria:

- the degree of pain, discomfort or distress caused;
- the length of time for which rodents are conscious and displaying clinical signs of poisoning; and
- the effect on any individual that escapes and survives.

Evidence for the evaluation of pain or discomfort was based on reports from human cases; the nature of the lesions or pathologies induced in rodents by the agent, from which clinicians can judge the associated pain; and information obtained from experimentally poisoned rodents (e.g. behaviour; reactivity). The authors state that a method that causes the minimum number of symptoms before rapidly inducing unconsciousness or death, with no lasting ill effects on surviving animals, would thus be humane. In contrast, a method that causes severe and/or prolonged pain or distress, and leaves surviving animals disabled, would be judged inhumane. As part of the humaneness assessment, the risk of poisoning non-target animals was also taken into consideration as well as methodological factors such as practicality and effectiveness.

A 5d Humaneness of wombat destruction techniques

In a review of the humaneness of techniques used for the destruction of the common wombat (*Vombatus ursinus*) in Victoria, techniques were listed, and the pros and cons for each method described, along with relevant data, where available (Marks 1998). No specific criteria were used to assess humaneness for all the techniques, but rather a wide range of information relevant to humaneness was collated and evaluated (e.g. for steel-jawed traps - observations of physical limb damage; for shooting – skill of shooter; type of firearm, type of ammunition and point of impact of bullet; for fumigation – mode of action, clinical signs, time to death, pathology of lung tissue, extrapolation from human data; live-trapping – extent of injuries and mortalities, thermal stress). The author concluded that a humane fumigant for wombat control should conform to the following criteria:

- have the ability to cause rapid and painless unconsciousness and then death; and
- will not cause permanent debilitation if the animal is subject to sub-lethal or chronic exposures.

A 5e Assessment of lethal methods for badger control

The UK Department for Environment, Food and Rural Affairs (DEFRA) recently considered humaneness as part of a review of lethal methods of badger control. Along with humaneness, the review also examined the impact on non-target species, environmental impact and effectiveness and feasibility of badger control methods (DEFRA 2005). The approach taken to assess humaneness in this review is similar to the approach taken by Marks (1998) in his review of wombat control techniques i.e. to collate all relevant information on each technique that may have a bearing on humaneness. For example, with regard to fumigation of setts (badger's burrows), the authors began by stating that the humaneness of gassing is



Feral pigs (*Sus scrofa*) (photo by NSW Department of Primary Industries)

dependent on three factors: (i) the effects of the exposure to a lethal concentration of the gas; (ii) the risk of animals only being exposed to sub-lethal-concentrations of a gas; and (iii) the consequences of such sub-lethal exposure. Each gas that could potentially be used to fumigate badger setts was then evaluated separately with information collated on a range of criteria including: mode of action; signs and symptoms in badgers (if available); signs and symptoms in other species including humans; time to death; effects of sub-lethal doses; risks to non-target animals; issues relating to concentration, source and dispersal of gases etc. The authors then made an assessment of the relative humaneness of the different fumigation gases based on the information they had collated:

- a) Phosphine –inhumane.
- b) Hydrogen cyanide – moderately humane.
- c) Carbon dioxide – moderately humane.
- d) Carbon dioxide with argon – humane provided sufficient concentrations can be achieved.

- e) Carbon monoxide alone- humane provided sufficient concentrations can be achieved.
- f) Carbon monoxide generated by diesel engine – not suitable as insufficient CO is generated and irritant pollutants are present in the exhaust gases.
- g) Carbon monoxide generated by idling, badly tuned petrol engines without catalytic converter – could produce lethal concentrations of CO, but the effect is limited by sett structure. Also, there may be a potential for pollutants to cause detrimental effects prior to insensibility.

A 5f Assessment of welfare of hunted deer

In a study to review the existing scientific evidence relating to the effects of hunting with dogs on the welfare of deer, five approaches were used to make an assessment (Bateson and Harris 2000). These were:

- I. Whether the physiological states were comparable to those found in suffering humans.

2. The animal's behaviour in response to hunting.
3. The animal's ability to cope with hunting.
4. The physical damage inflicted on the animal during hunting.
5. Departures during hunting from conditions to which the animal is well adapted.

Based on the evaluation of available data for each of these criteria, the authors concluded that:

1. The deer's state is comparable to humans exercising or in pain or distress.
2. The deer indicates by its behaviour that it is prepared to try very hard to escape from its predators, using a variety of stratagems to do so.
3. The deer is forced by hunting to cope in unusual ways.
4. Deer may experience mild to moderate damage to muscle and some destruction of red blood cells, but it is difficult to judge the severity and consequences of this to deer which escape.
5. Throughout their evolution deer have probably not typically been subject to predation by prolonged chases. Nonetheless, they have the capacity for prolonged exercise, such as that imposed by hunts.

The authors argue that, although many of these individual indicators of poor welfare have been challenged (i.e. the extent to which cortisol provides a measure of psychological stress is uncertain; dispute continues about whether or not deer are well adapted to long hunts; and the fate of deer that escape a hunt is not known) but taken together, they support the case that "hunting with hounds is a challenge to the welfare of deer that would not be tolerated in other situations of animal husbandry unless deemed necessary for overriding reasons" (p 47, Bateson and Harris 2000).

A 5g Assessment of humaneness of feral pig control techniques used in Australia

A review of the humaneness of control methods used for managing feral pigs in Australia was undertaken by Cowled and O'Connor (2004). The approach taken in this review was to consider a number of factors to assess the potential impact of a control method on the welfare of a feral pig and then combine these into the humaneness review framework developed for the assessment of pest animal toxins by Littin and O'Connor (2002). The factors considered were:

- the mode of action of the control method;
- the clinical signs of animals exposed to the control method;
- the time and severity that potentially painful/distressing clinical symptoms or experiences are perceived after application of a control method;
- the pathology caused by the method;
- reports of humans that have been affected by the control method; and
- the likelihood that the control method will cause physical damage to a feral pig without resulting in the death of the animal.

Briefly, the five steps of the humaneness review framework are: (1) consider the capacity of the species to suffer; (2) anticipate the likely effect of the poison; (3) determine the type, intensity and duration of effects, and the percentage of animals affected; (4) determine the degree of welfare compromise caused by each effect; and (5) assess the humaneness of the poison.

After compiling information for each of the pig control methods, the authors concluded that there was insufficient research data to conduct a humaneness review using the five-step framework. They found that all of the methods could be assessed to step 2 and some could be taken

through to step 3, however, none of the methods could be fully assessed to step 5 because there is a lack of complete data to make a definitive assessment.

A6. Can we achieve overall assessment of humaneness of pest animal control methods?

Considering the above examples and the literature, it becomes apparent that assessing the humaneness of pest animal control methods is a complex and difficult task. The methods used for the management of pest animals are diverse and vary greatly in their consequences for the welfare of both target and non-target species (Broom 1999). Also, a major difficulty in assessing the humaneness of pest control methods is that there is a lack of objective data for many of the welfare criteria. Only fragments of scientific information are currently available for many of the currently used pest control methods; therefore a 'fully objective' assessment of humaneness is not possible. To help resolve questions about what really matters to animals, scientists have been studying the behaviour, stress physiology and pathophysiology of different species of production animals under a wide range of conditions (Bracke 2006). Although there still remains much to be debated, many years of research have generated much information that can be used to compare different housing and management systems and help to provide an overall assessment of production-based animal welfare. Unfortunately, in the area of pest animal control, much of the data that is needed to objectively assess welfare are lacking or still to be researched. This means that where there are gaps in our knowledge (and there will be many) we will have to rely not only on objective data from other species, including humans, but on our own value judgements about the degree of suffering likely to be caused by a control method. If we keep these judgements and the reasoning behind them explicit and open to critical evaluation,

then the judgements become 'intersubjective' rather than subjective, emotional or anthropomorphic. 'Intersubjective' judgements, although not subjective and not completely objective, can still be morally persuasive because they reflect consensus not on the judgement *per se* but on the procedures used to arrive at it (Kirkwood *et al.* 1994; Bracke 2006).

So, in response to the question: 'can we achieve overall assessment of humaneness of pest animal control methods?' the answer is yes, but with some limitations since the information we need to make such an assessment is not always going to be objective or science-based.

A7. The role of 'best practice' and guidelines for the use of pest control methods

The humaneness of an individual control technique is highly dependent on the way in which the technique is applied and on the skill of the operator involved. Attention to details such as bait delivery, lethal dose rates, timing and coordination of control have significant effects on animal welfare and target outcomes of control programs (Humane Vertebrate Pest Control Working Group 2004). By standardising the way in which control methods are applied, many of the negative welfare impacts can be reduced or even prevented. Codes of practice (COPs) and standard operating procedures (SOPs) for the humane control of pest animals in Australia have been developed to address this issue (Sharp and Saunders 2004; Sharp and Saunders 2005). The SOPs describe control techniques and their application as well as animal welfare impacts for target and non-target species. The COPs provide general information on best practice management, control strategies, species biology and impact and also a summary of the humaneness, efficacy, cost-effectiveness and target specificity of each control method. These documents will allow uniform implementation of 'best practice' control techniques and training for proficiency in pest

animal management. They have also provided a starting point for the process of ranking humaneness of control methods currently used in Australia. During the writing of the documents, control methods were categorised as “*acceptable*”, “*conditionally acceptable*” and “*not acceptable*” based on an assessment of their impact on animal welfare. These assessments were originally performed by the authors and then modified by peer review. This way of classifying humaneness, and therefore the acceptability, of a method is easy for the *most* acceptable and the *least* acceptable methods, but becomes much more difficult for techniques where the extent of welfare compromise may not be fully understood. This is where the model developed in this current project will be used.

Consistent and careful application of control methods not only improves the humaneness of methods but allows comparisons to be made on the relative humaneness or acceptability of the methods. It would be an almost impossible task to compare the welfare impact of different control techniques if they are applied in a number of different ways. Any comparison must therefore be carried out assuming that best practice is met.

A8. Criteria for assessing overall suitability of a control method - how will humaneness fit in?

Although it is not the purpose of this project to consider in detail how humaneness should be incorporated into the overall assessment of suitability of a control method, the following provides an outline of how this could be done using either a cost-benefit analysis or multi-criteria decision analysis.

Assessing the humaneness of a pest animal control method is just one step in evaluating the suitability of a method for a particular situation. Decision-making concerning the specific need or continued use of a particular technique requires that a number of other criteria also be considered. For example:

- *effectiveness* – is the method going to produce the desired results? Is the method appropriate for the situation and the type and age of the target species?
- *target specificity* – does the method have primary or secondary non-target effects? These can occur in other wild species including predators, dependent young of the target species, companion animals or farm animals.
- *cost* – is implementation of the method cost-effective?
- *practicality* - are resources available to carry out the control method to its maximum effect?
- *regulation* – is the method legally approved for use in that particular situation?
- *acceptability to public* – what is the public’s attitude toward the method? Although the pest animal management profession tends to view pest animals as populations, the public often sees animals as individuals, particularly with some species such as feral horses and kangaroos. With an increasing trend toward public participation in pest management it is important that acceptable methods are used where possible;
- *occupational health and safety* – Is the method safe to use?
- *environmental impact* – Does the method have adverse environmental effects?

Cost/benefit assessment is a useful tool for deciding whether or not to proceed with a pest animal control method or to compare two different control methods based on a number of different criteria. Although traditionally used in an economic sense, the expected benefits of the proposed management methods can also be ‘weighed’ carefully against the possible costs in terms of harm to the welfare of the animals involved or to populations of target species. Methods that have the potential to harm the welfare of animals should not be used unless there are benefits in doing so that outweigh



Wild dog (*Canis* sp.) (photo by Peter Fleming)

the welfare costs. Where it is decided that a particular method has to be used, steps should be taken, as far as is practicable, to minimise the risks of adverse welfare impacts (IWGS (Independent Working Group on Snares) 2005).

Multi-criteria decision analysis (MCDA) is a procedure used to analyse complex problems whereby the relative merit of different alternatives can be compared using a range of criteria. The procedure involves dividing the decision problems into smaller more understandable parts; analysing each part; and integrating the parts in a logical manner to produce a meaningful solution. It is often used by decision-makers who are faced with making numerous complex and conflicting evaluations. MCDA aims to highlight the conflicts and derive a way to come to a compromise in a transparent process. MCDA can be used to identify a single most preferred option, to rank options, to list a limited number of options for subsequent detailed evaluation, or to distinguish acceptable from unacceptable possibilities.

A simple step-by-step approach to ranking pest animal control methods for suitability in a particular situation could take the following approach:

1. Identify the alternatives to be compared (e.g. for rabbit control compare options such as 1080 baiting, pindone baiting, shooting, introduction of RHD).

2. Identify the set of criteria for comparing the alternatives (e.g. efficacy, humaneness, cost-effectiveness, target specificity; practicality).
3. Identify the relative importance of each criterion (weighting).
4. Score the alternatives against each criterion.
5. Multiply the score by the weighting for the criterion.
6. Add all the scores for a given alternative and rank the alternatives by their total score.

A9. Summary

The humaneness of a particular pest animal control method refers to the overall welfare impact that the method has on an individual animal. A relatively more humane method will have less impact than a relatively less humane method. Assessing welfare involves describing how well the animals experience their world based on the best possible judgement of their situation (Botreau *et al.* 2007b). This judgement requires not only detailed knowledge of scientific information, but also subjective information based on what is ethically and socially acceptable. A range of objective welfare indicators have been established (e.g. corticosteroids); and these indicators are generally used, particularly for farm animals, by aggregating a range of measures to make an overall assessment. In the area of pest animal control, overall welfare assessment may prove difficult since there is a lack of objective data for many of the welfare indicators and there is no one set of objective measures that are applicable to all control methods. However, overall welfare assessment can be performed if we use the scientific data that is available, if we extrapolate data from other species (including humans) and if we apply ethical judgement. The aim of this project is to define a model for assessing the welfare impact of pest animal control methods. The main purpose of the model is to allow the comparison of distinctly different



Feral goat (*Capra hircus*) (photo by Peter Fleming)

techniques, so that the most humane method to be used in any particular situation can be identified.

The FAWC (1992) have defined five basic requirements for welfare; freedom from hunger and thirst, freedom from discomfort, freedom from pain, injury or disease, freedom to express

normal behaviour and freedom from fear and distress. Based on these five freedoms, a severity scale has been devised by Mellor and Reid (1994) to assess the degree of suffering imposed by research, teaching and testing manipulations on laboratory animals. This scale provides the basis for the proposed model to assess the humaneness of pest animal control methods. Although the proposed model will require the input and subjective opinion of experts, the reasoning process should be transparent and easily understood by all stakeholders whilst the structure of the model will allow all areas of potential welfare impact to be considered. The model can be applied to a wide range of control techniques and allows comparisons of different methods to be made. An outline of the proposed model follows.



Part B: A model for assessing the humaneness of pest animal control methods

B1. Introduction

The goal of a humaneness assessment is to evaluate the impact of a pest animal control method on individual animals and to also determine which methods are more or less humane compared to other methods. As described in Part A, some of the current models for assessment of humaneness focus on a specific method of control (e.g. poisoning or trapping) or on a particular impact that a method has on an animal (e.g. scales to assess physical injury from foot-hold traps). A model was needed that incorporated all the major dimensions of welfare (both physical and mental components) and could be applied in a comparative way to a wide range of pest animal control methods.

Three key ethical principles should be adhered to with regard to the assessment of suffering in pest animals. Derived from Stafleu *et al.* (2000) these are:

- *the benefit of the doubt* – in cases where there is doubt or lack of knowledge about whether an animal will suffer very severely, one should assume it will do so;
- *the worst case* – one should assume that the worst case will happen; and
- *equal weight of the different dimensions of suffering* – suffering due to pain, illness, or stress is equal.

Based on an assessment of the available and relevant literature it is recommended that a model for the relative assessment of humaneness be formulated from Mellor and Reid's (1994) system for predicting the impact of procedures of experimental animals. Below is a summary of this model followed by an outline of the proposed model for assessing the relative humaneness of pest animal control methods.

B2. Overview of Mellor and Reid's model

The five freedoms formulated by the UK Farm Animal Welfare Council are often used as a logical and comprehensive framework to assess the welfare of farm animals. The five freedoms define ideal states rather than standards for acceptable welfare. They are:

1. **Freedom from Hunger and Thirst** - by ready access to fresh water and a diet to maintain full health and vigour.
2. **Freedom from Discomfort** - by providing an appropriate environment including shelter and a comfortable resting area.
3. **Freedom from Pain, Injury or Disease** - by prevention or rapid diagnosis and treatment.
4. **Freedom to Express Normal Behaviour** - by providing sufficient space, proper facilities and company of the animal's own kind.

5. Freedom from Fear and Distress - by ensuring conditions and treatment which avoid mental suffering.

Mellor and Reid (1994) have subsequently used the five freedoms as the basis for developing a system to assess the impact of experimental, teaching and testing procedures on animals. They transformed the freedoms into 'domains of potential compromise' and redefined them to better emphasise the extent of welfare compromise rather than the ideal of absence of compromise. The five domains are (see Figure 1):

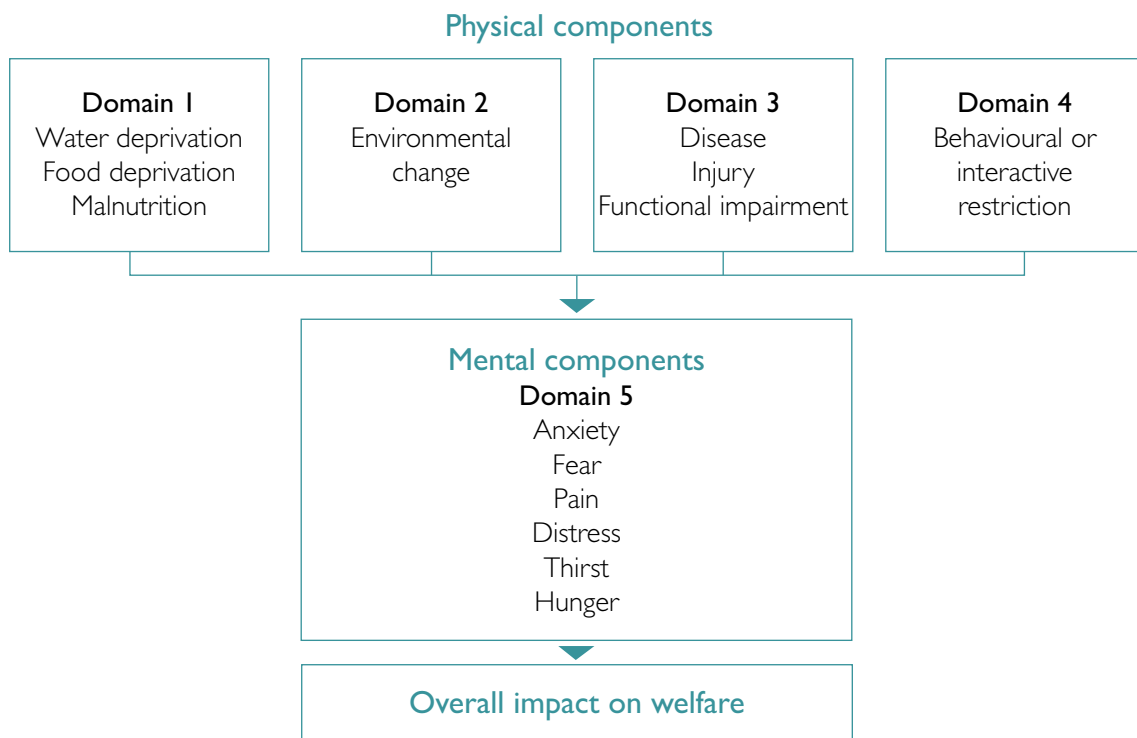
- Domain 1: Water deprivation/food deprivation/malnutrition;
- Domain 2: Environmental challenge;
- Domain 3: Disease/injury/functional impairment;
- Domain 4: Behavioural or interactive restriction; and
- Domain 5: Anxiety/fear/pain/distress.

The first four domains represent physical components of welfare compromise and the fifth domain includes mental components such as anxiety, fear, sickness, pain, thirst and hunger. Compromise in the first four domains will be usually registered in welfare terms in the fifth domain, which represents the components of suffering.

Mellor and Reid (1994) have also defined a 5-level, non-numerical severity scale to help assess the degree of compromise in each of the five domains. The scale consists of five grades: O, A, B, C and X, representing increasingly severe compromise. The different grades are linked to the severity of functional disruption caused by each procedure, the duration of the disruption and its reversibility, and whether or not its noxious effects might be mitigated or ended by withdrawal from the study, treatment or euthanasia.

For a detailed description of Mellor and Reid's model and subsequent revisions please refer to: Mellor and Reid (1994); Mellor and Stafford (2001); Mellor (2004); and Mellor *et al.* (2005).

Figure 1: Five domains of potential welfare impact divided broadly into physical and mental components. Modified from Mellor (2004)



B3. Proposed model for the assessment of relative humaneness of pest animal control techniques

Creating a model to assess the humaneness of pest animal control methods proved to be a difficult process due to the variety of control techniques used and the wide range of pest animals targeted. Also, whilst most methods are lethal; some are not (without further intervention), so to produce a list of 'humaneness criteria' that would be applicable to every technique and for every species did not seem to be a viable option. The aim was therefore to produce a practical, general model of assessment that can be applied to any pest control method. The model should allow a judgement to be made about the humaneness of a method and then methods can be ranked based on this judgement.

A two-part assessment process is proposed:

- *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 by evaluating the *intensity* of suffering and *duration* of suffering caused by the technique (for lethal methods).

For *lethal methods*, both Part A and Part B will be used to assess the overall humaneness of a method. This will take into account *how* the animal is killed and also the impact on welfare *prior* to killing. For *non-lethal methods*, Part A only will be used to examine the impacts on an animal's welfare.

For Part A, overall welfare impact is assessed using the approach taken by Mellor and Reid described above. For Part B, the effects of the killing method on welfare is assessed using the approach suggested by Broom (1999). The aim of including Part B is to differentiate the lethal methods of control based on how much suffering they cause and the duration of this

suffering. Some control methods have two phases, for instance, trapping involves capture of an animal followed by, in most cases, killing the animal. As an example, consider catching a fox in a steel-jawed trap and then killing it with a head shot from a rifle compared to trapping it in a cage followed by drowning. In a one-stage humaneness assessment (i.e. Part A only) these methods may turn out to have the same score, but a two-stage assessment will make it clear that the first method involves a relatively less humane trapping method and a more humane killing method and vice versa for the second method. Therefore, the proposed two stage assessment allows a separate evaluation of both the capturing/trapping and killing, ensuring that both aspects are addressed. Inevitably there will be some overlap between Parts A and B when they are applied to other techniques such as poisons. Part B may also be useful to pest animal researchers that need to assess the humaneness of a killing technique that is not part of an actual control method.

Lack of objective data on control methods means that there will need to be some reliance on subjective data. When using the model to evaluate the humaneness of a particular technique, the Assessors will be expected to state what type of evidence was used to assign the degree of welfare compromise in each domain.

For example:

- is it generally known that a method inhibits normal behaviour or deprives an animal of a basic need in a particular domain?
- is there evidence from experimental studies or reviews of effects on target species or related species showing the extent and nature of lesions or pathologies; behavioural responses; and physiological responses?
- are there any reports from human cases?
- if there is no available evidence, will extrapolation be required from the assessors' subjective experience?

When assessing the impact of a control method in each of the domains we have to assume that the method is being carried out according to 'best practice' as set out in relevant codes of practice and standard operating procedures (e.g. Codes of Practice and Standard Operating Procedures for the Humane Control of Pest Animals). This is to ensure we are evaluating the 'intrinsic humaneness' of a method rather than technical inadequacies associated with its application. Also, those performing the assessment must have an understanding of the biology and behaviour of the target species as well as knowledge and experience of practical aspects of the control method being assessed.

During the course of the project, the model has been developed with input from a range of stakeholders especially those with expertise in the areas of animal welfare and pest animal control. Over time it is expected that the model will continue to be developed and improved. Therefore, the descriptions and examples of grades on the impact scales given here should be seen as provisional and are likely to be refined further after applying the model to a range of techniques.

B4. Advantages and disadvantages of the humaneness model

Advantages:

- when there are no available objective data to categorise the impact in a particular domain, the assessor is required to choose an impact category based on informed judgement rather than abandoning the assessment because there is insufficient information;
- allows the assessment of a wide range of control methods including both lethal and non-lethal methods;
- because each control method is allocated an overall score, different methods can be compared with regard to their humaneness;
- assesses the impact of a method on both physical and mental components of welfare;
- highlights areas where more research is needed; and
- Provides a transparent reasoning process that can be understood by all stakeholders and also helps to generate consensus.

Disadvantages

- because there is a dearth of objective data relating to welfare in this particular field, some judgements will have to be made subjectively;
- the assessment will only provide a *grade* for humaneness rather than giving an absolute measure;
- individual assessors may be tempted to base their estimations of impact grades purely on their own subjective opinion without first consulting the relevant literature. People may make "In my experience" arguments without first looking for data to support their impact grade. This is a reason why the assessment process should be done by a *panel* of people with expertise in animal welfare and behaviour; practical pest animal management etc. who have access to relevant literature and can reach consensus on the final humaneness score; and
- the model can't tell us how the animal actually *feels* – no matter how good our physiological and behavioural data is, we are only making an 'educated guess' as to what the animal is experiencing.

B5. The humaneness assessment model

NON-LETHAL METHODS

METHODS WHICH HAVE AN IMPACT ON THE TARGET ANIMAL BUT DO NOT CAUSE DEATH

For example: exclusion fencing, mustering, cage-trapping and translocation, fertility control

Perform Part A of assessment only (assessment of overall welfare impact based on the five domains)

The humaneness score is a single numerical score that can be compared with other non-lethal or lethal methods. Potentially the most humane method would receive a score of 1 whilst the least humane method would score 8.

LETHAL METHODS

METHODS WHICH CAUSE THE DEATH OF THE TARGET ANIMAL

For example: 1080 baiting, pindone baiting, strychnine baiting, fumigation of burrows with phosphine, warren blasting, mustering followed by shooting in yards, leg-hold trapping followed by shooting, cage-trapping followed by overdose of barbiturate, aerial shooting, leg-hold trapping with strychnine cloths, infection with calicivirus

Perform both Part A and Part B of assessment (assessment of overall welfare impact based on the five domains and assessment of killing method based on time to insensibility and level of intensity of suffering)

The humaneness score is obtained by combining the numerical scores from part A and the alphabetical score from Part B. Potentially, the most humane method would receive a score of 1A, whilst the least humane method would score 8H.

NOTE ON ASSESSMENT OF LETHAL TOXINS

Part A examines the 'impact on the animal prior to the action that causes death'. Part B then looks at the 'actual mode of death' and the 'extent and duration of suffering caused'. With methods involving toxic baits it is likely that there will be no welfare impact prior to the animal ingesting the bait, therefore it is not necessary to assess both part A and B. Only Part B is required.

Principles for use

1. There are complex processes involved in developing an invasive animal control strategy. The assessment of humaneness should be considered in context with other factors such as target specificity, efficacy, practicality, cost-effectiveness and operator safety etc.
2. Assessment should be performed assuming that 'best practice' or standard operating procedures are applied.
3. Before performing an assessment, it is important to fully understand and state what is being assessed i.e. what is the method, how is it done, where is it done, who is doing it.
4. Where there is doubt or lack of objective knowledge about whether an animal will suffer severely, one should assume it will do so i.e. the 'benefit of the doubt' should be given in favour of the animal.

5. When determining welfare impact, it is important to consider what happens in the majority of situations. Although an assessment cannot include all possible scenarios, it is possible to incorporate the likelihood of a negative event happening when this information is known.
6. When determining the impact in Domain 5, it is important to remember that this impact is usually a cumulative effect of the other four domains and is generally, but not always, equivalent to the most extreme potential impact.
7. If a control method is not initially lethal or successful and is applied on multiple occasions to the same individual or population of animals (e.g. trapping, mustering, aerial shooting etc.) the overall stress will be compounded.

Part A: Assessment of overall welfare impact

Instructions

1. Anticipate the likely impact of the control method on the individual target animal. Information on the physiological, behavioural and pathological responses to a particular method should be obtained from the literature (i.e. experimental studies or review of effects on target species or related species). In some cases extrapolations from human cases may be necessary.
2. Using the impact scales (Boxes 1-5) as a guide, assign a grade (no impact, mild, moderate, severe or extreme impact) to reflect the level of impact of the control method in each of the five domains. This grade should reflect the state of the animal at the time of maximum impact.
3. Determine the overall impact grade (ranging from no impact to extreme impact). The overall grading is usually that assigned to domain 5- mental state. If however, the intensities of anxiety/fear/pain/distress etc. caused by a particular method are not known or cannot be evaluated, the grading of compromise in the known domain(s) would be used to determine the overall impact grade.
4. Determine the duration of welfare impact (immediate/seconds, minutes, hours, days, weeks).
5. Interpret the score for the overall welfare impact from the scoring matrix (Box 6) (scores range from 1 to 8, with 1 being the most humane and 8 the least humane).
6. Cite the references/evidence used to conduct the assessment.

Part B: Assessment of mode of death

Instructions

1. Anticipate the likely impact of the killing method on the individual target animal based on knowledge of the mode of action and observations of the physiological, behavioural and pathological responses. This information can be obtained from the literature (i.e. experimental studies or a review of the effects on target species or related species). In some cases extrapolations from human cases may be required. In the absence of objective information (especially with regard to assessment of pain, discomfort, distress etc.) the best interest of the animal should guide the grading of impact. Other information to consider includes the age of the animal, how, where and when the technique will be applied, degree of restraint required, technical competence of the operator, suitability of equipment etc.
2. Determine the time to insensibility for the action that causes death. For some methods (e.g. poisons such as 1080, anticoagulants) a lag time would be subtracted from the overall time, provided that the animal does not experience any negative welfare impacts during this interval.

3. Using the impact scale (Box 7) as a guide, determine the level of suffering experienced by the animal after application of the method that causes death but prior to onset of insensibility. Components of suffering include anxiety, pain, fear, distress, apprehension.
4. Interpret the alphabetical score for the action that causes death technique from the scoring matrix (Box 8) (scores range from A to H, with A being the most humane and H being the least humane).
5. Cite the references/evidence used to conduct the assessment.

Impact scales for part A: overall welfare impact

Box I

DOMAIN I: WATER DEPRIVATION, FOOD DEPRIVATION, MALNUTRITION		
Impact category	Description of impact	Examples
NO IMPACT	No effect on food/water intake	
MILD IMPACT	Short-term water or food restrictions that are within usual tolerance levels for the species.	An animal has a few hours without water, in shade conditions. Short-term deprivation of food.
MODERATE IMPACT	Water or food restrictions which cause serious short-term or moderate long-term effects on physiological state or body condition, but such effects remain within the capacity of the body to respond to nutritional variations and allow spontaneous recovery after restoration of a good quality diet.	An animal has a few hours without water, in hot, sunny conditions. Deprivation of food long enough to bring about mobilisation of body fat stores.
SEVERE IMPACT	Severe restrictions on food/water intake that lead to significant levels of debility.	An animal has many hours without water. Deprivation of food for many days resulting in severe loss of body weight.
EXTREME IMPACT	Extreme restrictions on food/water intake that would likely result in the animal dying from dehydration or starvation.	An animal has many days without water and /or food and dies from severe dehydration and/or starvation.

Box 2

DOMAIN 2: ENVIRONMENTAL CHALLENGE		
Impact category	Description of impact	Examples
NO IMPACT	Exposure to environmental challenge is not a feature of or consequence of the mode of action.	Exposure to ambient conditions that are within an animals' thermoneutral range.
MILD IMPACT	Short term exposure to environmental conditions which are outside the normal range encountered by the animal but remain within their physiological adaptive capacity.	Exposure to levels of heat or cold which are outside the thermoneutral range, but which do not lead to debility in the long-term.
MODERATE IMPACT	Marked short-term or moderate long-term environmental challenges that elicit body responses beyond the physiological adaptive capacity of the animal, but where the untoward effects are readily reversed by restoration of normal ambient conditions.	Short-term heat stress caused by exposure to high ambient temperatures combined with exercise.
SEVERE IMPACT	Severe environmental challenges that lead to serious physiological compromise or permanent dysfunction, injury or illness.	An animal is exposed to severe heat or cold which could possibly lead to failure of thermoregulation and collapse.
EXTREME IMPACT	Long-term exposure to extremes of heat or cold that bring about the death of the animal from hyper- or hypothermia.	Animals that are left in leg-hold traps, cage traps or yards in extremes of heat or cold and subsequently die from hyper- or hypothermia.

Box 3

DOMAIN 3: INJURY, DISEASE, FUNCTIONAL IMPAIRMENT		
Impact category	Description of impact	Examples
NO IMPACT	Disease, injury or functional impairment is not a feature of or consequence of the mode of action.	
MILD IMPACT	Body responses remain within the homeostatic capacity of the animal to react with no or only minor debility or incapacity.	Minor injuries (e.g. minor skin laceration, oedematous swelling of foot and/or leg, mild mouth injuries). Minor functional impairment (e.g. mild vomiting/retching, diarrhoea).
MODERATE IMPACT	Disease/injury/functional impairment that results in moderately severe debility or incapacity but from which recovery would normally occur spontaneously.	Moderate injuries (e.g. damage to minor tendon or ligament, amputation of a digit, joint haemorrhage, single tooth fracture, major laceration of mouth or tongue, joint dislocation). Moderate or functional impairment (e.g. moderate vomiting/retching, diarrhoea, increased breathing, moderate haemorrhages, convulsions).
SEVERE IMPACT	Injury/disease/functional impairment that result in severe debility or incapacity and serious physiological compromise and would normally cause permanent disability. Includes injuries that are likely to reduce survival if the animal were to be released.	Severe injuries (e.g. deep and wide lacerations, severed tendons, broken foot and leg bones below elbow or stifle, joint dislocations, amputations). Severe or functional impairment (e.g. severe vomiting/retching, diarrhoea, abnormal breathing, severe haemorrhages, convulsions).
EXTREME IMPACT	Injury/disease/functional impairment that result in very severe debility or incapacity due to the effects of traumatic injury, infectious agent or toxin.	Extreme injuries (e.g. death caused by excessive blood loss or shock, spinal chord injury, severe internal bleeding, fractures of more than one limb, severe jaw fracture, fractures of limbs above elbow or stifle). Extreme or functional impairment (e.g. extreme persistent vomiting/retching, diarrhoea, laboured breathing, convulsions, blindness, immobility/prostration, excessive and prolonged haemorrhaging).

Box 4

DOMAIN 4: BEHAVIOURAL, INTERACTIVE RESTRICTION		
Impact category	Description of impact	Examples
NO IMPACT	No interference with the behavioural needs of an animal (an animal's behavioural needs being those activities which when thwarted produce untoward physiological or psychological effects).	
MILD IMPACT	Mild interference with the behavioural needs of an animal.	Mild and short-term physical restraint resulting in minor behavioural or interactive restriction.
MODERATE IMPACT	Moderate interference with the behavioural needs of an animal resulting in negative physiological or psychological effects which are readily reversed after restoration of normal conditions.	Restraint that results in agitation from not being able to perform natural behaviour that the animal is highly motivated to perform e.g. feeding, moving, resting, grooming, mating, caring for young.
SEVERE IMPACT	Marked interference with the behavioural needs of an animal leading to physiological or psychological compromise that may cause long-term or permanent negative effects.	Severe abnormal self-directed behaviour e.g. chewing/biting of feet and limbs when restrained. Normal defensive and/or escape reactions to visibility of or presence of predators are prevented.
EXTREME IMPACT	Extreme interference with the behavioural needs of individuals or groups of animals leading to psychotic-like behaviour or to agonistic interactions that result in very severe injury or death.	Restraint that results in extreme abnormal self-directed behaviour, excessive aggression, stereotypy (e.g. severe fighting among incompatible social groups, unfamiliar individuals that are in close proximity). Inability to escape attack by a predator.

Box 5

DOMAIN 5: ANXIETY, FEAR, PAIN, DISTRESS, THIRST, HUNGER ETC.		
Impact category	Description of impact	Examples
NO IMPACT	Anxiety, fear, pain, sickness, breathlessness, nausea, lethargy/ weakness. dizziness, greater than normal thirst and/or hunger or other negative affective experiences causing distress are not a feature or consequence of the method.	
MILD IMPACT	Mild anxiety, fear, pain, sickness, breathlessness, nausea, lethargy/ weakness. dizziness, unsatisfied thirst and/or hunger or other negative affective experience causing distress.	Limited human contact with no physical handling.
MODERATE IMPACT	Moderate anxiety, fear, pain, sickness, breathlessness, nausea, lethargy/ weakness. dizziness, unsatisfied thirst and/or hunger or other negative affective experience causing distress.	Moderate level of human contact with minimum of physical handling.
SEVERE IMPACT	Severe anxiety, fear, pain, sickness, breathlessness, nausea, lethargy/ weakness. dizziness, unsatisfied thirst and/or hunger or other negative affective experience causing distress.	High level of human contact with a degree of physical handling.
EXTREME IMPACT	Extreme inescapable or unrelieved anxiety, fear, pain, sickness, breathlessness, nausea, lethargy/ weakness. dizziness, unsatisfied thirst and/or hunger or other negative affective experience causing distress which is judged to be at or beyond the limits of reasonable endurance and results in the death of the animal.	Excitement, fear and distress in struggling restrained animals that result in death from capture myopathy.

Scoring matrix for part A: overall welfare impact

Box 6

Overall impact on welfare	Duration of impact				
	Immediate to Seconds	Minutes	Hours	Days	Weeks
EXTREME	5	6	7	8	8
SEVERE	4	5	6	7	8
MODERATE	3	4	5	6	7
MILD	2	3	4	5	6
NO IMPACT	1	1	1	1	1

Impact scale for part B: assessment of mode of death

Box 7

Impact category	Description of impact	Examples
NO SUFFERING	<p>No suffering before death. There is immediate death or immediate loss of consciousness lasting until death.</p> <p><i>Note that components of suffering include (but are not limited to) fear, anxiety, pain, distress, apprehension, sickness, fatigue, thirst, hunger.</i></p> <p><i>Aversion refers to the avoidance or attempted avoidance of unpleasant, noxious stimuli and distressing stimuli</i></p>	<p>Direct destruction/concussion of brain tissue resulting in rapid unconsciousness e.g. accurate shooting in the head.</p> <p>Inhaled vapour with no irritant effect that induces unconsciousness without pain or discernable discomfort.</p> <p>Does not involve physical handling or restraint</p>
MILD SUFFERING	<p>Loss of consciousness is not immediate and there is no or only minimal aversion and no or only mild suffering before death.</p>	<p>Inhaled vapour causing mild irritancy and mild pain and/or distress.</p> <p>Mild dyspnoea (breathlessness).</p> <p>Mild degree of sickness e.g. vomiting/retching, diarrhoea, lethargy/weakness etc.</p> <p>Does not involve physical handling or restraint.</p>
MODERATE SUFFERING	<p>Loss of consciousness is not immediate and there is moderate aversion and suffering before death.</p>	<p>Inhaled vapour causing moderate irritancy and moderate pain and/or distress.</p> <p>Moderate degree of sickness e.g. vomiting/retching, diarrhoea, lethargy/weakness etc.</p> <p>Moderate dyspnoea.</p> <p>May involve physical handling and restraint e.g. to administer an injectable agent via intravenous (IV) or intraperitoneal (IP) route of entry; to apply cervical dislocation; to apply blunt trauma to the head.</p>

Box 7 (continued)

Impact category	Description of impact	Examples
<p>SEVERE SUFFERING</p>	<p>Loss of consciousness is not immediate and there is severe suffering before death.</p>	<p>Inhaled vapour causing severe irritancy and severe pain and/or distress.</p> <p>Convulsions occurring during unconsciousness when animal recovers consciousness prior to death (i.e. muscle spasms with periods of relaxation as in clonic convulsions).</p> <p>Severance of major arteries resulting in rapid blood loss, hypovolaemia and shock.</p> <p>Severe degree of sickness e.g. vomiting/retching, diarrhoea, lethargy/weakness etc.</p> <p>Severe dyspnoea</p> <p>May involve physical handling and restraint e.g. administration of an injectable agent to a non-sedated animal via a difficult-to-access route of entry (e.g. intracardiac, intrahepatic, intrarenal).</p>
<p>EXTREME SUFFERING</p>	<p>Loss of consciousness is not immediate and there is extreme suffering before death.</p>	<p>Inhaled vapour causing extreme irritancy and extreme pain and/or distress.</p> <p>Partial or full paralysis whilst conscious.</p> <p>Convulsions whilst conscious (i.e. prolonged muscle spasm without periods of relaxation as in tonic convulsions).</p> <p>Extreme degree of sickness e.g. vomiting/retching, diarrhoea, lethargy/weakness etc.</p> <p>Extreme dyspnoea.</p> <p>Severe internal haemorrhages causing swelling within confined spaces.</p> <p>May involve physical handling and restraint.</p>

Scoring matrix for part B:
assessment of mode of death

Box 8

Level of suffering (after application of the method that causes death but before insensibility)	Time to insensibility (minus any lag time)				
	Immediate to Seconds	Minutes	Hours	Days	Weeks
EXTREME	E	F	G	H	H
SEVERE	D	E	F	G	H
MODERATE	C	D	E	F	G
MILD	B	C	D	E	F
NO IMPACT	A	A	A	A	A

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Section 2 - Assessing the humaneness of commonly used invasive animal control methods

1. Project Information

Project name

Assessing the humaneness of commonly used invasive animal control methods

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3. Executive summary

Negative animal welfare impacts associated with the management of invasive animals can be minimised by using the most humane method that is effective for a given situation. A framework has recently been developed to assess the overall humaneness of invasive animal control methods. This model uses published scientific information and informed judgment to examine the negative impacts that a method has on an animal's welfare and, if a lethal method, how the animal is killed. A score is generated so that the relative humaneness of different methods can be compared.

This report presents the results of a project that applied the Model for Assessing the Relative Humaneness of Pest Animal Control Methods developed by Sharp and Saunders (2008)¹ to a range of invasive animal control methods used in Australia. A 'humaneness assessment panel' consisting of experts with knowledge and experience in animal welfare and invasive animal management performed the assessments with the assistance of experts with knowledge on specific animal species. Sixty humaneness assessments for 12 different species were completed. The results are presented in the form of humaneness assessment worksheets and matrices that will be published as a hard copy document and also on a public access website.

4. Background to the project

Animals such as rabbits, feral pigs, foxes, wild dogs and feral cats continue to cause significant environmental damage and agricultural losses despite improvements in control methods and the development of new techniques. Each year hundreds of thousands of pest animals are trapped, poisoned, shot or otherwise destroyed because of the harm they cause². Historically, pest animal control has focused on killing as many pests as cheaply as possible, but in today's society the management of pest animals is considered most acceptable when it is both humane³ and justified. However, many of the methods used to control pest animals in Australia are far from being humane.

This project is the second stage of a process to assess the welfare impact of invasive animal control methods. The first stage was completed in July, 2008, as part of a project titled: "Ranking the humaneness of vertebrate pest control techniques" which was undertaken by Ms. Trudy Sharp and Dr. Glen Saunders of the Vertebrate Pest Research Unit, NSW Department of Primary Industries with funding from the Commonwealth Department of Agriculture, Fisheries and Forestry. The aim of that project was to evaluate the existing literature relating to the assessment of invasive animal control methods and then use this information to develop a humaneness ranking model that contains key welfare assessment principles. The aim of this current project is to apply the newly developed model to currently used control techniques and disseminate the results to stakeholders.

At a workshop to discuss the humaneness model held in April 2008, representatives from various State/Territory and Commonwealth governments (including the CSIRO and APVMA), and non-governmental organisations such as RSPCA Australia, Animals Australia, NSW Farmers and Australian Veterinary Association agreed that the model was acceptable and will be workable with some

minor modifications. These changes were made and the model was published in a final report¹.

Discussions on how the model should be applied were also undertaken at the workshop with the majority of stakeholders expressing their support for its application to currently used control methods. There was general agreement that a panel of experts should determine the priority methods for assessment, complete the assessments using the humaneness model and then disseminate the results to a wider audience.

The results of the assessment process could potentially be applied in the in the following ways:

- During crisis management situations (e.g. situations similar to the kangaroo problem at Belconnen or exotic disease outbreaks);
- When writing new standard operating procedures or codes of practice;
- When the humaneness of a technique is questioned (e.g. aerial shooting of feral horses, stunning of joeys);
- To identify techniques that are unacceptable and to support the phasing out of these techniques;
- During the planning or reviewing of management strategies; and
- To support funding applications (for control operations or research).

5. Project aims and objectives

The aim of this project was to examine the humaneness of invasive animal control techniques using a nationally endorsed assessment model. This model allows an evaluation of humaneness using a systematic, comprehensive and transparent process that helps to generate consensus among diverse stakeholders. Following on from its recent

development and acceptance at a national level, the next logical step was to apply the model to existing control methods and disseminate this information to all those involved in the management of invasive animals. It was proposed that a panel of experts consisting of stakeholders with knowledge and experience in animal welfare and invasive animal management will undertake the assessments for a selection of currently used control methods.

By providing information on the humaneness of control methods the project will also contribute to community skills, knowledge and engagement. The information gained will improve best practice management of invasive animal species by enabling humaneness to be considered alongside efficacy, cost-effectiveness, practicality, target specificity, operator safety etc. when determining the most appropriate method for managing the impact of an invasive animal.

6. Methodology

The activities undertaken during the project included:

- Identification and coordination of an expert panel to perform the humaneness assessments;
- Development of a list of priority invasive animal control methods to be assessed, in consultation with the panel. This list included existing routine methods that need to be assessed and those methods that are either controversial and /or new where stakeholders have requested urgent guidance on humaneness;
- Performing an extensive literature search to gather relevant information to do assessments;
- Preparation and organisation of meetings of panel members and invited species experts to conduct assessments using the humaneness model; and

- Preparation of assessment worksheets and also humaneness matrices to assist with interpretation of results. The worksheets and matrices will be published both in a hard copy document and on the website feral.org.au.

7. The humaneness panel

A panel of experts with knowledge and experience in animal welfare and invasive animal management was identified and appointed at the start of the project. The panel members were:

Dr Glen Saunders
Research Leader, Vertebrate Pest Research Unit, Orange, Industry & Investment, NSW

Glen has over 30 years experience in pest animal management and research. He has conducted a variety of long-term, field based projects and has particularly focused on improving management strategies for vertebrate pests in line with best practice principles and with an ongoing theme of providing information appropriate for decision making on the basis of costs and benefits. In many situations this has required the development of new and innovative research tools with which to address various hypotheses. He has also contributed to the understanding of vertebrate pest impact on agricultural production as well as population ecology and demographics: pre-requisites for the effective design of more cost effective management strategies.

At a more applied level, he has targeted individual control practices with the intent of improving their efficacy. For high risk species such as the feral pig and fox, he has played a nationally important role in research and contingency planning for their control during exotic disease outbreaks (principally foot and mouth disease and rabies). Most of his research has been based on continuous themes. Through

a combination of published research, policy intervention and information transfer he has made a significant impact on the science and implementation of wildlife management in Australia. His research interests include improved implementation of broad-scale fox control programs; humane pest animal control; liaison with CMA/NRM groups on pest animal control; and biological control of rabbits.

Ms Trudy Sharp

Project Officer, Vertebrate Pest Research Unit, Orange, Industry & Investment, NSW

Trudy is a Project Officer within the Vertebrate Pest Research Unit, located at Orange Agricultural Institute. Since starting with the Unit in 2003 she has reviewed invasive animal management techniques and developed and published 43 standard operating procedures and 7 codes of practice for the humane control of 10 invasive animal species. The aim of these documents is to encourage a more humane and uniform approach to the management of invasive animals. Recently she has developed a model to assess the relative humaneness of invasive animal control methods so that animal welfare impact can be considered when planning management programs.

She has also spent some time with the Department's Animal Welfare Unit assisting with the development of codes of practice. Trudy joined NSW Agriculture in 1991 as a Technical Officer in the Regional Veterinary Laboratory, Orange. She has over 12 years experience in performing technical diagnostic and research procedures in veterinary microbiology. Her research interests include assessing the humaneness of invasive animal control methods; developing standard operating procedures and codes of practice for the humane control of invasive animals; and developing strategies to improve the welfare of commercially harvested kangaroos.

Mr Chris Lane

Terrestrial Products and Strategies Program Coordinator – Invasive Animals Cooperative Research Centre (IA CRC)

Chris coordinates the Industry and Investment NSW node of the IA CRC. The IA CRC aims to counteract the impact of invasive animals through the development and application of new technologies and by integrating approaches across agencies and jurisdictions. His role requires management of more than 15 research projects to address the corporate goals of the IA CRC and many of the national Australian Pest Animal Strategy. Chris has a broad background knowledge in pest animal management across rural agriculture, industry, research, management and control having worked closely with stakeholders in the industry for more than 15 years. He provides tremendous linkage with landholders and the agricultural community coupled with well developed program coordination skills and expertise.

Mr Jason Neville

Senior Ranger, Pest Management Officer, DECCW Western Rivers Region.

Jason graduated from Charles Sturt University Riverina (Wagga Wagga) in 1992 and for a period worked within Western NSW in weed & water management issues within a Jojoba plantation near Hillston on the Lachlan River. He then moved to Bathurst and worked with the Bathurst District of the National parks and Wildlife Service as a Field Officer. As he becomes established in the Pest Management position, from here he has been able to develop skills to succeed to the Senior Ranger position.

In his role as Senior Ranger with DECCW - Western Rivers Region he has been working with stakeholder to deliver landscape scale vertebrate pest and noxious weed control programs, focusing on conservation and agricultural production outcomes, with an

emphasis on a approach to restoration ecology. With a focus and concern on Threatened Species recovery of Bush Stone-curlew, Mallee fowl and Plains-wanderer ground nesting birds, by way of strategic fox control programs as well as the reduction of large vertebrate pest animals through FFAST Aerial control programs and working with a skilled PCO Jim Balnaves on supporting lateral fencing program to exclude feral goats from conservation areas.

He has been involved in a number of state-wide DECCW committees of which include, Fox Threat Abatement Plan, Pesticide Use Notification, Pest and Weed Information Management Systems and the Firearms Management Standing Committee.

Jason has also been involved on the organising committees for the Vertebrate Pest Management Conferences and convener of the NPWS Orange 1997, and committee member for 2002, 2005 & associate member for 2008.

He has established a suite of operational programs throughout the Central West and Riverina landscapes and hopes to expand and improve these programs using new SOP's and the through application of animal welfare principals and practices.

Dr Bidda Jones

Bidda Jones is the Chief Scientist with RSPCA Australia, based in Canberra. She graduated with honours in zoology from the University of Sheffield in 1988 and completed her PhD on the vocal behaviour of common marmosets at the University of London in 1993. She began working to improve the welfare of laboratory primates during her PhD and then as the first Scientific Officer to specialise in primate welfare for the UK RSPCA. Since 1996 she has worked for RSPCA Australia providing science-based advice and information on a wide range of animal welfare policy issues to government, industry and the public.

Bidda has represented the RSPCA on many different national committees and has been involved in examining and reporting on a wide range of animal welfare issues, including the transport and export of livestock, native wildlife management, intensive farming, the care, supply and breeding of companion animals, trade in zoo animals, and the use of genetically modified animals. She has been an honorary associate/lecturer with the Faculty of Veterinary Science at the University of Sydney since 2000.

Bidda has been actively working to improve the humaneness of vertebrate pest control in Australia since 2003. This began with organising a seminar and workshop to develop a national strategy, and has continued with the publication of a discussion paper on the topic, promotion of principles for humane vertebrate pest control and the development and implementation of the humaneness model.

Mr Frank Keenan

Frank is Manager, Policy and Strategy for Invasive Plants and Animals, Biosecurity Queensland. Part of this role is ensuring that humaneness is an integral part of implementing control of pest animals. Frank is a veterinarian with extensive experience in large scale animal health and pest management programs particularly in rangelands environments

Dr Andrew Braid Research Scientist, CSIRO Sustainable Ecosystems, Gungahlin ACT

Andrew graduated from the University of Melbourne, Faculty of Veterinary Science in 1969 and initially worked in the beef cattle industry in Victoria, far North Queensland and the Northern Territory before moving to dairy cattle and general practice as the principal of the Kiama Veterinary Hospital in Kiama, NSW, from 1973 to 1989.

In 1993 joined the CSIRO Division of Wildlife and Ecology (now Sustainable Ecosystems) in

Canberra as the Executive Officer of the Division's Animal Ethics Committee and manager of the animal facilities. In that role he was responsible for the care and welfare of colonies of Australian wild rabbits, mice, foxes and cane toads used in research by the CRC for Biological Control of Vertebrate Pest Populations.

Andrew is a member of the ACT Animal Welfare Advisory Committee and the Therapeutics Goods Administration AEC. In addition to his animal welfare role at CSIRO Sustainable Ecosystems, he works as a research scientist with a specific interest in the sustainability of the emerging biofuel and bioenergy industry in Australia.

Dr Andrew Fisher
Associate Professor, Faculty of Veterinary Science, University of Melbourne

Andrew graduated from the Faculty of Veterinary Science in 1989 and after a period of working in Colac, Victoria, moved to the UK, later completing a PhD at the Faculty of Veterinary Medicine at the University College, Dublin.

He then moved to New Zealand where he carried out animal health and welfare research with dairy, cattle and sheep. Prior to taking up his current role, he was the leader of the Animal Welfare Group at CSIRO, which he joined in 2002.

In his role as Associate Professor, Andrew is working to provide sustainable improvements in animal management and welfare for the benefit of both animal-related industries and the community. He completed Membership examinations in animal welfare with the Australian College of Veterinary Scientists in 2001. Dr Fisher is the author of 47 scientific papers and 7 book chapters, mostly on animal welfare.

The invited species experts were:

Dr Peter Fleming
Senior Research Scientist, Vertebrate Pest Research Unit, Orange, Industry & Investment, NSW

Peter has been researching vertebrate pest management issues with the Vertebrate Pest Research Unit of Industry & Investment, NSW since 1983. He commenced his research career at Glen Innes in northern NSW where his initial research subjects were the impacts and control of flying foxes in stonefruit crops, damage to sunflower crops by Australian parrots, and the impacts and management of wild dogs and red foxes. During his time at Glen Innes, Peter was a member of the Animal Care and Ethics Committee and investigated welfare consequences of leghold traps to wild dogs, foxes, cats and rabbits.

On moving to Orange in 1994, Peter worked on the economic impacts of rabbits on wool production, the management of feral pigs and red foxes for exotic disease control, and an integrated program for the management of dingoes and other wild dogs in south-eastern New South Wales and the ACT. He investigated behavioural aspects of feral goats and merino sheep to derive spatial models of exotic disease transmission for his PhD study. Currently, Peter is researching the effectiveness of netting to prevent damage to stonefruit crops by grey-headed flying foxes, aerial methods for surveying wildlife, cooperative wild canid management in arid, temperate and coastal environments and the manipulation of waterpoints for feral goat management.

Peter is the author of over 150 scientific and extension papers, a book on managing wild dog impacts and a video about modifying leghold traps to improve animal welfare outcomes

Dr Amanda Warren-Smith
Honorary Lecturer, Faculty of Veterinary
Science, University of Sydney

Amanda has extensive experience working with horses from all disciplines and her specific interest areas include applied animal behaviour and animal welfare. Her experience as a coach and as an equitation scientist has led to numerous requests to speak nationally and internationally. Having completed a PhD that focussed on training horses, her knowledge of applying learning theory to the training of horses is world-class. Amanda has conducted numerous studies which have been published in the peer-reviewed literature and have been widely cited. Amanda has also written and edited several book chapters and is frequently asked to review manuscripts for international journals. Amanda is currently involved in research projects including objective measures of performance and improving training of domesticated horses.

Mr Robert Hunt
Research and Advisory Officer (Pest Animals),
NSW Department of Environment Climate
Change and Water

Robert has been involved in pest animal control with NSW National Parks since 1991. His experience relating to the implementation of pest animal control programs has been undertaken across a number of sites within NSW where he has been employed as a Field Officer, Ranger and more recently as Research and Advisory Officer with the NSW DECCW Pest Management Unit.

Robert helped pioneer the "Nil Tenure" approach to pest animal management as facilitator and author of the Brindabella Wee Jasper Wild Dog and Fox Control Plan. His interest and field experience relating to cooperative pest animal control has resulted in ongoing presentations as part of pest animal courses with Canberra and Sydney Universities. He has presented a number of papers at

conferences and has co-authored papers relating to cooperative pest animal planning and wild dog and fox management.

As a result of a "canid management" study tour with the US Department of Agriculture, Robert's current research focus is on the evaluation of innovative control techniques for the management of wild dogs and foxes. This research has resulted in the commercialisation of a synthetic aerosol based lure to increase fox and wild dog visitation to control points along with field evaluation of the M-44 ejector.

Dr Brendan Cowled
Senior Veterinary Officer, Department of
Agriculture, Fisheries and Forestry

Brendan graduated as a veterinarian in 1997 and worked in clinical practice for 7 years in Australia, New Zealand and the UK. He completed a PhD in feral pig management in 2008 at the University of Sydney's Faculty of Veterinary Science. He completed Membership examinations in veterinary epidemiology with the Australian College of Veterinary Scientists in 2008.

He has worked as a veterinary epidemiologist at the Department of Agriculture, Fisheries and Forestry for the last 4 years. His work involves epidemiological policy advice on animal health management, outbreak management and investigating the role of feral pigs in disease transmission and maintenance. He is the author of many scientific papers on feral pig management, simulation modelling and disease emergencies.

Mr David Croft

David started with the old Department of Agriculture at Trangie in 1969 before joining the Noxious Animal Unit in 1970. During his term in the research area he gained his university qualifications including an MSc investigating the impact of rabbits on pastures and sheep production.

For many years he was involved in research on foxes, rabbits, feral pigs, wild dogs, feral goats and rodents until 1987 when he moved to the extension area and was appointed as an Agricultural Protection Officer based in Wagga Wagga.

More recently he has been recognised as an authority on rabbits, mice and plague locusts and conducts regular workshops principally to promote effective control of vertebrate pests and noxious insects by providing advice and training to land managers, RLPB, LHPA and DECCW staff.

Dr Andrew Moriarty
REACH Officer, Game Council NSW

Andrew graduated with first class honours from the faculty of Science at the University of Western Sydney in 1999. During his honours year he studied mortality patterns in adult rabbits in central western NSW with NSW Agriculture's Vertebrate Pest Research Unit. Andrew then went on to complete a PhD in the ecology and environmental impact of Rusa deer in Royal NP with the NSW National Parks and Wildlife Service and the University of Western Sydney, graduating in 2004.

From 2002 to 2009 Andrew worked in a number of NSW government departments including the NSW National Parks and Wildlife Service (Project Officer Pest and Firearms Management) Moss Vale Rural Lands Protection Board (Senior Ranger), Murray Catchment Management Authority (Catchment Coordinator) and Department of Environment and Climate Change (Project Manager for the Hume Highway Upgrade). During this time Andrew broadened his career to encompass pest animal and livestock health management, firearm and aerial shooting training and management, natural resource management and environmental and infrastructure planning.

In 2009 Andrew joined the Game Council of NSW to lead its research and education programs. Andrew continues to develop and

deliver hunter and game manager education programs and conduct research on game and feral animals, particularly on wild deer and waterfowl.

Andrew is currently an editor with the Journal of Wildlife Management and is the author of five technical manuals, eight scientific papers and two book chapters mostly on wildlife management and wild deer management.

Mr Tim Fraser
Resource Protection Officer and Team Leader
Aerial Shooting Team, SA DEH

Tim is a Resource Protection Officer with the South Australian Department of Environment and Heritage (D.E.H.) and also Team Leader for the DEH Aerial Shooting Team. As well as being a Firearms Safety Instructor, he writes policies and delivers training on the humane destruction of native wildlife and feral animals, and oversees feral animal control programmes. He also gets called in on serious wildlife enforcement matters particularly if it they are likely to involve the seizing of firearms.

Mr John Tracey
Research Officer, Vertebrate Pest Research
Unit, Orange, Industry & Investment, NSW

For the last 13 years John has managed a range of research projects which investigate the dynamics, ecology, impacts and management of vertebrate pest species and exotic and endemic diseases. He currently manages the national CRC research program on pest birds, Kakadu Feral Animal Training Program and Aerial Survey and other projects including targeting surveillance of avian influenza in wild birds, density estimators of feral goats, feral pigs and macropods, and oral delivery of Rabbit Haemorrhagic Disease. His research is focussed on improving scientific based decision making for sustainable agriculture and the adaptive management of wildlife populations. John's research interests include efficacy of existing techniques for managing pest birds; improving the relevance and efficiency of wild bird

surveillance for avian influenza; towards national best practice strategies for managing pest birds; Lord Howe Island Ducks: hybridisation, abundance, impacts and management; bio-economic evaluations of management strategies for pest birds; measuring and managing non-target impacts of rodenticides; and Kakadu feral animal training program and aerial survey.

Dr Peter R. Brown
Senior Research Scientist, CSIRO Ecosystem Sciences, Canberra

Peter completed his Bachelor of Applied Science at the Canberra College of Advanced Education in 1988 then completed his Masters of Applied Science in Resource Management at the University of Canberra in 1993. He has a strong interest in the management of vertebrate pests, particularly examining their impact on pasture and crops.

He joined CSIRO Wildlife and Ecology in 1993 as a Technical Officer then an Experimental Scientist working on projects on the management of mouse plagues in Australia (field testing of rodenticides, non-target impacts, farm management practices, decision support systems and laboratory testing of rodenticides). He also worked extensively on rodent management projects in rice cropping systems in SE Asia. In 2005 he completed his PhD at the University of NSW and became a Senior Research Scientist. He has five CSIRO awards for Scientific Achievement. He has authored 2 books (one on field methods for managing rodents), 40 refereed journal articles, 17 refereed book chapters and 30 industry reports and conference chapters, mostly on methods for managing rodent pests and reducing their impact.

8. Panel meetings

Panel meetings were held on the following dates:

- 17 April 2009 – Teleconference

- 23-24 July 2009 – CSIRO, Gungahlin, ACT
- 15-16 October 2009 – CSIRO, Gungahlin, ACT
- 12-13 November 2009 – CSIRO, Gungahlin, ACT
- 10-11 December 2009 – CSIRO, Gungahlin, ACT

9. Invasive animal control methods assessed

A range of stakeholders (including workshop participants for the assessment model and State/Territory representatives from the Vertebrate Pest Committee) were contacted to seek suggestions on priority species and methods to be assessed. These suggestions and comments were collated and distributed to the panel.

At the first meeting of the Humaneness Assessment Panel, a teleconference held on 17 April, a list of priority methods to be assessed was drawn up. This preliminary list of priority species and methods included:

- Feral horses – all methods that have SOPs.
- Wild dogs - all methods that have SOPs plus LTD's, M44's and cyanide
- Rabbits - all methods that have SOPs plus chloropicrin and treatment of warrens using LPG technology.
- Feral pigs- all methods that have SOPs plus use of dogs for hunting.
- Other species and techniques to be considered as new SOPs were written.

During the four face-to-face meetings, the panel completed 60 separate assessments involving 12 different species. These are listed in Table 1. A number of completed assessment worksheets are included in the appendix.

Table 1: Humaneness assessments performed by the panel

Species	Methods assessed
Feral donkeys	Ground shooting, aerial shooting
Feral cats	Ground shooting, padded foot-hold traps, cage trapping
Feral camels	Ground shooting, aerial shooting, mustering
Feral goats	Ground shooting, aerial shooting, mustering, trapping
Feral horses	Ground shooting, aerial shooting, mustering, trapping
Feral pigs	Ground shooting, aerial shooting, trapping, I080 baiting, CSSP baiting, warfarin baiting, sodium nitrite baiting
Foxes	Ground shooting, I080 baiting, fumigation with carbon monoxide, cage trapping, padded foot-hold traps, ejector devices
Pest birds	Ground shooting, cage trapping, net trapping
Rabbits	Ground shooting, I080 baiting, pindone baiting, chloropicrin fumigation, phosphine fumigation, padded foot-hold traps, warren ripping, warren blasting, inoculation with RHDV, baiting with RHDV, warren treatment with LPG technology
Rodents	Baiting with anticoagulants, baiting with zinc phosphide, trapping with glue boards, trapping with live traps
Wild deer	Ground shooting, aerial shooting, trapping
Wild dogs	Ground shooting, cage trapping, padded foot-hold traps, I080 baiting, ejector devices

10. Suggested changes to model

Overall, the model developed by Sharp and Saunders (2008)¹ was found to be highly applicable to for the evaluation of animal welfare impacts associated with invasive animal control methods used in Australia.

With the assessment of lethal toxins, initial discussions of the panel questioned if it was necessary to assess Part A of the assessment since there is (usually) no welfare impact prior to ingesting a poison bait. It was decided to treat Part A as the 'impact on the animal prior to the action that causes death'. Part B then looks at the 'actual mode of death' and the 'extent and duration of suffering caused'. Therefore for those methods involving toxic baits, only Part B (assessment of mode of death) was completed.

During the course of the assessment process, notes were made on suggested changes to improve the Model for Assessing the Relative Humaneness of Pest Animal Control Methods. These were:

- Add comments on the multiple application of the same method to the same populations of animals thereby increasing stress.
- Move the impact from asphyxia (in Part B- assessment of mode of death) e.g. strangulation, smothering, chest compression etc. from Extreme to Severe.

11. Gaps in knowledge

During the course of the assessment process, notes were made on gaps in knowledge that prevented the assessment of some methods or

where a method should or should not be included in the code of practice for a particular species. These were:

Aerial shooting of horses – there are no actual figures on accuracy rates, the effect of helicopter on behaviour and physiological responses of horses in the short term is unknown.

Trapping of rabbits – need to determine if laminated traps used for rabbits. If so, should they be included in the COP?

Rabbit warren destruction using explosives – there is a lack of knowledge on what actually happens to rabbits inside the warren when explosives are used.

Rabbit warren destruction using ripping – there is a lack of knowledge on what actually happens to rabbits inside the warren when it is ripped.

Pindone baiting of rabbits – there is a lack of knowledge on the welfare impact of pindone in rabbits.

I080 baiting of feral pigs – there is no physiological data on the action of I080 on pigs or information what happens with sub-lethal dosing.

Treatment of rabbit warrens with LPG technology – with the 'Rodenator' device – this method has two lines going into the warren, one containing LPG and the other, oxygen. There is no information on the effectiveness or humaneness of this device. We don't know if the blast is sufficient to render animals unconscious. Need to determine if inhalation of LPG has any welfare impacts. The use of the 'Rid-a-Rabbit' device should not be recommended – this is a more 'hit-and miss' technique compared with the 'Rodenator'. Mixes LPG with air rather than oxygen.

Note that many of the gaps in scientific knowledge regarding animal welfare impact are included in the humaneness worksheets rather than listed separately here.

12. Outputs of humaneness assessment project

Humaneness worksheets and matrices

The panel completed 60 separate humaneness assessments for 12 different species of invasive animals following the 'principles for use' and 'instructions' as outlined in the Sharp and Saunders (2008) model¹.

The results are presented in a worksheet that describes the animal welfare impact in each of five domains (Part A) and, for lethal methods, the duration and suffering associated with the mode of death (Part B). Scores are provided for Parts A and B (where applicable) and also an overall humaneness score, which is the combination of scores for Parts A and B. [A small sample of completed worksheets are include in the Appendix.](#)

For each species, the overall score for the methods assessed has also been presented in a matrix format. This provides a simplified overview of the relative humaneness of all the methods for each species. [Humaneness matrices for each species are included in the Appendix. An explanatory matrix is also included to help with interpretation of the matrices.](#)

The final versions of all completed humaneness assessment worksheets and matrices will be published on the website: feral.org.au

13. References

1. Sharp, T. & Saunders, G. (2008). *A model for assessing the relative humaneness of pest animal control methods*. (Australian Government Department of Agriculture, Fisheries and Forestry: Canberra, ACT).at <http://www.daff.gov.au/__data/assets/pdf_file/0008/929888/humaneness-pest-animals.pdf>
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4. Sharp, T. & Saunders, G. (2005). *Humane pest animal control: codes of practice and standard operating procedures*. (New South Wales Department of Primary Industries: Orange).



APPENDICES

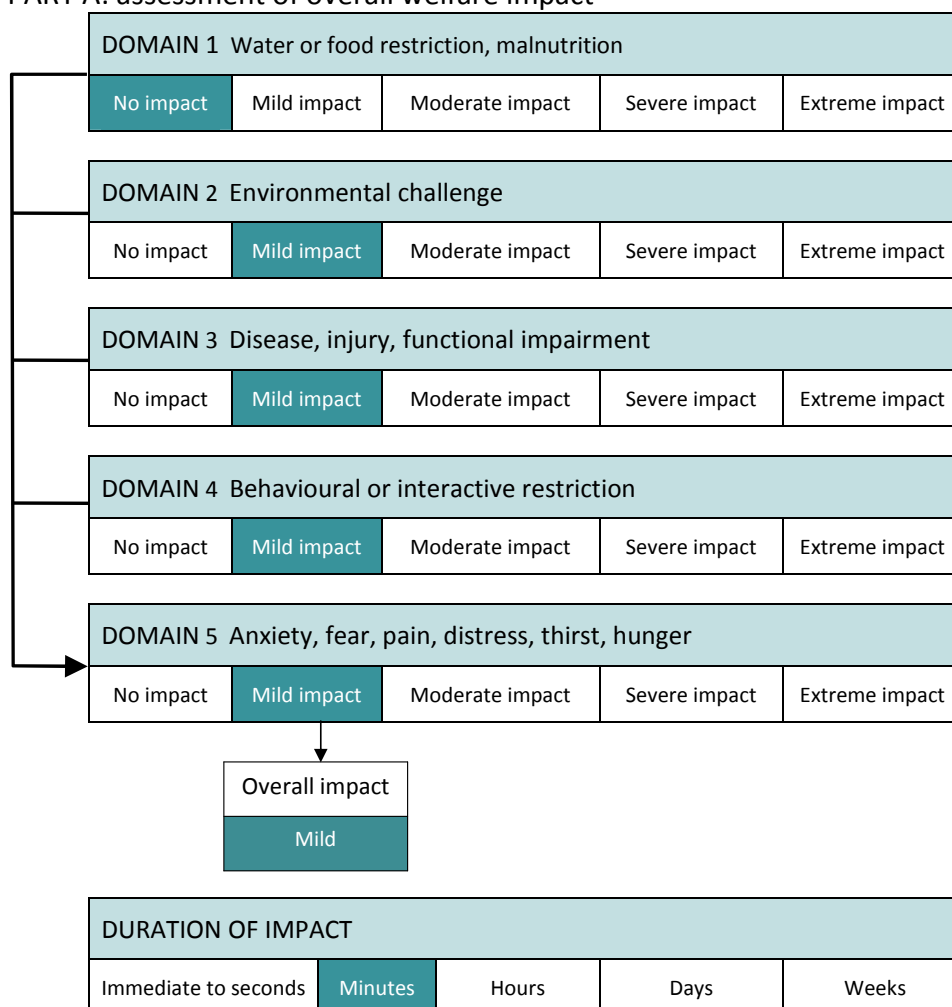
Appendix I

Control method: Ground shooting of feral donkeys

Control method: Ground shooting of feral donkeys

<p>Assumptions:</p>	<ul style="list-style-type: none"> ▪ Best practice is followed in accordance with the standard operating procedure DON001. ▪ The shooter is competent and will make accurate decisions about whether the shot can be successfully placed. ▪ Small mobs are shot often from a vehicle. The impacts were considered on the group of donkeys being targeted – the first animal would be naïve but the impact would increase with each subsequent animal. ▪ The lead jack or jenny should be shot first and the rest of the mob will then mill around it. ▪ Since donkeys will remain in close proximity to the lead animal after it has been shot and as they have relatively flat foreheads, an accurate head shot is achievable.
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PART A: assessment of overall welfare impact



Appendix I (cont'd)

Control method: Ground shooting of feral donkeys

SCORE FOR PART A:	3
Summary of evidence:	
Domain 1	No impact in this domain.
Domain 2	Mild impact arising from exercise during flight response (after at least one donkey in group has been shot).
Domain 3	Unlikely to be injured due to flight response. There is only a low risk of not being able to follow-up injured animals. Donkeys are not fast and most country is accessible.
Domain 4	The impact in this domain was graded in relation to the effect on donkeys after the first animal is shot (the first animal is naïve to behavioural impact). The disruption of the social group is likely to have an impact by affecting subsequent behaviour. Donkeys are very family-group orientated with strong maternal bonding. Lactating females stay with mob.
Domain 5	There will be some impact in this domain due to donkeys being frightened by the noise of the gunshot and also if other donkeys in the group start to panic after the first shot has been fired. However this response will be less than with horses as donkeys are less 'flighty'. If some animals in a group are not killed, the impact on the remaining animals is unknown but we assumed that removal of individuals in a group could potentially cause distress.

PART B: assessment of mode of death – head shot

Time to insensibility (minus any lag time)				
Immediate to seconds	Minutes	Hours	Days	Weeks
Level of suffering (after application of the method that causes death but before insensibility)				
No suffering	Mild suffering	Moderate suffering	Severe suffering	Extreme suffering

PART B: assessment of mode of death – chest shot

Time to insensibility (minus any lag time)				
Immediate to seconds	Minutes	Hours	Days	Weeks
Level of suffering (after application of the method that causes death but before insensibility)				
No suffering	Mild suffering	Moderate suffering	Severe suffering	Extreme suffering

Appendix I (cont'd)

Control method: Ground shooting of feral donkeys

SCORE FOR PART B:	Head shot - A Chest shot - D
Summary of evidence:	Note that frontal head shots are recommended and are more likely to be achievable than with other species.
Duration –	<p>With head shots, a properly placed shot will result in immediate insensibility^{1, 2, 3}.</p> <p>With chest shots, time to insensibility can range from seconds to a few minutes. The time to loss of consciousness and the time to death will depend on which tissues are damaged and, in particular, on the rate of blood loss and hence the rate of induction of cerebral hypoxaemia⁴. Loss of consciousness and death is likely to be quick when animals have been shot in the heart. ‘Hydrostatic shock’ (see below) may also contribute to rapid incapacitation and potentially rapid loss of consciousness with shots to the chest; however this effect seems to be variable and doesn’t occur in all instances. There are anecdotal reports that donkeys are less susceptible to shock compared to other species such as deer or horses, therefore the time to death may be longer.</p>
Suffering –	<p>When animals are rendered insensible immediately with a well-placed head shot that causes adequate destruction of brain tissue there should be no suffering¹.</p> <p>Animals that are chest shot and still conscious are likely to have a short period of suffering, though the extent of suffering will vary depending on which tissues are damaged and the rate of blood loss. During haemorrhage there is likely to be tachypnoea and hyperventilation, which, when severe, would indicate that there is a sense of breathlessness before the loss of consciousness⁴. Severe haemorrhage in humans is also associated with anxiety and confusion⁵.</p> <p>If chest shot animals are rendered insensible by the mechanism of ‘hydrostatic shock’ and they do not regain consciousness prior to death they are unlikely to suffer.</p>

Summary

CONTROL METHOD:	Ground shooting of feral donkeys
OVERALL HUMANENESS SCORE:	Head shot – 3A Chest shot – 3D
<p>Comments</p> <p>Wounding rates with ground shooting</p> <p>When animals are shot at, some will be killed outright, others will be missed and some will be wounded but not killed. Of the ones that are wounded, some will be killed by subsequent shots but some will escape to either die later or recover. Therefore to determine welfare impact we are interested in the extent of injury or wounding associated with ground shooting and the likelihood of it happening. There do not appear to be any reported wounding rates from ground shooting of feral donkeys but there have been a few studies in other species. For example:</p> <p><i>Impala</i></p> <p>A study of the night shooting of wild impala found that 93% of animals were killed instantaneously by the first shot⁶. The point of aim was the head. Of the 6.3% of animals that were wounded and timing of shots was recorded (n=31), the mean time between wounding and death was 30 seconds (maximum time 1 min 57s; minimum time 4.8s). Of a total of 990 shots fired, 74 (7.5%) missed</p>	

Assessment performed by: Humaneness Assessment Panel

Date of assessment: 11 December 2009

Last saved 20/05/2011 10:19 AM

Date file created: 13/10/2010

Page 3 of 5

Appendix I (cont'd)

Control method: Ground shooting of feral donkeys

animals completely and 57 (5.8%) resulted in animals being wounded (3 animals were wounded before dispatch). No animals escaped after wounding.

Deer

Estimates of wounding rates by deer stalkers have shown that 2% of deer escape wounded, 11% of deer required two or more shots to kill and 7% took 2-15 minutes to die.⁷

In a study to examine the effects of wound site and blood collection method on biochemical measures obtained from red deer, 84% of 69 deer were killed with a single shot and no deer escaped wounded⁸. Eleven of the deer were shot twice (and one deer was shot 3 times), the first shot usually being in the chest. Of the deer killed with one shot, 38% of stags and 80% of hinds were shot in the head or neck. When deer had been shot in the chest, they often ran a short distance. An estimate was made of the time between the first shot and the deer falling to the ground. The median time was 60 secs for the multiple shot animals and 0 secs for the single-shot.

What would be considered to be an acceptable wounding rate for ground shooting?

As a guide, for captive bolt stunning in abattoirs, the level of acceptability is that 95% of animals must be rendered insensible with one shot. An excellent score is 99%.⁹

It has been suggested that a review of deer culling by shooting is warranted when, in a cull of average size (between 80 and 120 deer), 14 to 16% of the carcasses contain more than one permanent wound tract (i.e. required more than one shot).¹⁰

For comparison with a method that is considered to be less humane than shooting – bow hunting of deer-between 12% and 48% of shot deer may escape whilst injured.⁴

Hydrostatic shock

With shooting, in addition to the damage caused by the penetrating projectile, there is scientific evidence that organs can also be damaged by the pressure wave that occurs when a projectile enters a viscous medium, a phenomenon known as 'hydrostatic shock'¹¹. Experimental studies on pigs and dogs demonstrate that a significant ballistic pressure wave reaches the brain of animals shot in an extremity such as the thigh^{12, 13, 14}. It is hypothesised that damage to the brain occurs when the pressure wave reaches the brain from the thoracic cavity via major blood vessels but could also occur via acceleration of the head or by passage of the wave via a cranial mechanism¹⁵. It is also thought that hydrostatic shock may produce incapacitation more quickly than blood loss effects, however not all bullet impacts will produce a pressure wave strong enough to cause this rapid incapacitation¹⁶.

Anecdotal reports by hunters maintain that some species are more susceptible to this shock effect than others; however no studies were found that confirmed this. However there is some speculation that, if one of the mechanisms that contribute to the effect of hydrostatic shock and subsequent damage to the brain is caused by acceleration of the head, it is possible that some animals may be more resistant to the incapacitating effects of shooting. It is recognised that animals such as head-butting ruminants appear to be more resistant to concussion than humans and are thought to have a higher acceleration threshold which could make them more resistant to traumatic brain injury not only from externally imposed forces, accelerations and blunt force trauma but also from an internal ballistic pressure wave generated by a projectile^{17, 18}.

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Page 4 of 5

Appendix I (cont'd)

Control method: Ground shooting of feral donkeys

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Appendix 2

Control method: Cage trapping of feral cats followed by killing

Control method: Cage trapping of feral cats followed by killing

Assumptions:	<ul style="list-style-type: none"> ▪ Best practice is followed in accordance with CAT002. ▪ Traps are set in the evening and checked in the morning. ▪ Efforts are made to locate and kill any kittens if lactating queen is caught. ▪ The effect on dependant young is not taken into consideration with this assessment only the impact on the target animal. ▪ Shooting is the usual method of euthanasia although lethal injection is sometimes used. With this assessment it is assumed that animals are shot or injected at site of capture. The impact will be significantly increased if animals are transported to another location for euthanasia – see separate assessment. ▪ Cage trapping is often used when cats are at high densities around human settlements e.g. around rubbish tips, camping grounds and less often when cat densities are low in areas away from human habitation.
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PART A: assessment of overall welfare impact

DOMAIN 1 Water or food restriction, malnutrition					
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact	
DOMAIN 2 Environmental challenge					
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact	
DOMAIN 3 Disease, injury, functional impairment					
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact	
DOMAIN 4 Behavioural or interactive restriction					
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact	
DOMAIN 5 Anxiety, fear, pain, distress, thirst, hunger					
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact	
DURATION OF IMPACT					
Immediate to seconds	Minutes	Hours	Days	Weeks	
↓					
Overall impact					
Mild					
SCORE FOR PART A:		4			

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 Page 1 of 3

Appendix 2 (cont'd)

Control method: Cage trapping of feral cats followed by killing

Summary of evidence:	
Domain 1	Traps are set in the evening and checked in the morning. Food bait is provided but no water.
Domain 2	Assumes traps are not set in bad weather and are placed in shaded areas.
Domain 3	There is the potential for minor injuries to be sustained, usually self-inflicted abrasions to the face ^{1,2} .
Domain 4	There will be some restraint stress but cats quickly recover from this if released. The physiological response to capture has been found to be lower in animals caught in cage traps compared with leg-hold traps ³ . In foxes, cage traps caused an increase in cortisol compared with animals that were not trapped but this was lower than individuals caught in leg-hold traps ⁴ . There will be some exertion from struggling within the trap; however this will be lower compared with animals held by leg-hold traps ⁴ . Long entrapment periods could result in disruption of natural behaviour and motivational systems ⁵ .
Domain 5	It is likely that the animal will experience an elevation in anxiety and distress whilst trapped, however evidence that animals can be recaptured may indicate that overall impact is not high or long-term ² .

PART B: assessment of mode of death – shooting (head shot)

Time to insensibility (minus any lag time)				
Immediate to seconds	Minutes	Hours	Days	Weeks
Level of suffering (after application of the method that causes death but before insensibility)				
No suffering	Mild suffering	Moderate suffering	Severe suffering	Extreme suffering

PART B: assessment of mode of death – lethal injection

Time to insensibility (minus any lag time)				
Immediate to seconds	Minutes	Hours	Days	Weeks
Level of suffering (after application of the method that causes death but before insensibility)				
No suffering	Mild suffering	Moderate suffering	Severe suffering	Extreme suffering

SCORE FOR PART B:	Shooting (head shot) - B
Summary of evidence:	
Duration –	With head shots, a properly placed shot will result in immediate insensibility ^{6,7,8}
Suffering –	The approach of a human to trapped cat will cause some distress ⁹ . A well-placed head shot which causes immediate insensibility should not cause any additional suffering.

Appendix 2 (cont'd)

Control method: Cage trapping of feral cats followed by killing

SCORE FOR PART B:	Lethal injection - D
Summary of evidence:	
Duration –	The duration will start from approach of human followed by an intramuscular injection (IM) of sedative and/or anaesthetic agent with a pole syringe. Heavy sedation/loss of consciousness occurs approx. 15 minutes afterwards.
Suffering –	The approach of a human to trapped cat will cause some distress ⁹ . Also there will be some pain associated with the IM injection via the pole syringe. The animal is then not approached again until fully sedated or unconscious. An overdose of barbiturate administered by the intravenous, intraperitoneal or intracardiac routes should cause no suffering in an anaesthetised or heavily sedated cat ⁷ .

Summary

CONTROL METHOD:	Cage trapping of feral cats followed by killing
OVERALL HUMANENESS SCORE:	Cage trapping with shooting (head shot) – 4B Cage trapping with lethal injection – 4D
Comments	

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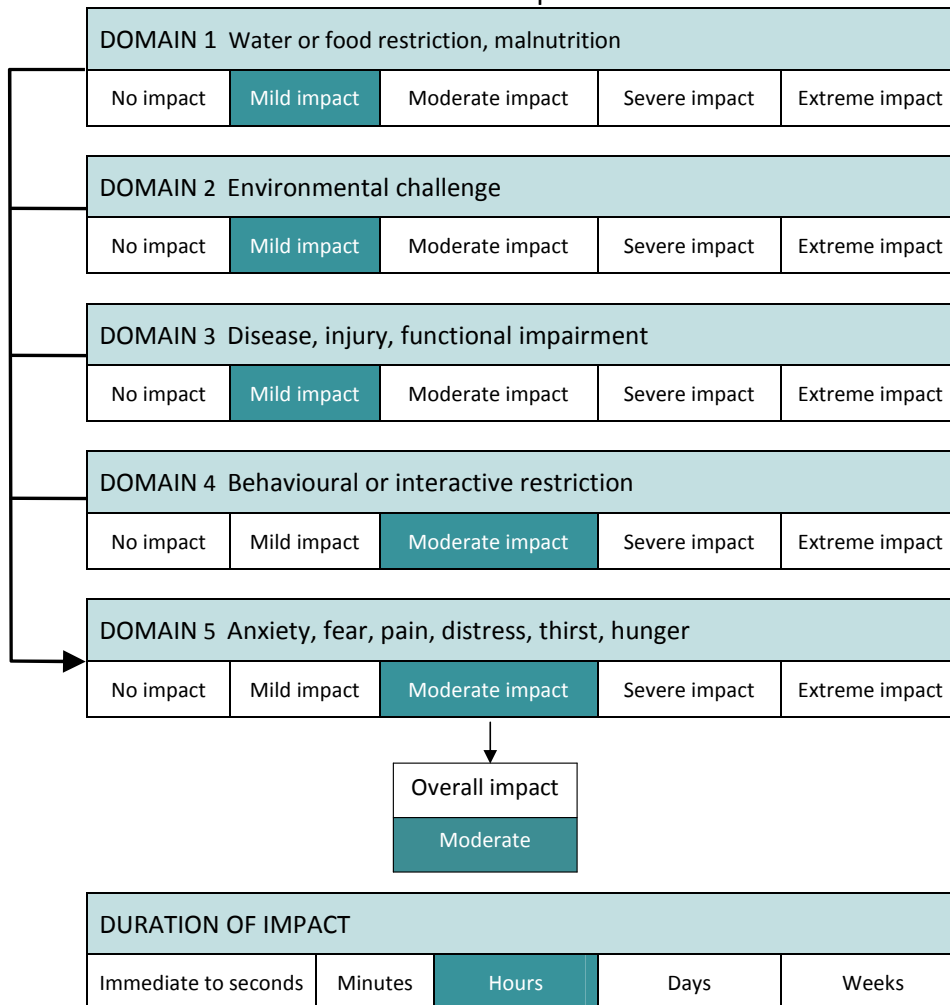
Appendix 3

Control method: Cage trapping of feral cats (with transport) followed by killing

Control method: Cage trapping of feral cats (with transport) followed by killing

Assumptions:	<ul style="list-style-type: none"> ▪ Best practice is followed in accordance with CAT002. ▪ Traps are set in the evening and checked in the morning. ▪ Efforts are made to locate and kill any kittens if lactating queen is caught. ▪ Shooting is the usual method of euthanasia although lethal injection is sometimes used. In some situations it is necessary to transport the trapped animals to another location for euthanasia. ▪ Cage trapping is often used when cats are at high densities around human settlements e.g. around rubbish tips, camping grounds and less often when cat densities are low in areas away from human habitation.
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PART A: assessment of overall welfare impact



Appendix 3 (cont'd)

Control method: Cage trapping of feral cats (with transport) followed by killing

SCORE FOR PART A:	5
Summary of evidence:	Note that the cat will spend additional time in the trap compared with being shot at the site of capture but this is still likely to be less than 24 hours.
Domain 1	Traps are set in the evening and checked in the morning. Food bait is provided but no water.
Domain 2	Assumes traps are not set in bad weather and are placed in shaded areas.
Domain 3	There is the potential for minor injuries to be sustained, usually self-inflicted abrasions to the face ^{1,2} .
Domain 4	There will be some restraint stress but cats quickly recover from this if released. The physiological response to capture has been found to be lower in animals caught in cage traps compared with leg-hold traps ³ . In foxes, cage traps caused an increase in cortisol compared with animals that were not trapped but this was lower than individuals caught in leg-hold traps ⁴ . There will be some exertion from struggling within the trap; however this will be lower compared with animals held by leg-hold traps ⁴ . Long entrapment periods could result in disruption of natural behaviour and motivational systems ⁵ . Although the cage will be covered, transporting the cat to another site will cause additional stress
Domain 5	It is likely that the animal will experience an elevation in anxiety and distress during trapping and transportation ⁶ . Evidence that animals can be recaptured in cage traps may indicate that overall the impact of trapping alone is not high or long-term ² .

PART B: assessment of mode of death – shooting (head shot)

Time to insensibility (minus any lag time)				
Immediate to seconds	Minutes	Hours	Days	Weeks
Level of suffering (after application of the method that causes death but before insensibility)				
No suffering	Mild suffering	Moderate suffering	Severe suffering	Extreme suffering

PART B: assessment of mode of death – lethal injection

Time to insensibility (minus any lag time)				
Immediate to seconds	Minutes	Hours	Days	Weeks
Level of suffering (after application of the method that causes death but before insensibility)				
No suffering	Mild suffering	Moderate suffering	Severe suffering	Extreme suffering

SCORE FOR PART B:	Shooting (head shot) - B
Summary of evidence:	
Duration –	With head shots, a properly placed shot will result in immediate insensibility ^{7,8,9} .

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 Page 2 of 3

Appendix 3 (cont'd)

Control method: Cage trapping of feral cats (with transport) followed by killing

Suffering –	The approach of a human to a trapped cat will cause some distress ¹⁰ . A well-placed head shot which causes immediate insensibility should not cause any additional suffering.
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SCORE FOR PART B:	Lethal injection - D
Summary of evidence:	
Duration –	The duration will start from approach of human followed by an intramuscular injection (IM) of sedative and/or anaesthetic agent administered with the aid of a crush/squeeze cage or with a pole syringe. Heavy sedation/loss of consciousness occurs approx. 15 minutes afterwards.
Suffering –	The approach of a human to a trapped cat will cause some distress ¹⁰ . Also there will be some pain associated with the IM injection. The animal is then not approached again until fully sedated or unconscious. An overdose of barbiturate administered by the intravenous, intraperitoneal or intracardiac routes should cause no suffering in an anesthetised or heavily sedated cat ⁸ .

Summary

CONTROL METHOD:	Cage trapping of feral cats (with transport) followed by killing
OVERALL HUMANENESS SCORE:	Cage trapping with shooting (head shot) – 5B Cage trapping with lethal injection – 5D

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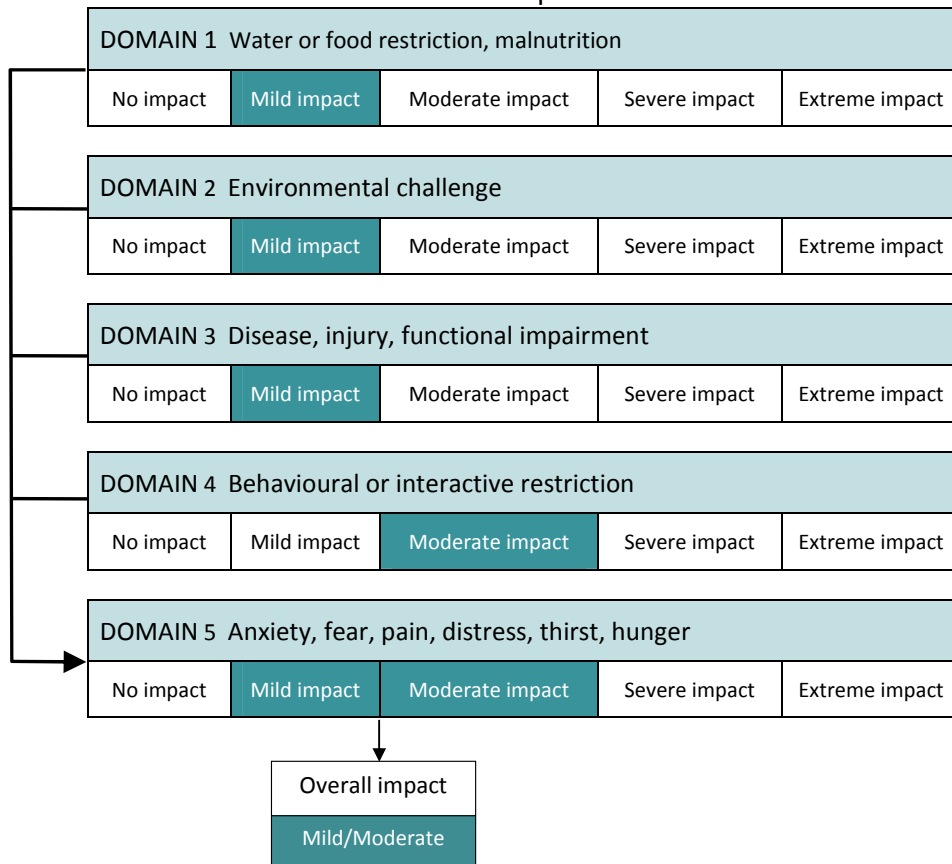
Appendix 4

Control method: Mustering of feral camels

Control method: Mustering of feral camels

<p>Assumptions:</p>	<ul style="list-style-type: none"> ▪ Best practice is followed in accordance with the standard operating procedure CAM003. ▪ The assessment applies from the beginning of contact with the herd to when they are contained in yards (i.e. up to the point of shutting the gate). It does not cover actions after arrival in yards such as separating different classes of camels, as these will vary depending on the fate of camels (e.g. transported for slaughter or relocation, shooting in yards). ▪ Mustering is completed within daylight hours and that feed and water is provided on completion of mustering according to the standard operating procedure. ▪ The assessment of the impact of mustering should not be considered in isolation from subsequent stages (i.e. the period held in yards, drafting, shooting or transporting). The cumulative effects of these stages will compound welfare impact. Assessments of these stages are beyond the scope of the current assessment. ▪ Aerial and ground mustering are often used in combination so they are considered together here.
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PART A: assessment of overall welfare impact



Appendix 4 (cont'd)

Control method: Mustering of feral camels

DURATION OF IMPACT				
Immediate to seconds	Minutes	Hours	Days	Weeks

SCORE FOR PART A:	4-5
Summary of evidence:	
Domain 1	There is some opportunity to feed on the way. The camels are being moved along within their normal environment and range so resources are available to them as they would be in absence of mustering. There will be some water loss with increasing exercise.
Domain 2	As above. Within normal ranges.
Domain 3	Assumes mustering is carried out without placing additional stress (i.e. that the pace is appropriate). Less susceptible to flightiness than other species during mustering. There is the potential for injuries to occur during funnelling and yarding stages.
Domain 4	Mixing of different groups is not a problem although bulls in rut must be either left out of the muster or, if inadvertently captured, must be kept separate from other animals until they can be released or euthanased ¹ . The camels are not moving as fast as during aerial shooting. The most stressful stage of the procedure will be when camels are channelled into the yards.
Domain 5	Assuming that impact is measured up to when the gates are shut, camels are likely to experience mild to moderate levels of anxiety and fear as they are being driven into yards.

PART B: assessment of mode of death

Not performed – non-lethal method

Summary

CONTROL METHOD:	Mustering of feral camels
OVERALL HUMANENESS SCORE:	4 - 5
Comments	

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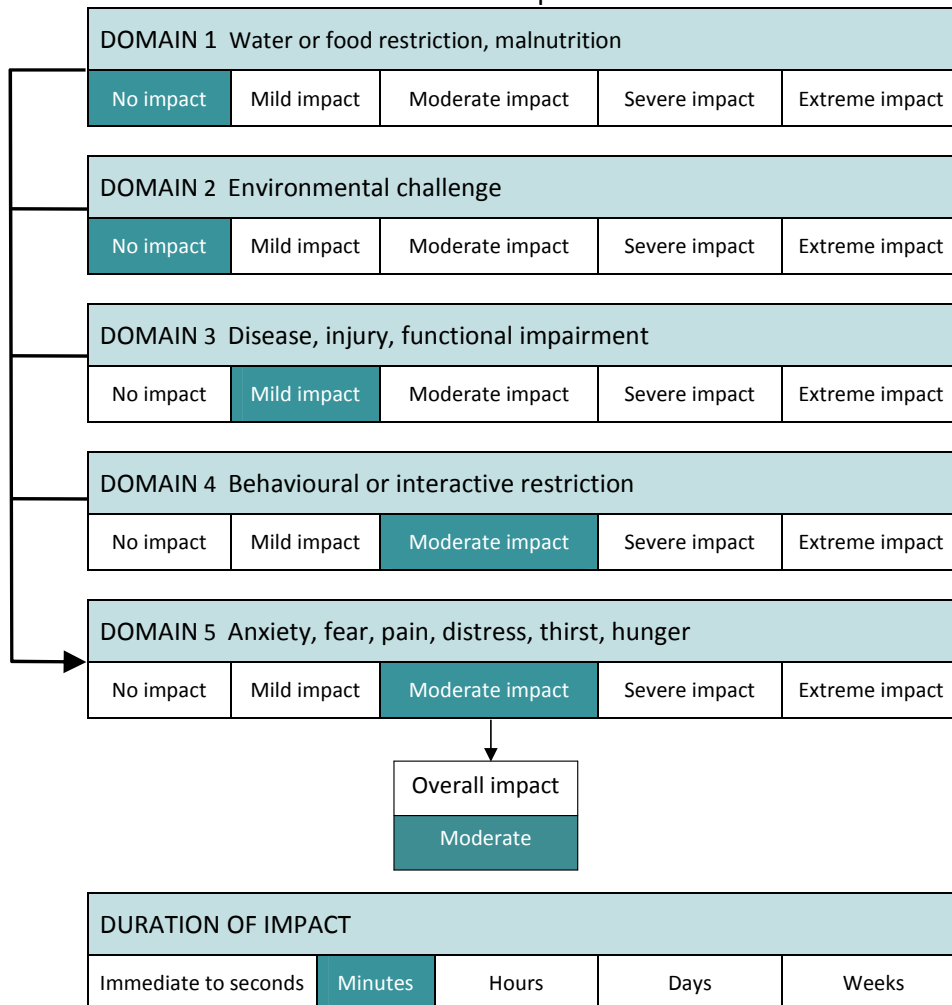
Appendix 5

Control method: Aerial shooting of feral goats

Control method: Aerial shooting of feral goats

Assumptions:	<ul style="list-style-type: none"> ▪ Best practice is followed in accordance with the standard operating procedure GOA002. ▪ The shooter is competent and will make accurate decisions about whether the shot can be successfully placed. Competency also applies to the pilot who is required to provide the optimum target presentation for the shooter. ▪ For aerial shooting of goats, chest shots are preferred over head shots (because they are easier to achieve with a moving animal), however there is a provision for an initial head shot if presentation of the animal and other conditions are ideal.
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PART A: assessment of overall welfare impact



Appendix 5 (cont'd)

Control method: Aerial shooting of feral goats

SCORE FOR PART A:	4
Summary of evidence:	
Domain 1	No impact in this domain
Domain 2	No impact in this domain
Domain 3	There may be mild impact due to the probability of injuries from shooting occurring. Goats were considered to be less flighty than other species (e.g. horses, deer) so this unlikely to be a cause of increased injury ¹ . The wounding rate may be higher with aerial shooting (compared with ground shooting) because animals are shot whilst they are moving, however the range is likely to be much shorter and any wounded animals can be followed up quickly.
Domain 4	There will be a short-term restriction of behaviour since the animal will be in a heightened state of alertness due to the presence of the helicopter. The SOP recommends that aerial culling is not performed when females are kidding. Females leave the group to give birth in isolated and/or sheltered locations and are therefore less likely to be seen. Also, if females are targeted, it may be difficult to find their young – approximately half of mothers tend to stay in the vicinity of the newborn kid, while others leave them alone to forage (stayers and leavers) ² . If kids are bigger, they will be with the mother.
Domain 5	The presence of the helicopter will cause increased alertness and fear with a subsequent escape response that includes running and changing the size and composition of groups ^{3,1} . With aerial shooting it is more likely that all animals in a group will be shot, however, if individuals are left behind they will be isolated from their usual social group, and are likely to experience distress until they find another group to associate with ⁴ .

PART B: assessment of mode of death - chest shot

Time to insensibility (minus any lag time)				
Immediate to seconds	Minutes	Hours	Days	Weeks
Level of suffering (after application of the method that causes death but before insensibility)				
No suffering	Mild suffering	Moderate suffering	Severe suffering	Extreme suffering

SCORE FOR PART B:	C
Summary of evidence:	

Appendix 5 (cont'd)

Control method: Aerial shooting of feral goats

Duration –	<p>With chest shots, time to insensibility can range from seconds to a few minutes. The time to loss of consciousness and the time to death will depend on which tissues are damaged and, in particular, on the rate of blood loss and hence the rate of induction of cerebral hypoxaemia⁵. Loss of consciousness and death is likely to be quick when animals have been shot in the heart. ‘Hydrostatic shock’ (see below) may also contribute to rapid incapacitation and potentially rapid loss of consciousness with shots to the chest; however this effect seems to be variable and doesn’t occur in all instances. ‘Double tap’ shots (two quick shots in succession) are always used with chest shots.</p> <p>With head shots, a properly placed shot will result in immediate insensibility^{6,7,8}. A follow-up shot to ensure death (‘insurance shot’) is required in all cases.</p>
Suffering –	<p>Animals that are chest shot and still conscious are likely to have a short period of suffering, though the extent of suffering will vary depending on which tissues are damaged and the rate of blood loss. During haemorrhage there is likely to be tachypnoea and hyperventilation, which, when severe, would indicate that there is a sense of breathlessness before the loss of consciousness⁵. Severe haemorrhage in humans is also associated with anxiety and confusion⁹.</p> <p>If chest shot animals are rendered insensible by the mechanism of ‘hydrostatic shock’ and they do not regain consciousness prior to death they are unlikely to suffer.</p> <p>When animals are rendered insensible immediately with a well-placed head shot that causes adequate destruction of brain tissue there should be no suffering⁶.</p>

Summary

CONTROL METHOD:	Aerial shooting of feral goats
OVERALL HUMANENESS SCORE:	4C
<p>Comments</p> <p>Hydrostatic shock</p> <p>With shooting, in addition to the damage caused by the penetrating projectile, there is scientific evidence that organs can also be damaged by the pressure wave that occurs when a projectile enters a viscous medium, a phenomenon known as ‘hydrostatic shock’¹⁰. Experimental studies on pigs and dogs demonstrate that a significant ballistic pressure wave reaches the brain of animals shot in an extremity such as the thigh^{11,12,13}. It is hypothesised that damage to the brain occurs when the pressure wave reaches the brain from the thoracic cavity via major blood vessels but could also occur via acceleration of the head or by passage of the wave via a cranial mechanism¹⁴. It is also thought that hydrostatic shock may produce incapacitation more quickly than blood loss effects, however not all bullet impacts will produce a pressure wave strong enough to cause this rapid incapacitation¹⁵.</p> <p>Anecdotal reports by hunters maintain that some species are more susceptible to this shock effect than others; however no studies were found that confirmed this. However there is some speculation that, if one of the mechanisms that contribute to the effect of hydrostatic shock and subsequent damage to the brain is caused by acceleration of the head, it is possible that some animals may be more resistant to the incapacitating effects of shooting. It is recognised that animals such as head-butting ruminants appear to be more resistant to concussion than humans and are thought to have a higher acceleration threshold which could make them more resistant to traumatic brain injury not only from externally imposed forces, accelerations and blunt force trauma but also from an internal ballistic pressure wave generated by a projectile^{16,17}.</p>	

Assessment performed by: Humaneness Assessment Panel
 Date of assessment: 12-13 November 2009
 Last saved 20/05/2011 12:18 PM

Date file created: 17/09/2010
 Page 3 of 5

Appendix 5 (cont'd)

Control method: Aerial shooting of feral goats

Wounding rates with aerial shooting

Statistics on wounding rates for aerial culling of animals are not readily available. Information provided by Tim Fraser, Team Leader of the SA DEH aerial shooting team states that "Animals killed instantly by my team would be better than 90 % and wounded animals less than 5 %". He also explained that "In most cases an experienced shooter knows as he/she touches off the shot whether it is perfectly placed or not, and if there is any doubt, second or even third shots are on there way instantly".

One published account of wounding rates during an aerial shooting cull of feral horses was found. This was in a report on the cull of feral horses in Guy Fawkes River National Park in 2000 prepared by English¹⁸. The cull occurred between 22 and 24 October 2000, during which time 606 horses were shot. One horse was found alive on 1st November despite having 2 bullet wounds in the killing zone. The report author states that 'many horses received 4 or more shots, but the great majority were killed by the first or second shot' (the actual numbers are not given in the report). Thirty-nine horses were examined after the cull on 2 and 10 November, and also 67 horses were examined by a veterinarian, and 'no evidence of indiscriminate killing away from the target zone was found'.

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Assessment performed by: Humaneness Assessment Panel

Date of assessment: 12-13 November 2009

Last saved 20/05/2011 12:18 PM

Date file created: 17/09/2010

Page 4 of 5

Appendix 5 (cont'd)

Control method: Aerial shooting of feral goats

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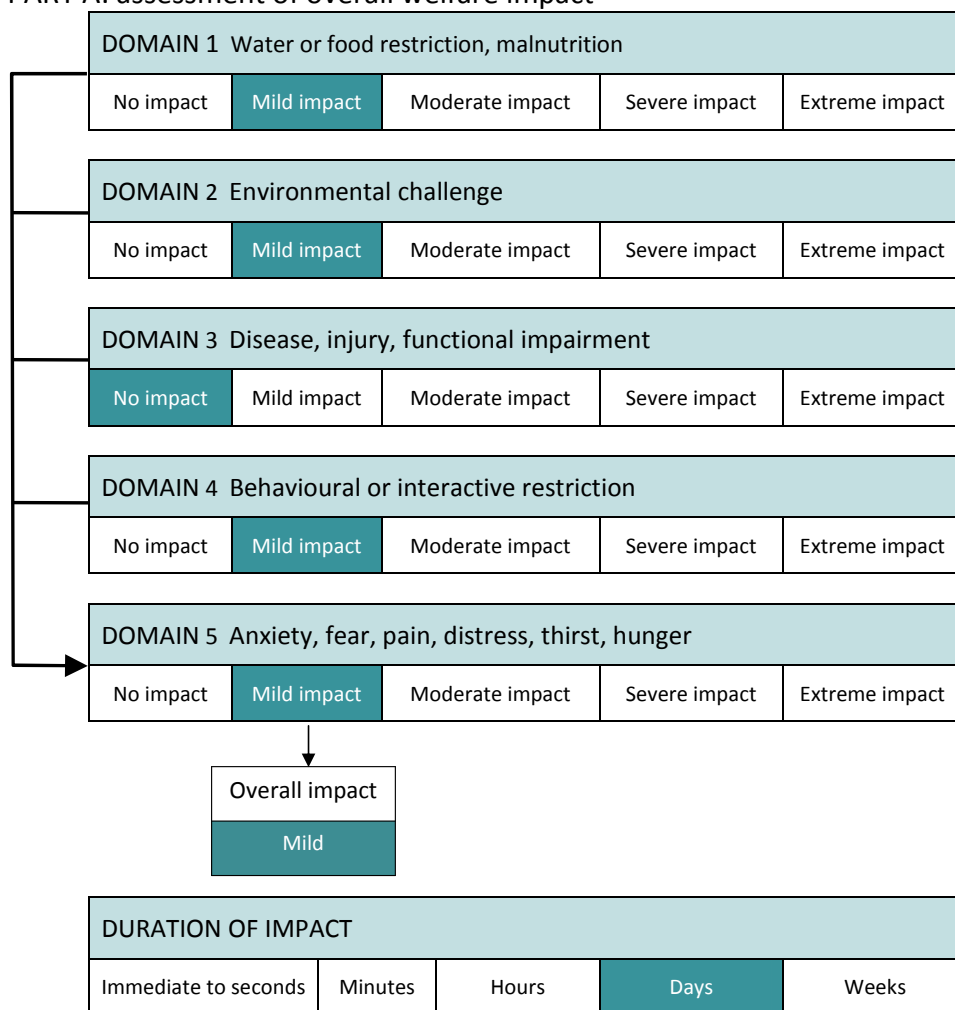
Appendix 6

Control method: Trapping of feral goats

Control method: Trapping of feral goats

<p>Assumptions:</p>	<ul style="list-style-type: none"> ▪ Best practice is followed in accordance with the standard operating procedure GOA004. ▪ This assessment applies from the time of entering the trap until traps are checked and the goats moved to the next stage (which could be any combination of holding, drafting and transporting, shooting). ▪ The impact of trapping should not be considered in isolation from subsequent stages (i.e. drafting and transporting, shooting). The cumulative effects of these stages will compound welfare impact. Assessments of these stages are beyond the scope of the current assessment. ▪ Traps are checked daily and that water is provided. Although preferred, it is not always possible to provide access to food or shade. Removing trapped goats from the trap yard every day reduces overcrowding and associated stresses and allows shy animals access to the water point. ▪ The traps could be operating over several days to allow goats to accumulate in the confined area.
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PART A: assessment of overall welfare impact



Assessment performed by: Humaneness Assessment Panel
 Date of assessment: 12-13 November 2009
 Last saved 2/05/2011 4:41 PM

Date file created: 17/09/2010
 Page 1 of 2

Appendix 6 (cont'd)

Control method: Trapping of feral goats

SCORE FOR PART A:	5
Summary of evidence:	
Domain 1	No impact on water but food restriction is possible. If there is a suitable period of training to allow animals to become familiar with the trap yard and accustomed to drinking from the water source there should be no problems with animals accessing sufficient water. If animals are reluctant to enter a trap there are anecdotal reports that they will leave to find another water source.
Domain 2	Dependent on whether shade provided. Not always possible. Goats are relatively tolerant of heat.
Domain 3	The animals are not under pressure, so injuries are not likely. Young kids could get trampled underfoot especially when the adult animals are stressed (e.g. in the presence of humans and working dogs, if trap becomes overcrowded).
Domain 4	No problem with mixing groups of goats compared with other species. Although the goats are contained they usually do not appear to be agitated by this, however some aspects of their behaviour will be restricted. Dependent young will get separated if they do not accompany their mother into the trap and could die of starvation ¹ , although some trap designs allow the movement of kids in and out of the trap.
Domain 5	When goats are trapped in a yard that has been well planned and well constructed using suitable materials they appear to mostly remain unstressed even where several small flocks with their own bucks are mixed together or when they are confined with other livestock species or non-target animals (e.g. macropods, emus) ¹ . Goats are likely to experience mild levels of apprehension, anxiety/fear as they are being moved into holding pen or loaded onto truck. Previous human contact would be limited.

PART B: assessment of mode of death

Not performed – non-lethal method

Summary

CONTROL METHOD:	Trapping of feral goats
OVERALL HUMANENESS SCORE:	5
Comments	

Bibliography

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Assessment performed by: Humaneness Assessment Panel
Date of assessment: 12-13 November 2009
Last saved 2/05/2011 4:41 PM

Date file created: 17/09/2010
Page 2 of 2

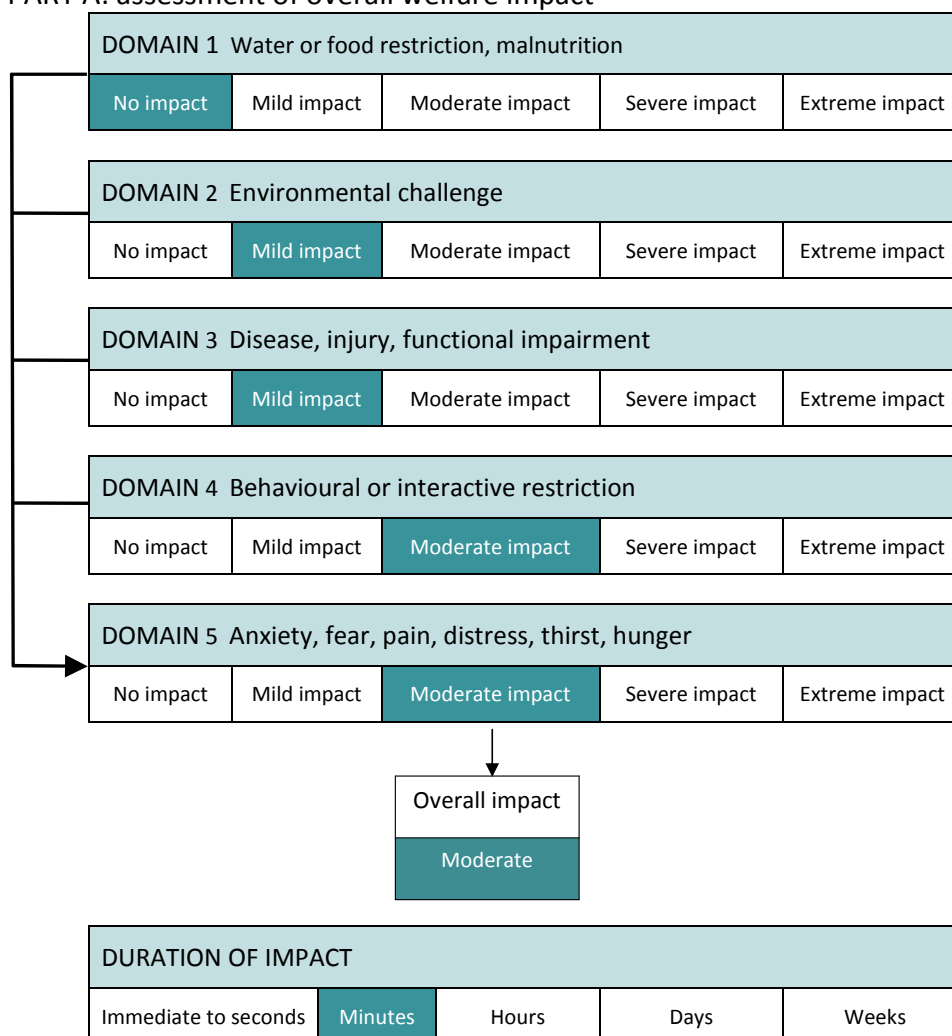
Appendix 7

Control method: Aerial shooting of feral horses

Control method: Aerial shooting of feral horses

Assumptions:	<ul style="list-style-type: none"> ▪ Best practice is followed in accordance with the standard operating procedure HOR002. ▪ The shooter is competent and will make accurate decisions about whether the shot can be successfully placed. Competency also applies to the pilot who is required to provide the optimum target presentation for the shooter. ▪ For aerial shooting, chest shots are preferred over head shots (because they are easier to achieve with a moving animal), however there is a provision for an initial head shot if presentation of the animal and other conditions are ideal.
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PART A: assessment of overall welfare impact



Appendix 7 (cont'd)

Control method: Aerial shooting of feral horses

SCORE FOR PART A:	4
Summary of evidence:	Note: The decision on impact grades reported here are those that were reached by the majority of the panel. Some of the domains were graded higher by one of the invited panel members. These assessments were done at the first meeting of the panel, at subsequent meetings consensus was reached on all impact grades.
Domain 1	No impact in this domain
Domain 2	There is less opportunity to move away from the shooter compared with ground shooting. Exercise challenge is increased as there is likely to be a period of pursuit before being shot.
Domain 3	There is some potential for injury during helicopter pursuit. The wounding rate may be higher with aerial shooting (compared with ground shooting) because animals are shot whilst they are moving, however the range is likely to be much shorter and any wounded animals can be followed up quickly.
Domain 4	There will be a restriction of behaviour since there is no escape for the animal that is being pursued by the helicopter. The long-term effect on the behaviour of any animals that escape and are not killed is unknown.
Domain 5	The presence of the helicopter will induce an escape response that includes running and changing the size and composition of groups ¹ .

PART B: assessment of mode of death

Time to insensibility (minus any lag time)				
Immediate to seconds	Minutes	Hours	Days	Weeks
Level of suffering (after application of the method that causes death but before insensibility)				
No suffering	Mild suffering	Moderate suffering	Severe suffering	Extreme suffering

SCORE FOR PART B:	C
Summary of evidence:	
Duration –	<p>With chest shots, time to insensibility can range from seconds to a few minutes. The time to loss of consciousness and the time to death will depend on which tissues are damaged and, in particular, on the rate of blood loss and hence the rate of induction of cerebral hypoxaemia². Loss of consciousness and death are likely to be quick when animals have been shot in the heart. ‘Hydrostatic shock’ (see below) may also contribute to rapid incapacitation and potentially rapid loss of consciousness with shots to the chest; however this effect seems to be variable and does not occur in all instances. ‘Double tap’ shots (two quick shots in succession) are always used with chest shots.</p> <p>With head shots, a properly placed shot will result in immediate insensibility^{3,4,5}. A follow-up shot to ensure death (‘insurance shot’) is required in all cases.</p>

Assessment performed by: Humaneness Assessment Panel
Date of assessment: 24 July 2009
Last saved 20/05/2011 12:16 PM

Date file created: 26/08/2010
Page 2 of 4

Appendix 7 (cont'd)

Control method: Aerial shooting of feral horses

Suffering –	<p>Animals that are chest shot and still conscious are likely to have a short period of suffering, though the extent of suffering will vary depending on which tissues are damaged and the rate of blood loss. During haemorrhage there is likely to be tachypnoea and hyperventilation, which, when severe, would indicate that there is a sense of breathlessness before the loss of consciousness². Severe haemorrhage in humans is also associated with anxiety and confusion⁶.</p> <p>If chest shot animals are rendered insensible by the mechanism of 'hydrostatic shock' and they do not regain consciousness prior to death they are unlikely to suffer.</p> <p>When animals are rendered insensible immediately with a well-placed head shot that causes adequate destruction of brain tissue there should be no suffering³.</p>
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Summary

CONTROL METHOD:	Aerial shooting of feral horses
OVERALL HUMANENESS SCORE:	4C
<p>Comments</p> <p>Wounding rates with aerial shooting</p> <p>Statistics on wounding rates for aerial culling of animals are not readily available. Information provided by Tim Fraser, Team Leader of the SA DEH aerial shooting team states that "Animals killed instantly by my team would be better than 90 % and wounded animals less than 5 %". He also explained that "In most cases an experienced shooter knows as he/she touches off the shot whether it is perfectly placed or not, and if there is any doubt, second or even third shots are on their way instantly".</p> <p>One published account of wounding rates during an aerial shooting cull of feral horses was found. This was in a report on the cull of feral horses in Guy Fawkes River National Park in 2000 prepared by English⁷. The cull occurred between 22 and 24 October 2000, during which time 606 horses were shot. One horse was found alive on 1st November despite having 2 bullet wounds in the killing zone. The report author states that 'many horses received 4 or more shots, but the great majority were killed by the first or second shot' (the actual numbers are not given in the report). Thirty-nine horses were examined after the cull on 2 and 10 November, and also 67 horses were examined by a veterinarian, and 'no evidence of indiscriminate killing away from the target zone was found'.</p> <p>Response to helicopter</p> <p>It was noted that there is limited knowledge on the short-term behavioural and physiological responses of horses to the presence of a helicopter. The study by Linklater¹ describes the flight response of running in the context of affecting the accuracy and precision of helicopter counts. The horses were seen to run for up to 2.75 km before leaving the ground observers view.</p> <p>Hydrostatic shock</p> <p>With shooting, in addition to the damage caused by the penetrating projectile, there is scientific evidence that organs can also be damaged by the pressure wave that occurs when a projectile enters a viscous medium, a phenomenon known as 'hydrostatic shock'⁸. Experimental studies on pigs and dogs demonstrate that a significant ballistic pressure wave reaches the brain of animals shot in an extremity such as the thigh^{9,10,11}. It is hypothesised that damage to the brain occurs when the pressure wave reaches the brain from the thoracic cavity via major blood vessels but could also occur via acceleration of the head or by passage of the wave via a cranial mechanism¹². It is also thought that hydrostatic shock may produce incapacitation more quickly than blood loss effects, however not all bullet impacts will produce a pressure wave strong enough to cause this rapid incapacitation¹³.</p> <p>Anecdotal reports by hunters maintain that some species are more susceptible to this shock effect</p>	

Assessment performed by: Humaneness Assessment Panel

Date of assessment: 24 July 2009

Last saved 20/05/2011 12:16 PM

Date file created: 26/08/2010

Page 3 of 4

Appendix 7 (cont'd)

Control method: Aerial shooting of feral horses

than others; however no studies were found that confirmed this. However there is some speculation that, if one of the mechanisms that contribute to the effect of hydrostatic shock and subsequent damage to the brain is caused by acceleration of the head, it is possible that some animals may be more resistant to the incapacitating effects of shooting. It is recognised that animals such as head-butting ruminants appear to be more resistant to concussion than humans and are thought to have a higher acceleration threshold which could make them more resistant to traumatic brain injury not only from externally imposed forces, accelerations and blunt force trauma but also from an internal ballistic pressure wave generated by a projectile^{14,15}.

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Appendix 8

Control method: Baiting of foxes with 1080

Control method: Baiting of foxes with 1080

<p>Assumptions:</p>	<ul style="list-style-type: none"> ▪ There is no difference in welfare impact between ground and aerial baiting so they are assessed here together. ▪ Best practice is followed in accordance with the standard operating procedures FOX001 and FOX002. ▪ Assumes that baiting is avoided during whelping periods in accordance with the SOP.
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PART A: assessment of overall welfare impact

DOMAIN 1 Water or food restriction, malnutrition					
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact	
DOMAIN 2 Environmental challenge					
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact	
DOMAIN 3 Disease, injury, functional impairment					
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact	
DOMAIN 4 Behavioural or interactive restriction					
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact	
DOMAIN 5 Anxiety, fear, pain, distress, thirst, hunger					
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact	
↓					
Overall impact					
No impact					
DURATION OF IMPACT					
Immediate to seconds	Minutes	Hours	Days	Weeks	

Appendix 8 (cont'd)

Control method: Baiting of foxes with 1080

SCORE FOR PART A:	1
Summary of evidence:	Note that Part A of the assessment examines the 'impact on the animal prior to the action that causes death'. Part B then looks at the 'actual mode of death' and the 'extent and duration of suffering caused'. With ingestion of lethal toxic baits there is usually or no impact in Part A.
Domain 1	No impact in this domain.
Domain 2	No impact in this domain.
Domain 3	No impact in this domain.
Domain 4	No impact in this domain.
Domain 5	No impact in this domain.

PART B: assessment of mode of death

Time to insensibility (minus any lag time)				
Immediate to seconds	Minutes	Hours	Days	Weeks
Level of suffering (after application of the method that causes death but before insensibility)				
No suffering	Mild suffering	Moderate suffering	Severe suffering	Extreme suffering

SCORE FOR PART B:	
Summary of evidence:	
Duration –	<p>After a fox has ingested a bait containing 1080 there is a latent period of around 30 minutes to 3 hours before initial signs such as hyperexcitability, vocalisation, manic running and retching are observed. Signs of central nervous system disturbance including collapse, convulsions and tetanic spasms, then follow. Death occurs usually about two hours after the onset of clinical signs.</p> <p>A study involving oral dosing of dingoes with 1080, recorded latent periods of 4.8-14.6 hours and time until death in the range of 5.3-10.8 hours¹. In an experimental study of foxes dosed with 1080 in meat baits, there was a mean time of 4.05 hours between dosage and onset of clinical signs and a mean of 1.57 hours from onset of clinical signs until death².</p>

Appendix 8 (cont'd)

Control method: Baiting of foxes with 1080

Suffering –	<p>The latent period is likely to be associated with minimal pain or distress^{3,2,4}. After the onset of clinical signs when animals are retching, displaying manic running and there is little or no CNS disturbance, it is likely that they will suffer and could experience distress, confusion, anxiety and pain².</p> <p>In the later stages, when severe CNS dysfunction has developed, it is unknown if animals are perceiving pain. The objective assessment of pain by an observer is difficult since CNS disruption appears to alter the normal behavioural indicators of pain². Also, perception of pain by the animal requires that it is conscious⁵. With 1080 poisoning it is difficult to assess if animals are conscious after collapse and during convulsive episodes³. During periods of prolonged convulsions it is possible that animals are lucid between fits. If animals <i>are</i> conscious during the convulsive episodes or if they become conscious afterwards it is possible that they may experience pain and/or anxiety.</p> <p>There is also potential for injuries to occur after the appearance of clinical signs.</p>
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Summary

CONTROL METHOD:	Baiting of foxes with 1080
OVERALL HUMANENESS SCORE:	1E-F
<p>Comments</p> <p>In human cases of 1080 poisoning, initial symptoms include nausea, vomiting and abdominal pain followed by anxiety, agitation, muscle spasm, stupor, seizure and coma. Respiratory distress is also prevalent in fatal cases⁶.</p>	

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Appendix 9

Control method: Trapping of pest birds using net traps

Control method: Trapping of pest birds using net traps

Assumptions:	<ul style="list-style-type: none"> ▪ Best practice is followed in accordance with BIR002. ▪ Birds captured in net traps are removed quickly. Birds removed from traps later will experience more stress than birds removed earlier. ▪ Trap size and design will vary depending on the species of bird being trapped. ▪ Handling will reduce the humaneness of the killing method. ▪ This method includes net traps such as pull nets (also known as single clap nets or book traps). It does not include mist nets which are used to capture birds for research rather than as a control method.
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PART A: assessment of overall welfare impact

DOMAIN 1 Water or food restriction, malnutrition					
	No impact	Mild impact	Moderate impact	Severe impact	Extreme impact
DOMAIN 2 Environmental challenge					
	No impact	Mild impact	Moderate impact	Severe impact	Extreme impact
DOMAIN 3 Disease, injury, functional impairment					
	No impact	Mild impact	Moderate impact	Severe impact	Extreme impact
DOMAIN 4 Behavioural or interactive restriction					
	No impact	Mild impact	Moderate impact	Severe impact	Extreme impact
DOMAIN 5 Anxiety, fear, pain, distress, thirst, hunger					
→	No impact	Mild impact	Moderate impact	Severe impact	Extreme impact
↓					
Overall impact					
Moderate					
DURATION OF IMPACT					
Immediate to seconds	Minutes	Hours	Days	Weeks	
SCORE FOR PART A:		4			
Summary of evidence:					
Domain 1		No impact in this domain.			

Assessment performed by: Humaneness Assessment Panel
 Date of assessment: 10-11 December 2009
 Last saved 20/05/2011 11:36 AM

Date file created: 23/09/2010
 Page 1 of 6

Appendix 9 (cont'd)

Control method: Trapping of pest birds using net traps

Domain 2	No impact in this domain.
Domain 3	There is a risk of injuries such as wing breaks as birds can get entangled in the net. Birds also have to be directly handled to be removed which increases the risk of injury.
Domain 4	Bird movement is restricted by the net. The birds are also being restrained during handling as they are removed from the net.
Domain 5	Captured birds are likely to experience fear and distress whilst in the net and especially during handling. With this method all trapped birds would be removed from the net within minutes.

PART B: assessment of mode of death – Carbon dioxide (CO₂) (with handling)

Time to insensibility (minus any lag time)				
Immediate to seconds	Minutes	Hours	Days	Weeks
Level of suffering (after application of the method that causes death but before insensibility)				
No suffering	Mild suffering	Moderate suffering	Severe suffering	Extreme suffering

SCORE FOR PART B:	CO ₂ with handling - D
Summary of evidence:	Note: Compressed CO ₂ gas in cylinders is the only recommended source of CO ₂ because the inflow to the chamber can be regulated precisely ¹ .
Duration –	The time to loss of consciousness depends on how the carbon dioxide is administered. If the birds are placed in a chamber that is pre-filled with a high concentration of CO ₂ (above 50%), loss of consciousness will be quicker (around 38 seconds) than placing the animals in a chamber and then increasing the concentration of CO ₂ (by 20% chamber volume per minute), (around 156 seconds), however placing animals in a pre-filled chamber causes pain, which is potentially severe ² . Handling will also increase the duration of the method.
Suffering –	<p>If animals are placed in a chamber containing a high concentration of CO₂ (above 50%) they will experience at least 10-15 seconds of pain in the mucosa of the upper airways before they lose consciousness. This method is therefore not recommended.</p> <p>If the rising concentration technique (i.e. introducing the CO₂ into the top of the chamber at a flow rate of 20% chamber volume per minute) is used there should not be any pain but the animals will find it aversive at a certain level and may experience distress, discomfort and dyspnoea ('air hunger')². This method involves physical handling so birds will also suffer from some fear and distress.</p>

PART B: assessment of mode of death – Carbon dioxide (CO₂) (without handling)

Time to insensibility (minus any lag time)				
Immediate to seconds	Minutes	Hours	Days	Weeks

Assessment performed by: Humaneness Assessment Panel
 Date of assessment: 10-11 December 2009
 Last saved 20/05/2011 11:36 AM

Date file created: 23/09/2010
 Page 2 of 6

Appendix 9 (cont'd)

Control method: Trapping of pest birds using net traps

Level of suffering (after application of the method that causes death but before insensibility)				
No suffering	Mild suffering	Moderate suffering	Severe suffering	Extreme suffering

SCORE FOR PART B:	CO ₂ without handling - C
Summary of evidence:	Note: Compressed CO ₂ gas in cylinders is the only recommended source of CO ₂ because the inflow to the chamber can be regulated precisely ¹ .
Duration –	Overall duration will be less than with handling. The time to loss of consciousness depends on how the carbon dioxide is administered. If the birds are placed in a chamber that is pre-filled with a high concentration of CO ₂ (above 50%), loss of consciousness will be quicker (around 38 seconds) than placing the animals in a chamber and then increasing the concentration of CO ₂ (by 20% chamber volume per minute), (around 156 seconds), however placing animals in a pre-filled chamber causes pain, which is potentially severe ² .
Suffering –	<p>If animals are placed in a chamber containing a high concentration of CO₂ (above 50%) they will experience at least 10-15 seconds of pain in the mucosa of the upper airways before they lose consciousness. This method is therefore not recommended.</p> <p>If the rising concentration technique (i.e. introducing the CO₂ into the top of the chamber at a flow rate of 20% chamber volume per minute) is used there should not be any pain but the animals will find it aversive at a certain level and may experience distress, discomfort and dyspnoea ('air hunger')².</p>

PART B: assessment of mode of death – Carbon monoxide (CO) from petrol engine (with handling)

Time to insensibility (minus any lag time)				
Immediate to seconds	Minutes	Hours	Days	Weeks
Level of suffering (after application of the method that causes death but before insensibility)				
No suffering	Mild suffering	Moderate suffering	Severe suffering	Extreme suffering

SCORE FOR PART B:	CO from a petrol engine (with handling) - D
Summary of evidence:	
Duration –	Handling increases the duration of the gassing procedure. The time to insensibility will be variable depending on the sources of the CO (i.e. type of engine, size of engine, date of manufacture) and also the chamber size. Data from common mynas and common starlings indicates that time to recumbency can range from 7-180 seconds ³ . With a larger engine (see below for type) and a small chamber the duration is likely to be seconds.

Appendix 9 (cont'd)

Control method: Trapping of pest birds using net traps

Suffering –

This method involves physical handling so birds will suffer from some fear and distress.

Commercially compressed carbon monoxide induces loss of consciousness without pain and minimal discernable discomfort¹. However the humaneness (and also efficacy) of gaseous euthanasia with carbon monoxide sourced from a petrol engine is highly dependent on the type of engine used:

a) *Carbon monoxide sourced from the cooled exhaust of non-vehicular petrol engines without a catalytic converter* (e.g. lawn mower, whipper snipper engine or purpose-built carbon monoxide generator) appears to be acceptable since the level of carbon monoxide remains high and results in a rapid death^{4,3}. Some literature suggests that contaminants such as hydrocarbons in the fumes can be irritating to the eyes and airways^{5,6} however it is unknown if this irritation occurs in the short time before insensibility is induced⁴.

b) *Carbon monoxide sourced from the cooled exhaust of vehicular petrol engines with a catalytic converter* i.e. from cars less than approximately 10 years old, is not acceptable on the basis of all current information. For example, research has shown that the levels of carbon monoxide drop off very quickly after the engine has started, leaving only a small window where concentration is adequate for a rapid death (i.e. for up to approx 60 seconds after a car has been cold started). It is also likely that the level of potential irritants e.g. carbon, are highest during this short time^{7,8}.

c) *Carbon monoxide sourced from the cooled exhaust of older vehicles without catalytic converters* may produce a lethal concentration of CO and would therefore be acceptable⁹; however there are still welfare concerns due to a high variability in the age and condition of engines and presence of contaminants which could potentially cause some irritation to the eyes and airways.

PART B: assessment of mode of death – Carbon monoxide (CO) from petrol engine (without handling)

Time to insensibility (minus any lag time)				
Immediate to seconds	Minutes	Hours	Days	Weeks
Level of suffering (after application of the method that causes death but before insensibility)				
No suffering	Mild suffering	Moderate suffering	Severe suffering	Extreme suffering

SCORE FOR PART B:	CO from a petrol engine (without handling) - C
Summary of evidence:	
Duration –	The time to insensibility will be variable depending on the sources of the CO (i.e. type of engine, size of engine, date of manufacture) and also the chamber size. Data from common mynas and common starlings indicates that time to recumbency can range from 7-180 seconds ³ . With a larger engine (see below for type) and a small chamber the duration is likely to be seconds.

Appendix 9 (cont'd)

Control method: Trapping of pest birds using net traps

Suffering –	<p>Commercially compressed carbon monoxide induces loss of consciousness without pain and minimal discernable discomfort¹. However the humaneness (and also efficacy) of gaseous euthanasia with carbon monoxide sourced from a petrol engine is highly dependent on the type of engine used:</p> <p>a) <i>Carbon monoxide sourced from the cooled exhaust of non-vehicular petrol engines without a catalytic converter</i> (e.g. lawn mower, whipper snipper engine or purpose-built carbon monoxide generator) appears to be acceptable since the level of carbon monoxide remains high and results in a rapid death^{4,3}. Some literature suggests that contaminants such as hydrocarbons in the fumes can be irritating to the eyes and airways^{5,6} however it is unknown if this irritation occurs in the short time before insensibility is induced⁴.</p> <p>b) <i>Carbon monoxide sourced from the cooled exhaust of vehicular petrol engines with a catalytic converter</i> i.e. from cars less than approximately 10 years old, is not acceptable on the basis of all current information. For example, research has shown that the levels of carbon monoxide drop off very quickly after the engine has started, leaving only a small window where concentration is adequate for a rapid death (i.e. for up to approx 60 seconds after a car has been cold started). It is also likely that the level of potential irritants e.g. carbon, are highest during this short time^{7,8}.</p> <p>c) <i>Carbon monoxide sourced from the cooled exhaust of older vehicles without catalytic converters</i> may produce a lethal concentration of CO and would therefore be acceptable⁹; however there are still welfare concerns due to a high variability in the age and condition of engines and presence of contaminants which could potentially cause some irritation to the eyes and airways.</p>
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PART B: assessment of mode of death – cervical dislocation

Time to insensibility (minus any lag time)				
Immediate to seconds	Minutes	Hours	Days	Weeks
Level of suffering (after application of the method that causes death but before insensibility)				
No suffering	Mild suffering	Moderate suffering	Severe suffering	Extreme suffering

SCORE FOR PART B:	Cervical dislocation - C
Summary of evidence:	
Duration –	This method does not have a concussive effect and therefore insensibility may not be immediate ^{10,11} . Data from chickens suggests that electrical activity in the brain can persist for 13 seconds following cervical dislocation ¹⁰ .
Suffering –	This method involves physical handling so birds will suffer from some fear and distress. A study in turkeys found that reflexes persisted for 43 seconds in broilers killed by cervical dislocation ¹¹ . During this time the birds were gasping due to hypoxia and were likely to be distressed before death. To ensure that loss of consciousness is induced as quickly as possible this technique requires mastering of technical skills by the operator.

Appendix 9 (cont'd)

Control method: Trapping of pest birds using net traps

Summary

CONTROL METHOD:	Trapping of pest birds using net traps
OVERALL HUMANENESS SCORE:	CO₂ (with handling) – 4D CO₂ (without handling) – 4C CO from petrol engine (with handling) – 4D CO from petrol engine (without handling) – 4C Cervical dislocation – 4C
Comments	

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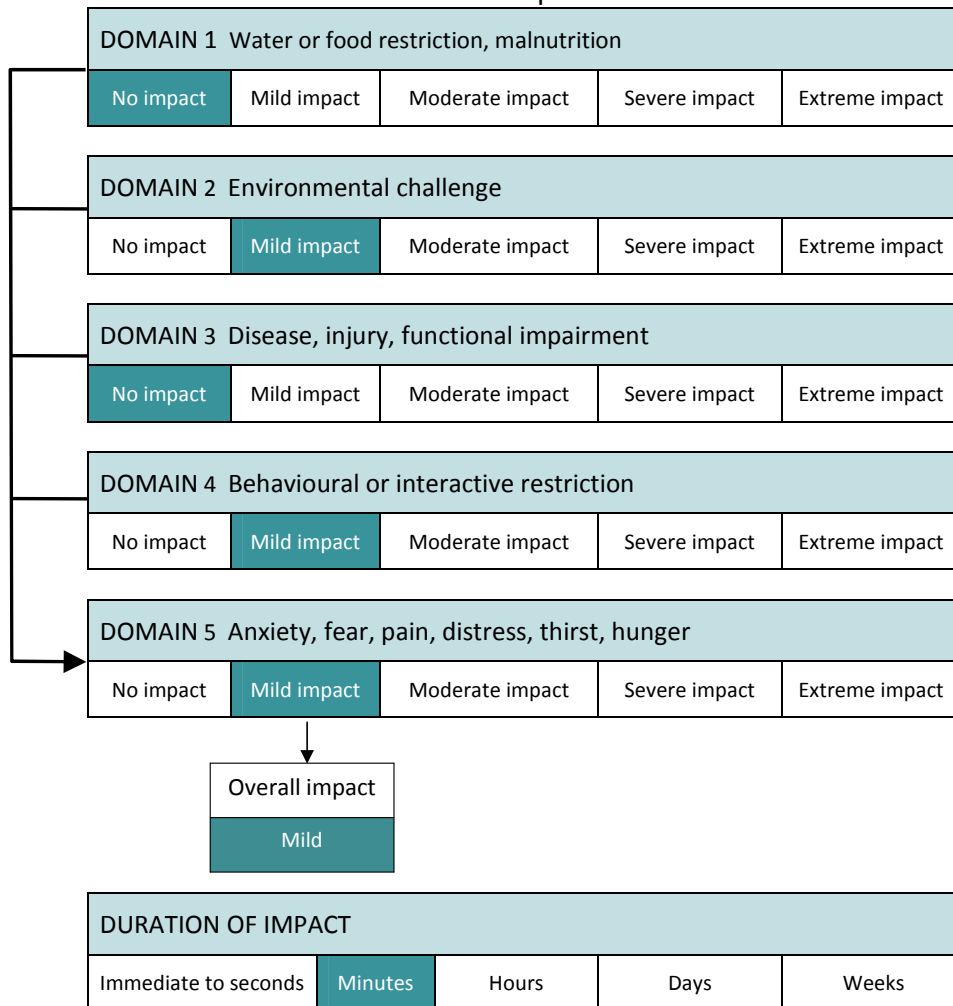
Appendix 10

Control method: Rabbit warren destruction by explosives

Control method: Rabbit warren destruction by explosives

<p>Assumptions:</p>	<ul style="list-style-type: none"> ▪ Best practice is followed in accordance with the standard operating procedure RAB007. ▪ Blasting is used primarily as a method of harbour destruction rather than for killing rabbits. It is best practice to perform warren blasting when rabbit numbers are at their lowest e.g. after a disease outbreak or after a control method such as fumigation or poisoning has been applied. The intention is that a more humane control technique is used (or natural population reduction) to reduce rabbit numbers prior to destruction of the warren. ▪ A high level of expertise is required to apply this technique due to the use of explosives. Ammonium nitrate mixed with fuel oil (ANFO) is the most commonly used explosive for warren destruction. Explosives are extremely hazardous and should only be used by suitably qualified and accredited operators.
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PART A: assessment of overall welfare impact



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 Date of assessment: 15-16 July 2009
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Date file created: 16/09/2010
 Page 1 of 3

Appendix 10 (cont'd)

Control method: Rabbit warren destruction by explosives

SCORE FOR PART A:	3
Summary of evidence:	
Domain 1	No impact in this domain.
Domain 2	Ripping would affect any rabbits that are not inside the warren at the time by depriving them of shelter from extreme temperatures (and also predators).
Domain 3	No impact in this domain.
Domain 4	Prior to ripping, rabbits are driven underground into the warren by making loud noises (e.g. riding motorbikes) and using dogs. These disturbances are likely to cause "flight or fight" stress responses that are similar to those seen when prey escape a predator. These endocrine responses are short lived and stress hormone levels quickly return to normal ³ .
Domain 5	The rabbits are likely to experience some fear due to the noise and activity when being moved into the warren and whilst the explosives are being placed.

PART B: assessment of mode of death

Time to insensibility (minus any lag time)				
Immediate to seconds	Minutes	Hours	Days	Weeks
Level of suffering (after application of the method that causes death but before insensibility)				
No suffering	Mild suffering	Moderate suffering	Severe suffering	Extreme suffering

SCORE FOR PART B:	A-B
Summary of evidence:	
Duration –	<p>In most cases the time to death is likely to be very rapid especially when complete destruction of the warren is achieved.</p> <p>Failure to cause complete collapse in deep warren systems may result in some rabbits becoming trapped in partly destroyed tunnels and then asphyxiating or dying from blast-related injuries that were not immediately lethal. It is essential that the tunnel system is completely destroyed so that the rabbit dies as quickly as possible.</p>

Appendix 10 (cont'd)

Control method: Rabbit warren destruction by explosives

Suffering –

If rabbits are rendered immediately insensible due to the blast-generated pressure waves and they do not regain consciousness prior to death, there will be no suffering. Although there have been no studies on rabbits to formally assess the effectiveness or humaneness of this method, field observations by operators indicate that it is likely that *all* rabbits in the warren will be affected when best practice is followed.

Depending on the distance from the nearest blast, rabbits in the warren may be killed or injured by the following:

- injuries and haemorrhages (especially to the lungs, ears and gastrointestinal tract) caused by the blast wave (see comments below);
- burns from the explosive gases produced (can be as high as 3000°C);
- injuries caused by fragments of solid material e.g. rock, wood fragments propelled by the blast; and
- crushing and suffocation from the collapse of the warren.

Summary

CONTROL METHOD:	Rabbit warren destruction by explosives
OVERALL HUMANENESS SCORE:	3A-B
<p>Comments</p> <p>Primary blast injuries are caused by the sudden increase in air pressure after an explosion. The term 'overpressure' is used to refer to the shock wave from an explosion that is greater than the surrounding atmospheric pressure. The amplitude of the peak overpressure, the rate of pressure rise, and its total duration all determine the biological effects of a primary blast. Air containing organs i.e. lungs, middle ear and the gastrointestinal tract are the most vulnerable to the effects of the blast wave. Exposure to pressure levels of 80 psi or above is considered lethal for more than 50% of cases ¹. Researchers have examined the injury patterns sustained by humans in terrorist bombings and concluded that explosions occurring in a confined space cause higher immediate mortality rates and more severe injuries compared with explosions occurring in the open air^{1,2}.</p> <p>Therefore in an enclosed warren situation where the blast will be contained, we could expect that the rabbits are exposed to a relatively prolonged peak overpressure resulting in increased severity of injury and high immediate fatality rate.</p>	

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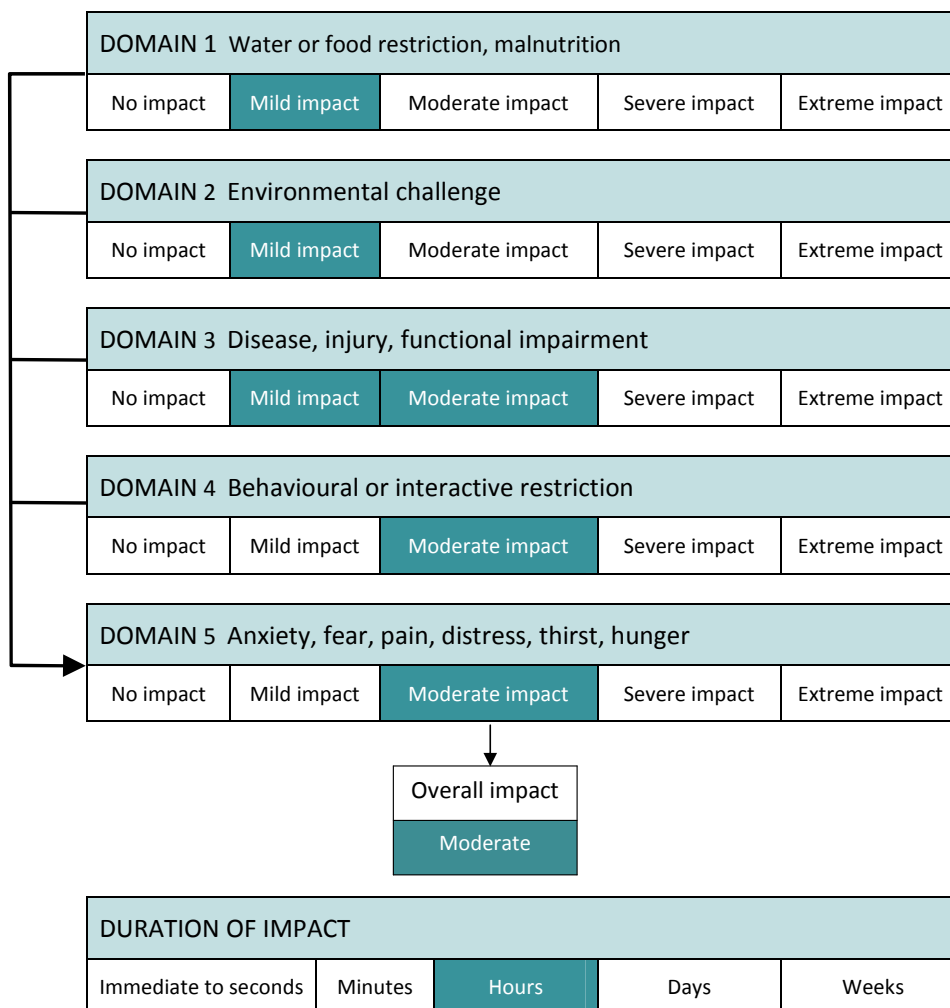
Appendix I I

Control method: Trapping of wild dogs using padded-jaw traps followed by killing

Control method: Trapping of wild dogs using padded-jaw traps followed by killing

Assumptions:	<ul style="list-style-type: none"> ▪ Best practice is followed in accordance with the standard operating procedure DOG001. ▪ Assumes that traps are checked every 24 hours. Best practice states that traps are set in the evening and checked in the morning – but if the trap is empty they will often be left set and checked the next morning. ▪ This assessment is very specific to the standard of traps considered. ▪ Note that the effect on dependent young is not taken into consideration with this assessment, only the impact on the target animal.
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PART A: assessment of overall welfare impact – padded foothold traps (e.g. Victor Soft Catch #3)



Appendix II (cont'd)

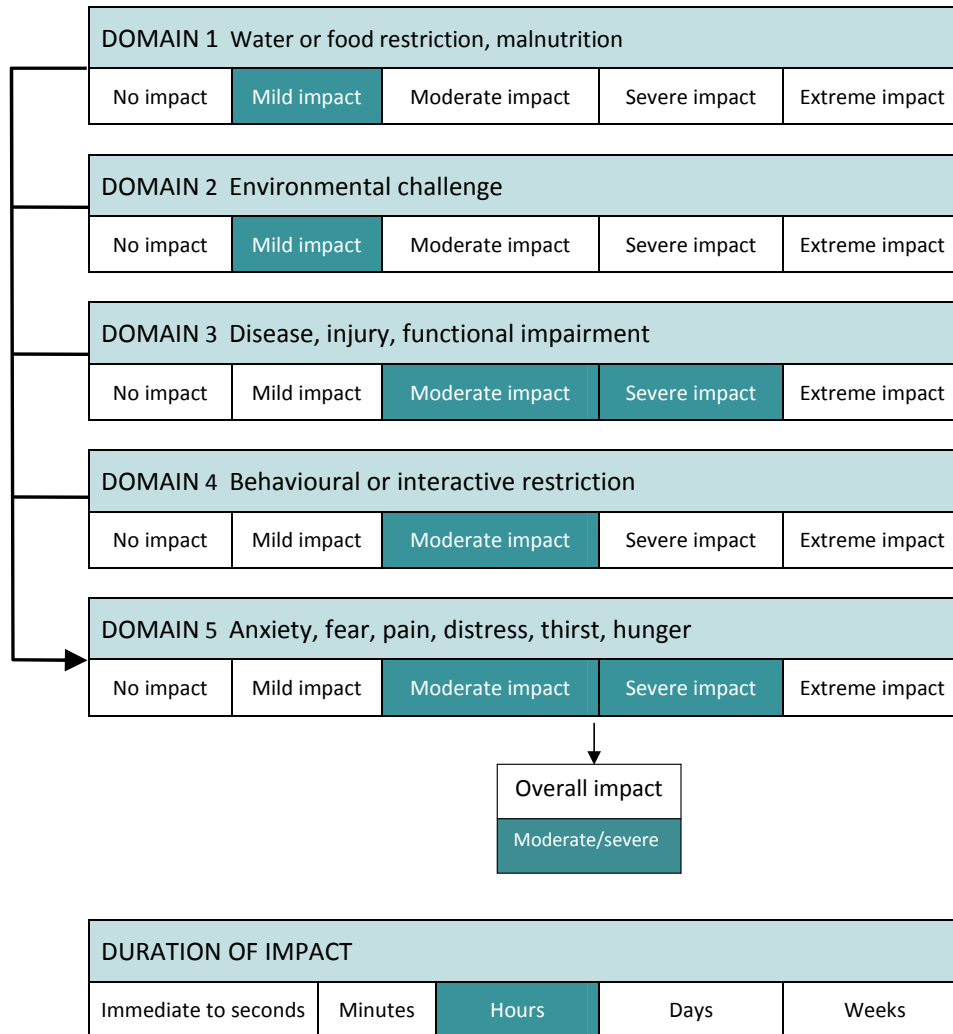
Control method: Trapping of wild dogs using padded-jaw traps followed by killing

SCORE FOR PART A:	Padded foothold traps (e.g. Victor Soft Catch #3) 5
Summary of evidence:	
Domain 1	Trapped dogs will be without food/water for a period up to 24 hours.
Domain 2	Assumes that traps are not set in bad weather and are placed in shaded areas.
Domain 3	The majority of injuries are likely to be minor skin lacerations. Self-mutilation is more likely with increasing time spent in the trap but is generally uncommon. Leg fractures are not usually seen with these types of traps but dislocations can occur. Tooth and mouth injuries may also occur ^{1, 2, 3} .
Domain 4	Physiological studies indicate that restraint by foot/leg-hold traps causes more stress than other capture techniques ⁴ . In foxes, cortisol levels were highest in animals trapped in leg-hold traps compared with cage traps and untrapped animals ^{5, 6} . There will also be periods of physical exertion from struggling against the trap especially during the first on 1-2 hours after capture ⁷ . Long entrapment periods could result in disruption of natural behaviour and motivational systems ⁸ .
Domain 5	The combination of psychological stress (anxiety, fear, frustration) from being restrained, pain from any injuries and exertion from struggling against the trap will have a significant impact on overall welfare ⁴ .

Appendix 11 (cont'd)

Control method: Trapping of wild dogs using padded-jaw traps followed by killing

PART A: assessment of overall welfare impact – padded leg-hold traps ('off-the-shelf' Padded Lanes Dingo trap)



SCORE FOR PART A:	Padded leghold traps ('off-the-shelf' Padded Lanes Dingo trap) 5-6
Summary of evidence:	
Domain 1	Trapped dogs will be without food/water for a period up to 24 hours.
Domain 2	Assumes that traps are not set in bad weather and are placed in shaded areas.

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Date of assessment: 24 July 2009
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Date file created: 7/09/2010
Page 3 of 6

Appendix II (cont'd)

Control method: Trapping of wild dogs using padded-jaw traps followed by killing

Domain 3	Although these traps are padded, they are substantially heavier and have a larger jaw spread than many of the contemporary foot-hold traps. Their weight and the tendency to catch animals higher on the leg have been implicated in increased incidence of fractures and amputations ⁹ . Tooth and mouth injuries also occur.
Domain 4	Physiological studies indicate that restraint by foot/leg-hold traps causes more stress than other capture techniques ⁴ . In foxes, cortisol levels were highest in animals trapped in leg-hold traps compared with cage traps and untrapped animals ^{5, 6} . There will also be periods of physical exertion from struggling against the trap especially during the first 1-2 hours after capture ⁷ . Long entrapment periods could result in disruption of natural behaviour and motivational systems ⁸ .
Domain 5	The combination of psychological stress (anxiety, fear, frustration) from being restrained, pain from injuries and exertion from struggling against the trap will have a significant impact on overall welfare ⁴ . Since these larger, heavier traps cause more significant injuries, the impact in this domain is higher than for the smaller foot-hold traps.

PART B: assessment of mode of death –shooting (head shot)

Time to insensibility (minus any lag time)				
Immediate to seconds	Minutes	Hours	Days	Weeks
Level of suffering (after application of the method that causes death but before insensibility)				
No suffering	Mild suffering	Moderate suffering	Severe suffering	Extreme suffering

SCORE FOR PART B:	B
Summary of evidence:	
Duration –	With head shots, a properly placed shot will result in immediate insensibility ^{10,11,12}
Suffering –	The approach of a human to trapped dog will cause some distress ¹³ . A well-placed head shot which causes immediate insensibility should not cause any additional suffering.

PART B: assessment of mode of death - strychnine

Time to insensibility (minus any lag time)				
Immediate to seconds	Minutes	Hours	Days	Weeks
Level of suffering (after application of the method that causes death but before insensibility)				
No suffering	Mild suffering	Moderate suffering	Severe suffering	Extreme suffering

SCORE FOR PART B:	G
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Last saved 20/05/2011 11:39 AM

Date file created: 7/09/2010

Page 4 of 6

Appendix II (cont'd)

Control method: Trapping of wild dogs using padded-jaw traps followed by killing

Summary of evidence:	Note: The use of strychnine on traps applies only where traps cannot be checked daily. It is also important to note that not all trapped dogs will chew at the strychnine cloth; therefore if traps are not checked regularly, it is possible that dogs will be left to suffer for long periods of time.
Duration –	After ingestion of strychnine, in the majority of cases dogs die within 1 to 2 hours, however, death can take up to 24 hours or longer if the dose is low ¹⁴ . The use of a strychnine soaked cloth or powder on the trap jaw is likely to result in unpredictable dosage rates due to the varying amounts of strychnine on the trap jaws and variable uptake into the mouth of the dog.
Suffering –	Strychnine is considered an inhumane poison and its use has been banned in many countries including NZ and the UK. The signs of strychnine poisoning are described as follows: “Early signs consist of apprehension, nervousness, tenseness, and stiffness. Severe tetanic seizures may appear spontaneously or may be initiated by stimuli such as touch, sound, or a sudden bright light. An extreme and overpowering extensor rigidity causes the animal to assume a ‘sawhorse’ stance. Hyperthermia due to stiffness and seizures is often present in dogs. The tetanic convulsions may last from a few seconds to around one minute. Respiration may stop momentarily. Intermittent periods of relaxation are seen during convulsions but become less frequent as the clinical course progresses. The mucous membranes become cyanotic, and the pupils dilated. Frequency of the seizures increases and death eventually occurs from exhaustion or asphyxiation during seizures” ¹⁵ .

Summary

CONTROL METHOD:	Trapping of wild dogs using padded-jaw traps followed by killing
OVERALL HUMANENESS SCORE:	Padded foot-hold trap with shooting – 5B Padded foot-hold trap with strychnine – 5G Padded leg-hold trap with shooting – 5-6B Padded leg-hold trap with strychnine – 5-6G
Comments <p>Although most trap-related injuries occur during the first one to two hours of capture, the degree of injury from self-mutilation and stress sustained during restraint increases as the time held increases; therefore trap inspection periods should be at least once per day to conform to a minimum accepted standard.</p> <p>Note that an Australian trap standard is urgently required that includes specifications for trap size and jaw spread, trap weight, closure speed, impact force, clamping force, jaw offset distances, padding material (type, thickness) and pan tension⁹.</p> <p>There is an urgent need to replace the use of strychnine on traps with a more humane method (i.e. Lethal Trap Device (LTD) with a toxin such as cyanide, PAPP or 1080).</p>	

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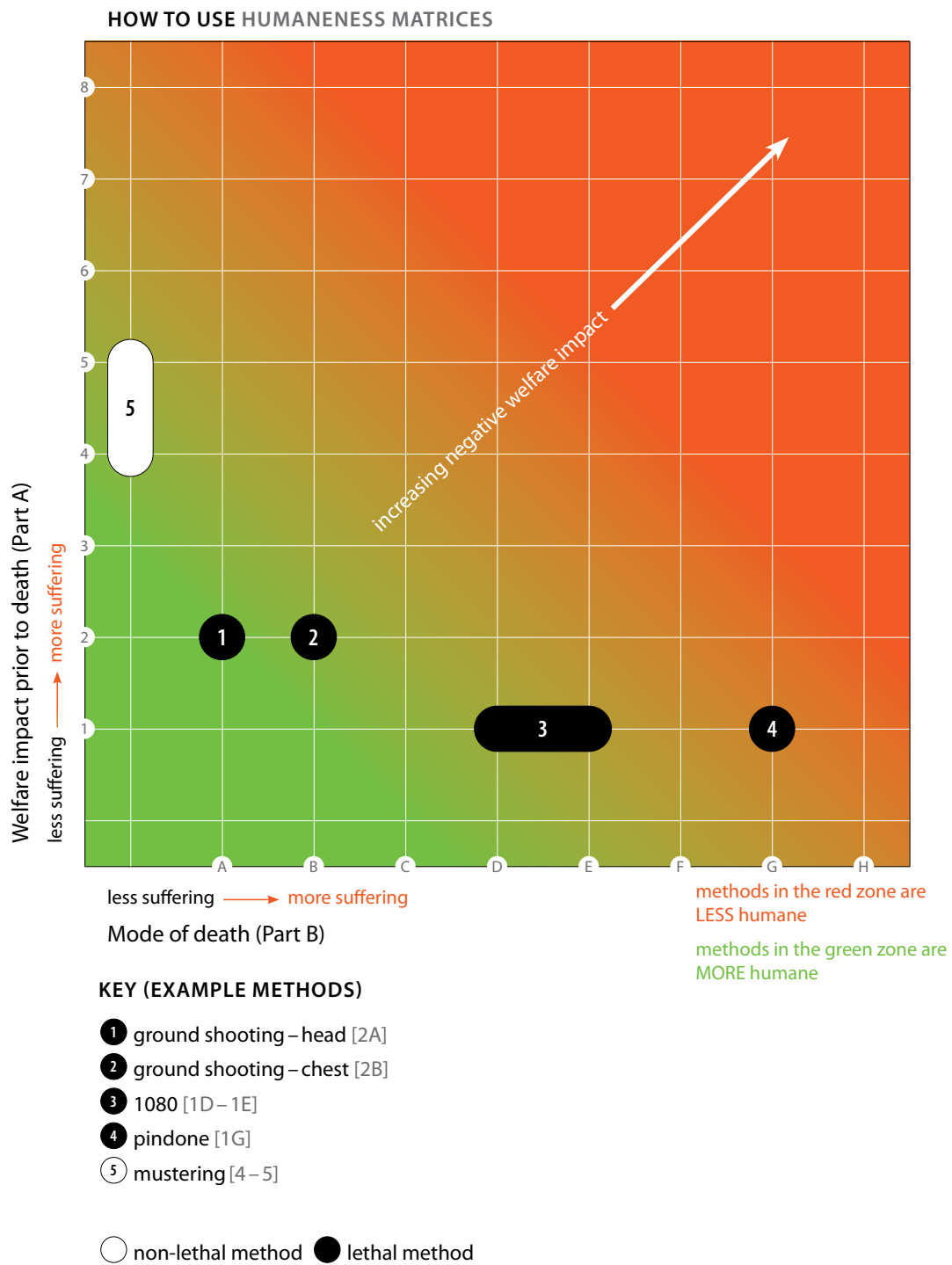
Page 5 of 6

Appendix I I (cont'd)

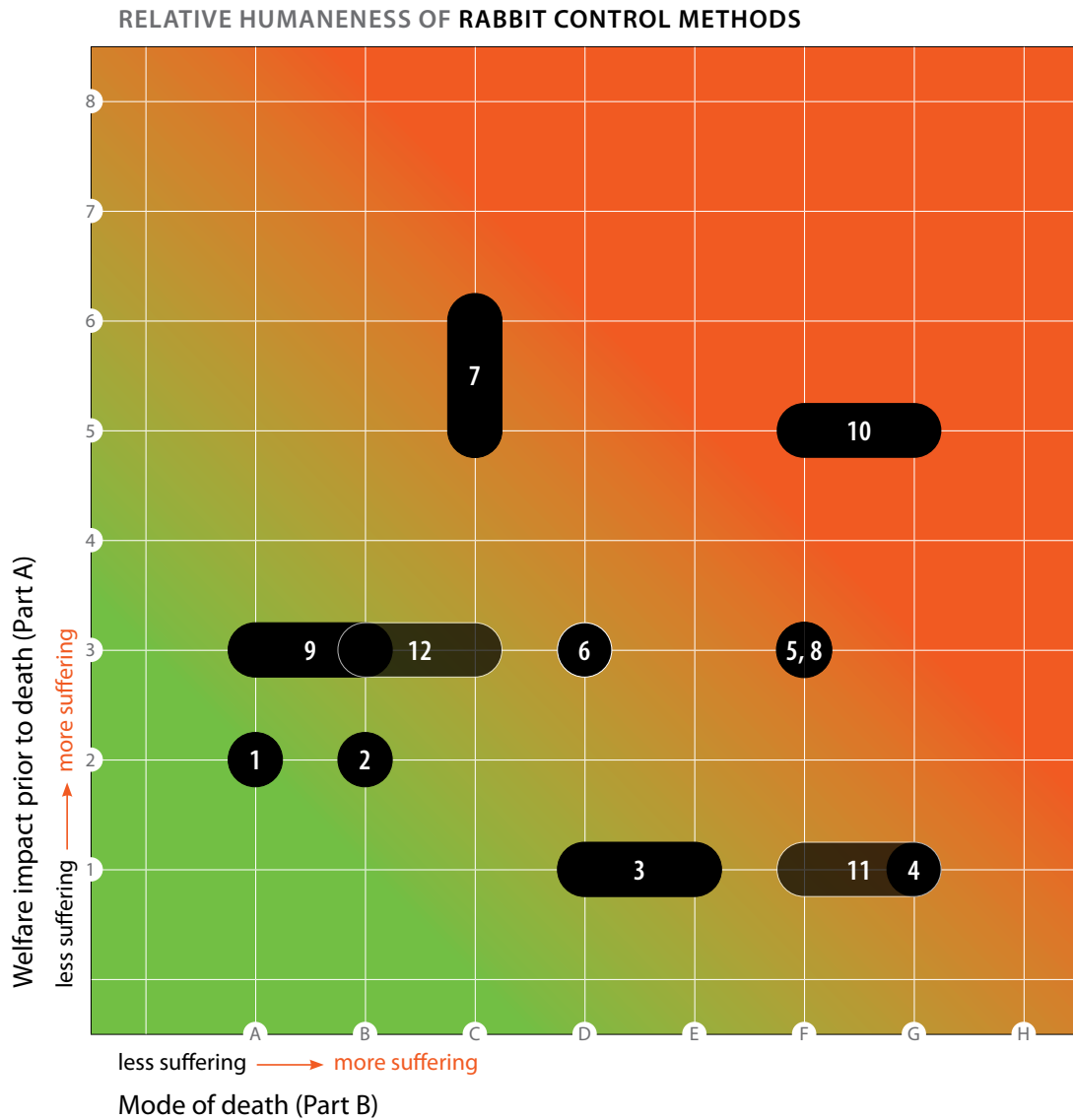
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Appendix I2



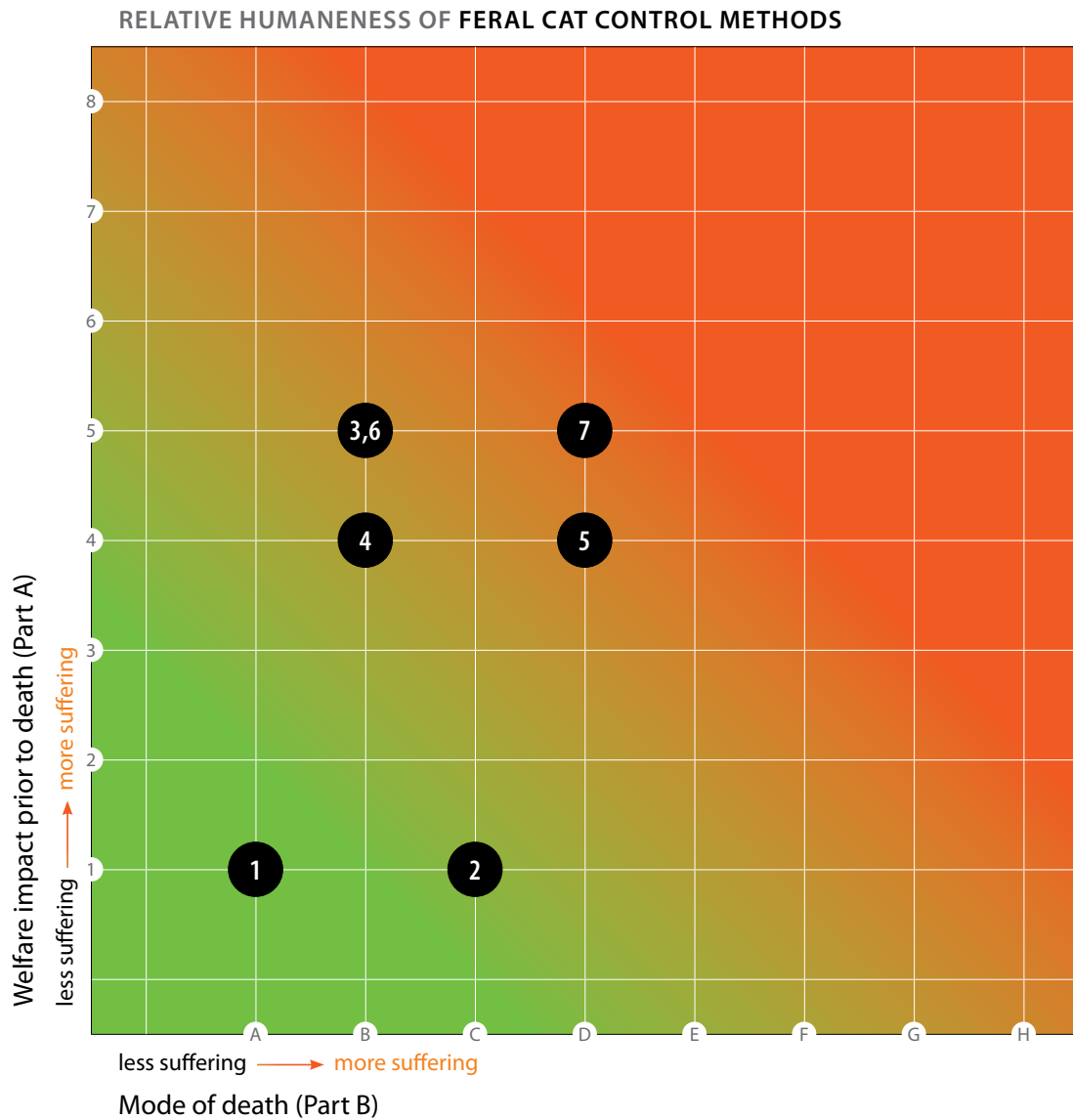
Appendix 12 (cont'd)



KEY

- | | |
|--------------------------------|--|
| ① ground shooting – head [2A] | ⑦ padded foot-hold trap [5C – 6C] |
| ② ground shooting – chest [2B] | ⑧ warren ripping [3F] |
| ③ 1080 [1D – 1E] | ⑨ warren blasting [3A – 3B] |
| ④ pindone [1G] | ⑩ RHDV inoculation [5F – 5G] |
| ⑤ chloropicrin [3F] | ⑪ baits RHDV [1F – 1G] |
| ⑥ phosphine [3D] | ⑫ warren treatment with LPG technology [3B – 3C] |

Appendix I2 (cont'd)

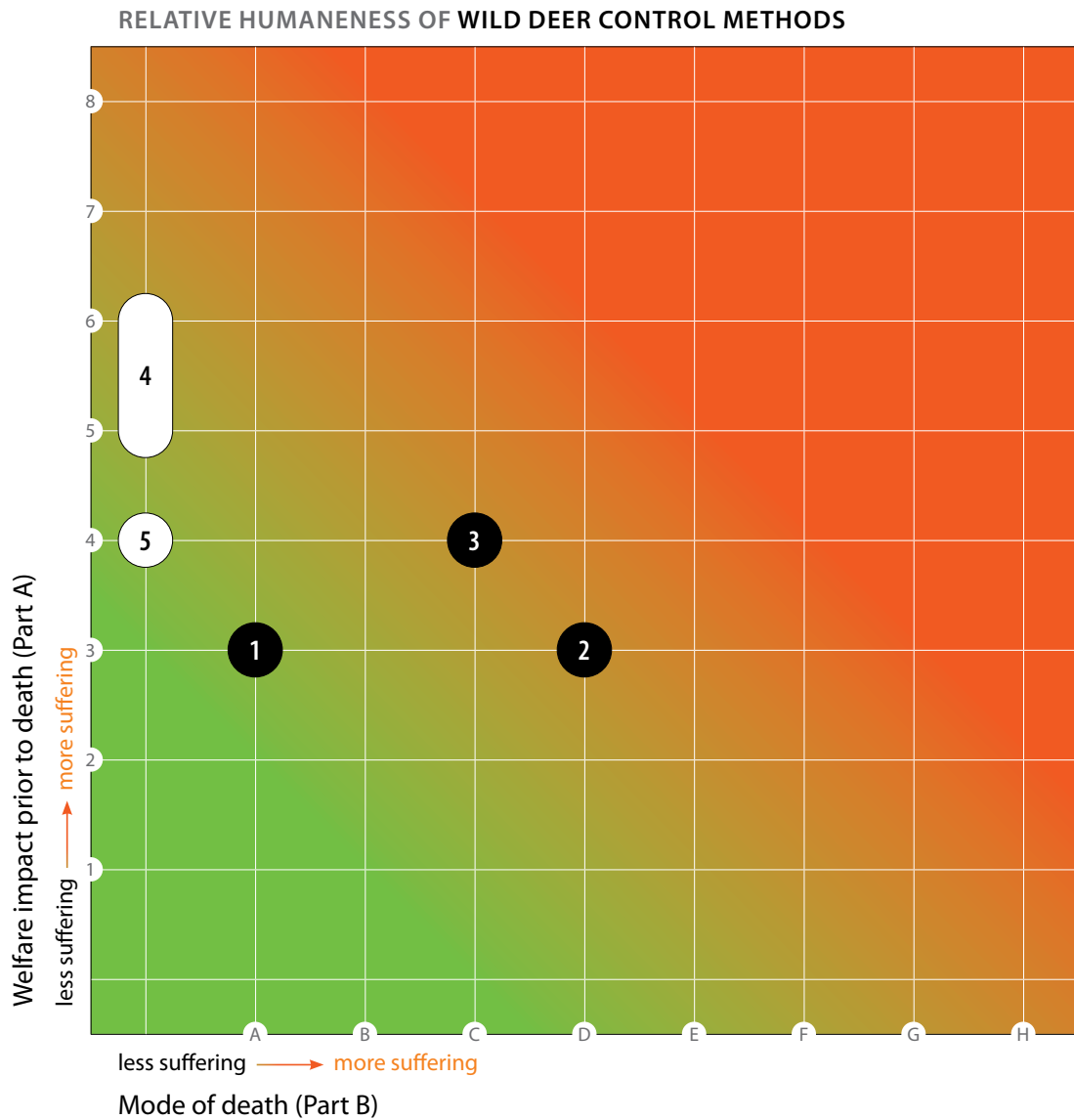


KEY

- ① ground shooting – head [1A]
- ② ground shooting – chest [1C]
- ③ padded foot-hold trap [5B]

- ④ cage trap – shooting [4B]
- ⑤ cage trap – lethal injection [4D]
- ⑥ cage trap, transport – shooting [5B]
- ⑦ cage trap, transport – lethal injection [5D]

Appendix 12 (cont'd)



KEY

① ground shooting – head [3A]

② ground shooting – chest [3D]

③ aerial shooting [4C]

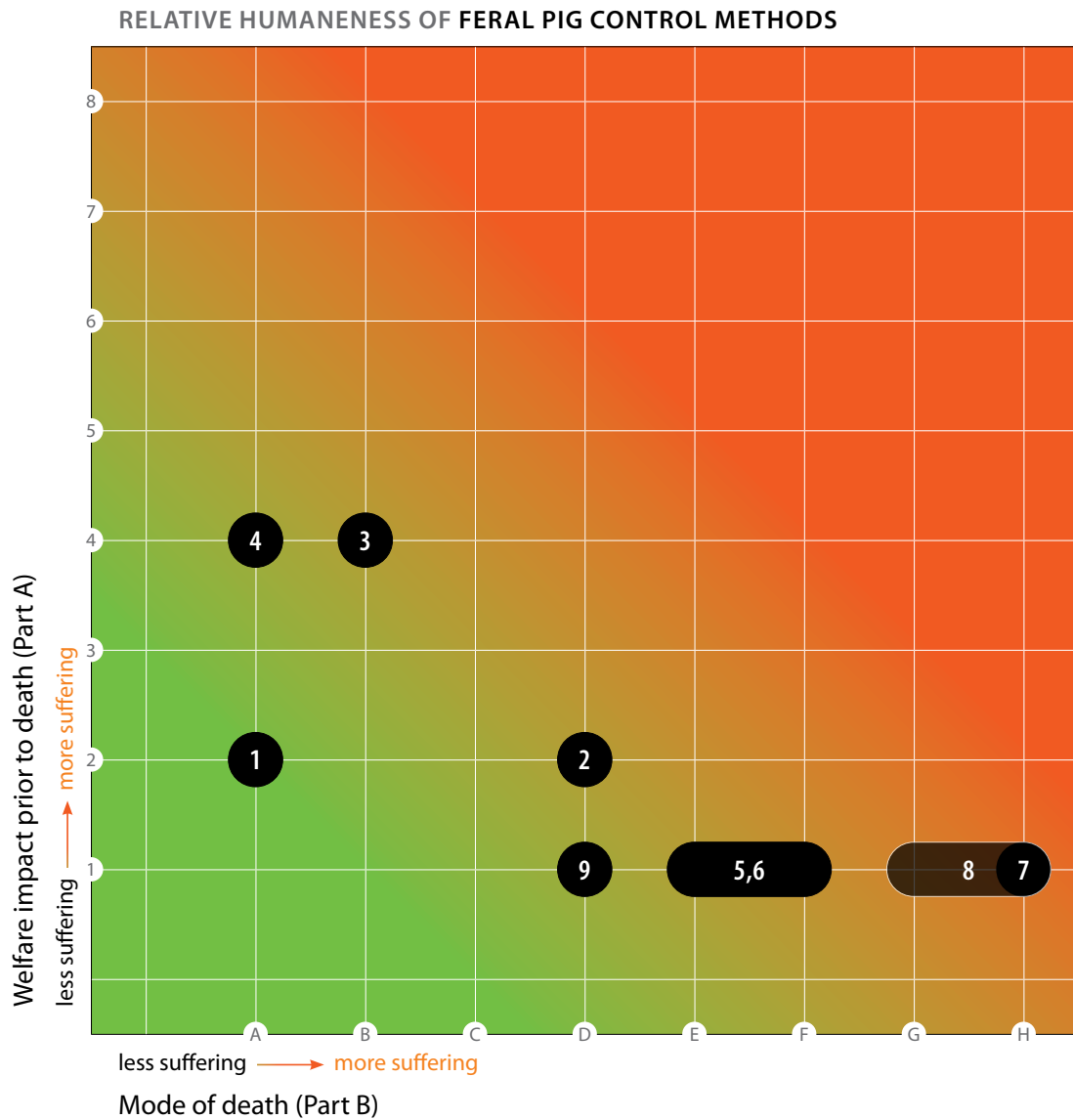
④ trap – group* [5 – 6]

⑤ trap – single* [4]

○ non-lethal method ● lethal method

*Note: the humaneness of trapping is highly dependent on how the subsequent stages (i.e. holding in the yards, drafting, shooting or transport) are conducted. The cumulative effects of these stages will compound welfare impact.

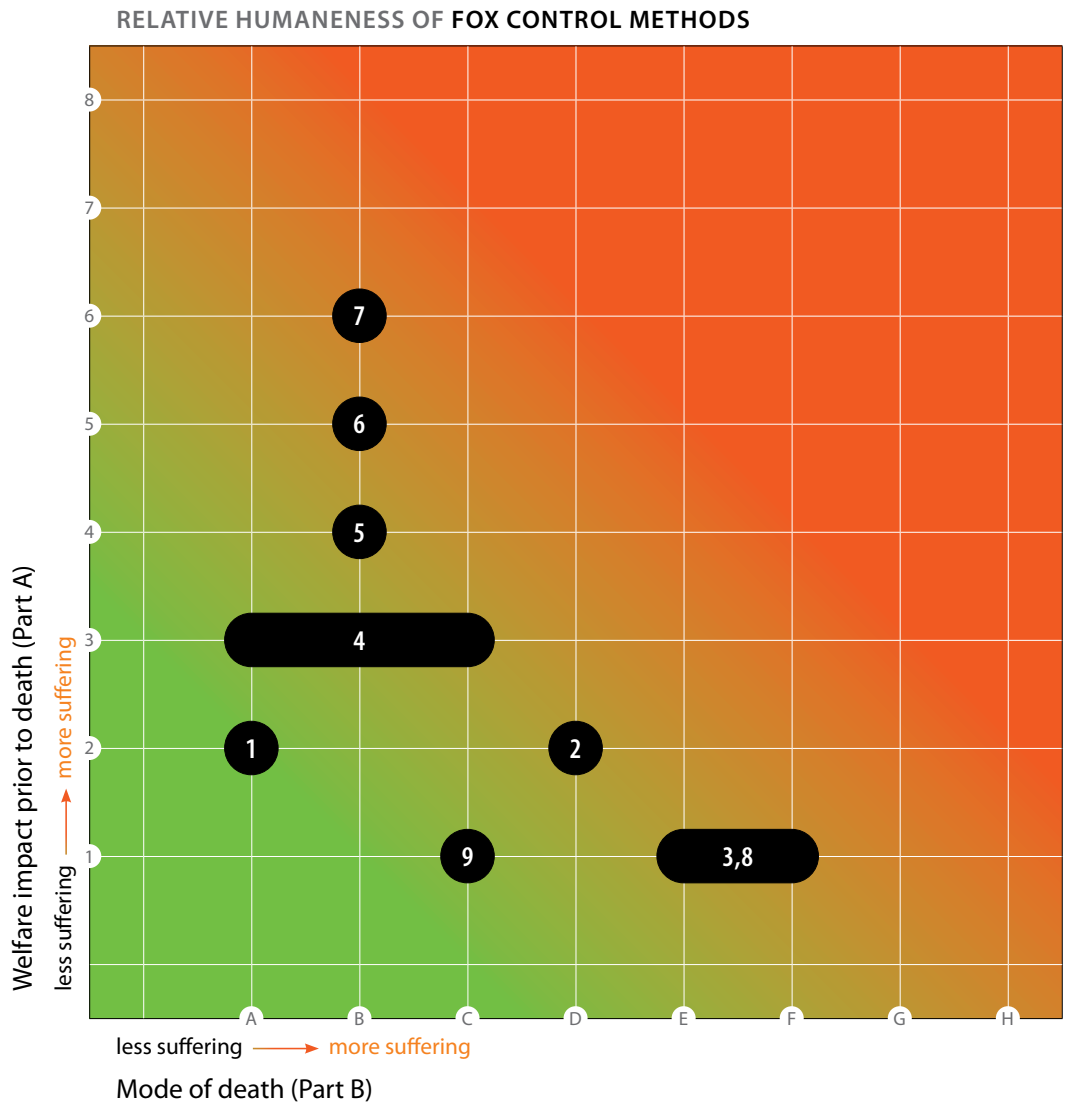
Appendix I2 (cont'd)



KEY

- | | |
|--------------------------------|--------------------------|
| ① ground shooting – head [2A] | ⑥ 1080 PIGOUT® [1E – 1F] |
| ② ground shooting – chest [2D] | ⑦ CSSP [1H] |
| ③ aerial shooting – chest [4B] | ⑧ warfarin [1G – 1H] |
| ④ trapping [4A] | ⑨ sodium nitrite [1D] |
| ⑤ 1080 [1E – 1F] | |

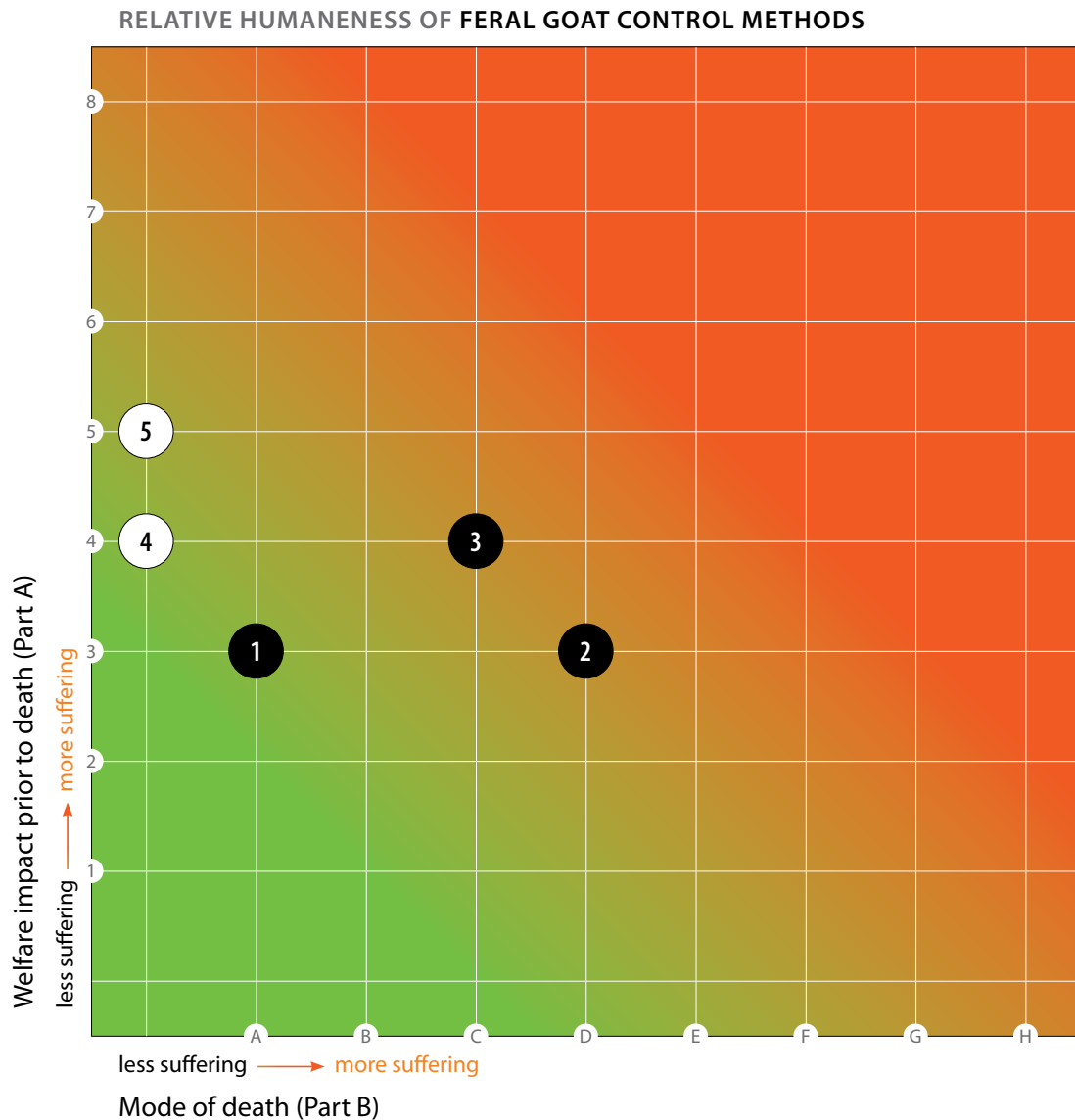
Appendix 12 (cont'd)



KEY

- | | |
|--------------------------------|---|
| ① ground shooting – head [2A] | ⑥ padded foot-hold trap – e.g. Victor Soft Catch [5B] |
| ② ground shooting – chest [2D] | ⑦ padded leg-hold trap – e.g. Lanes [6B] |
| ③ 1080 [1E – 1F] | ⑧ ejector devices – e.g. 1080 [1E – 1F] |
| ④ fumigation – CO [3A – 3C] | ⑨ ejector devices – e.g. cyanide [1C] |
| ⑤ cage trapping [4B] | |

Appendix I2 (cont'd)

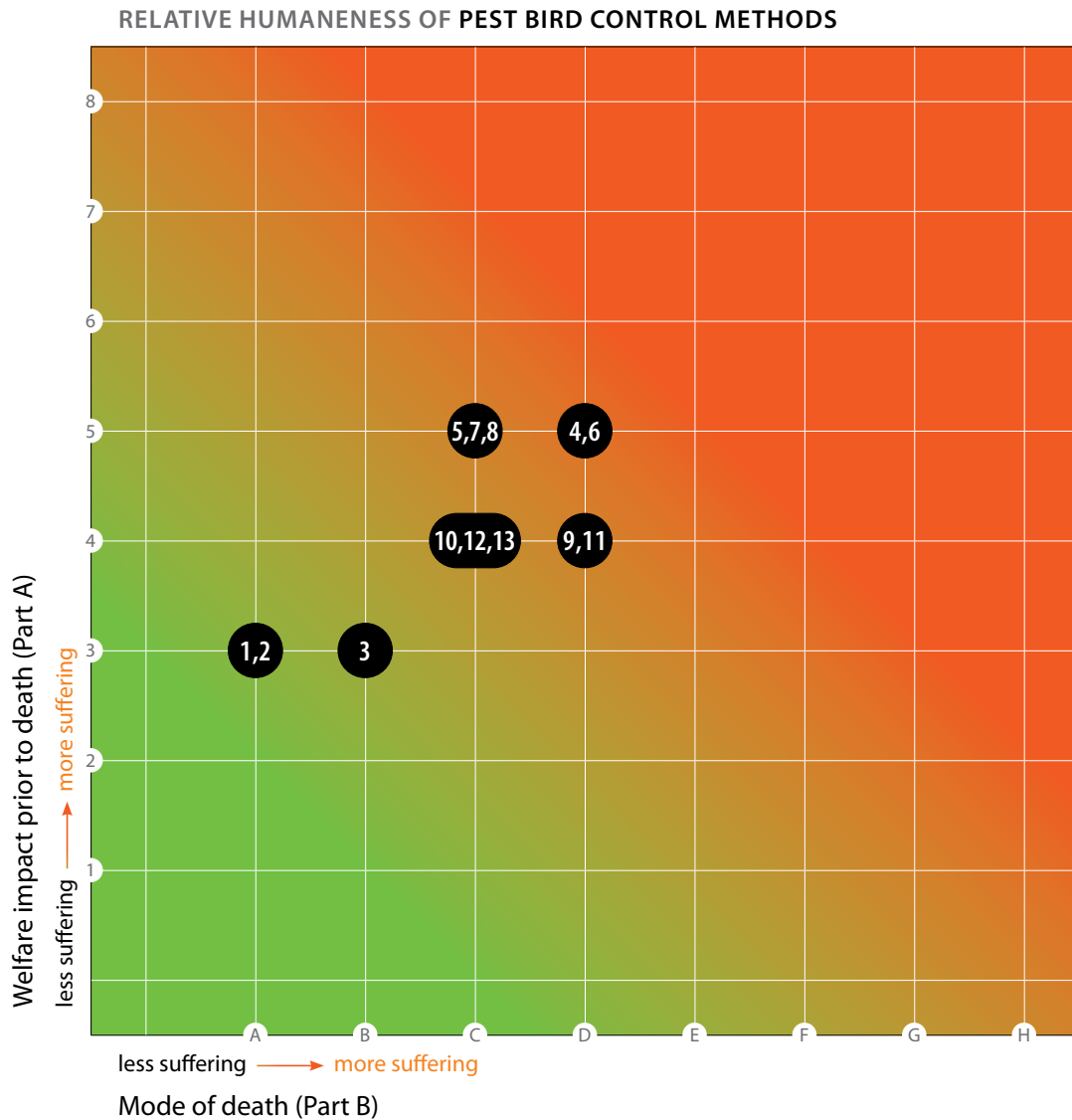


KEY

- ① ground shooting – head [3A]
- ② ground shooting – chest [3D]
- ③ aerial shooting [4C]
- ④ mustering* [4]
- ⑤ trapping* [5]
- non-lethal method ● lethal method

*Note: the humaneness of mustering or trapping is highly dependent on how the subsequent stages (i.e. holding in the yards, drafting, shooting or transport) are conducted. The cumulative effects of these stages will compound welfare impact.

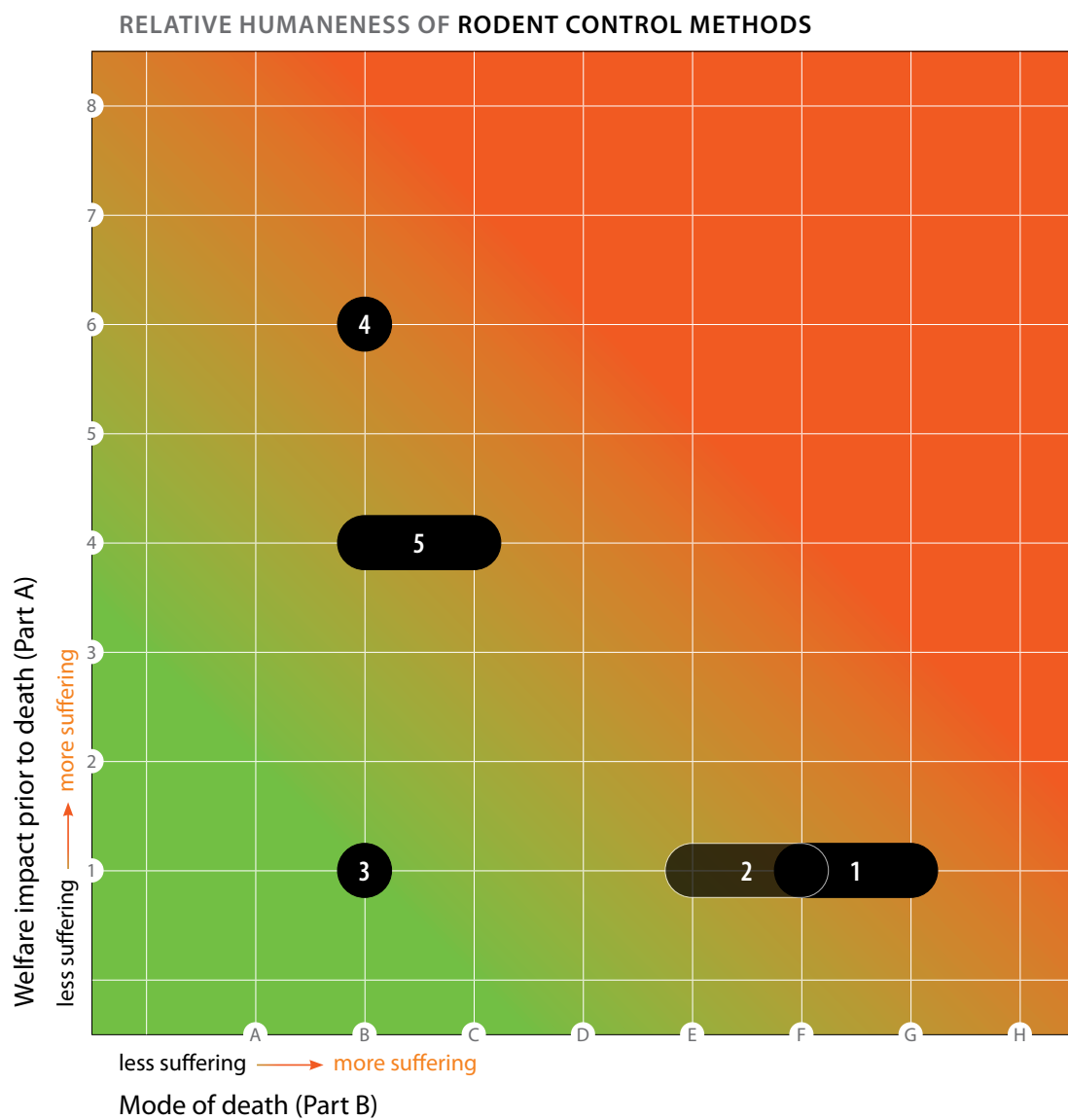
Appendix I2 (cont'd)



KEY

- | | |
|--|---|
| ① ground shooting – small to medium birds [3A] | ⑨ net trap – CO ₂ with handling [4D] |
| ② ground shooting – large birds – head [3A] | ⑩ net trap – CO ₂ no handling [4C] |
| ③ ground shooting – large birds – chest [3B] | ⑪ net trap – CO with handling [4D] |
| ④ cage trap – CO ₂ with handling [5D] | ⑫ net trap – CO no handling [4C] |
| ⑤ cage trap – CO ₂ no handling [5C] | ⑬ net trap – cervical dislocation [4C] |
| ⑥ cage trap – CO with handling [5D] | |
| ⑦ cage trap – CO no handling [5C] | |
| ⑧ cage trap – cervical dislocation [5C] | |

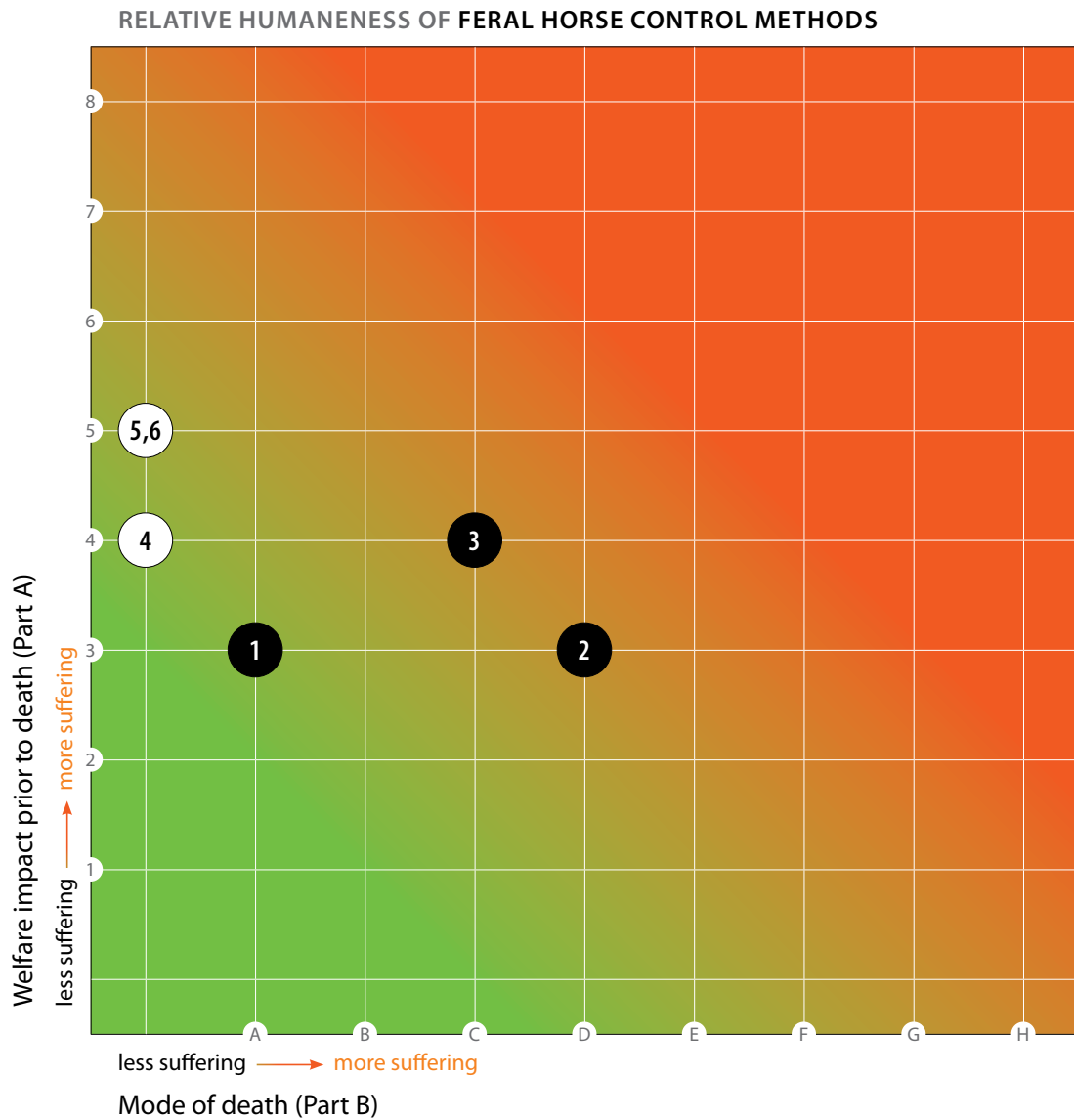
Appendix I2 (cont'd)



KEY

- ① baiting – anticoagulants [1F – 1G]
- ② baiting – zinc phosphide [1E – 1F]
- ③ trap – snap-back [1B]
- ④ trap – glue boards, blunt trauma [6B]
- ⑤ trap – live, blunt trauma with handling [4B – 4C]

Appendix 12 (cont'd)

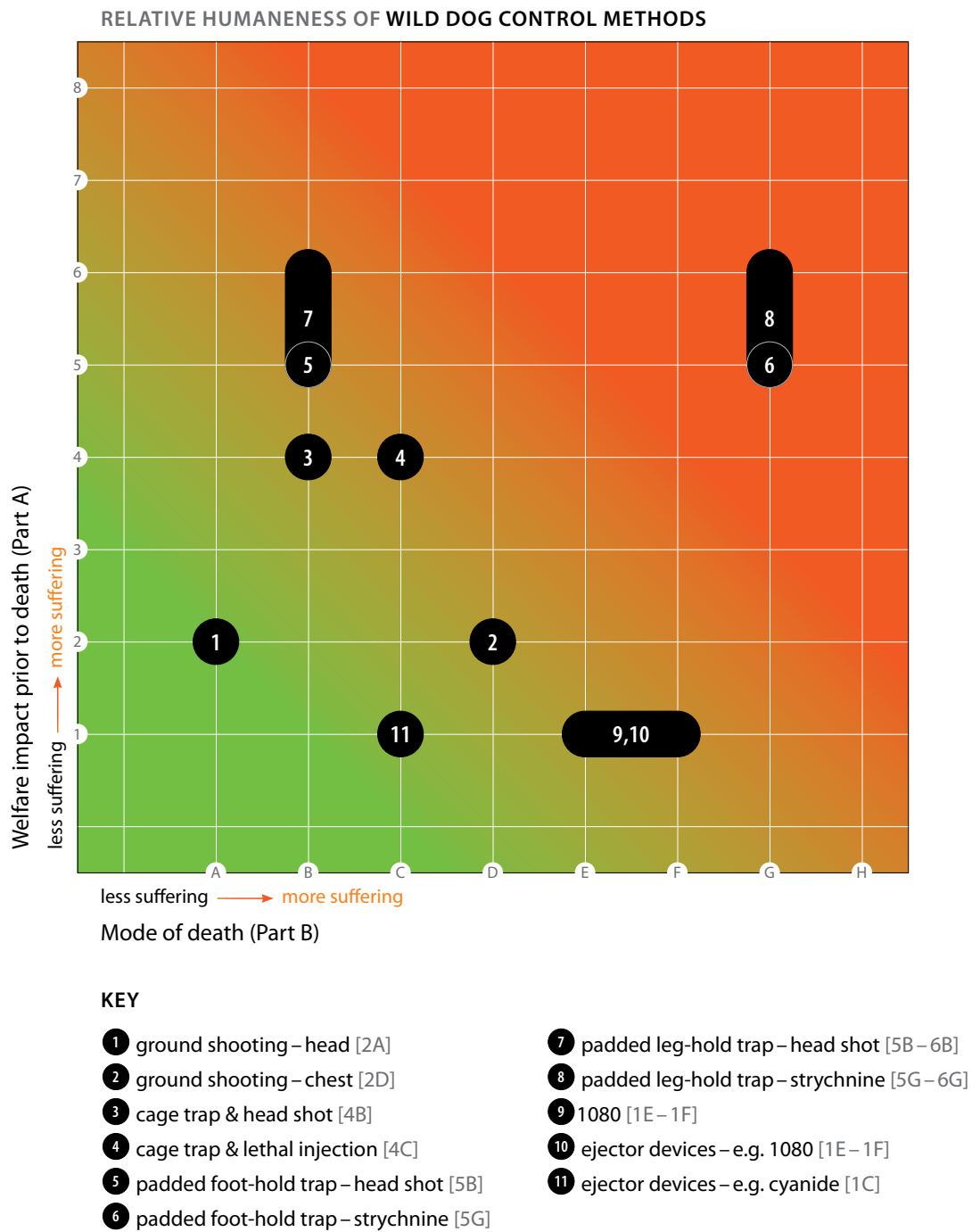


KEY

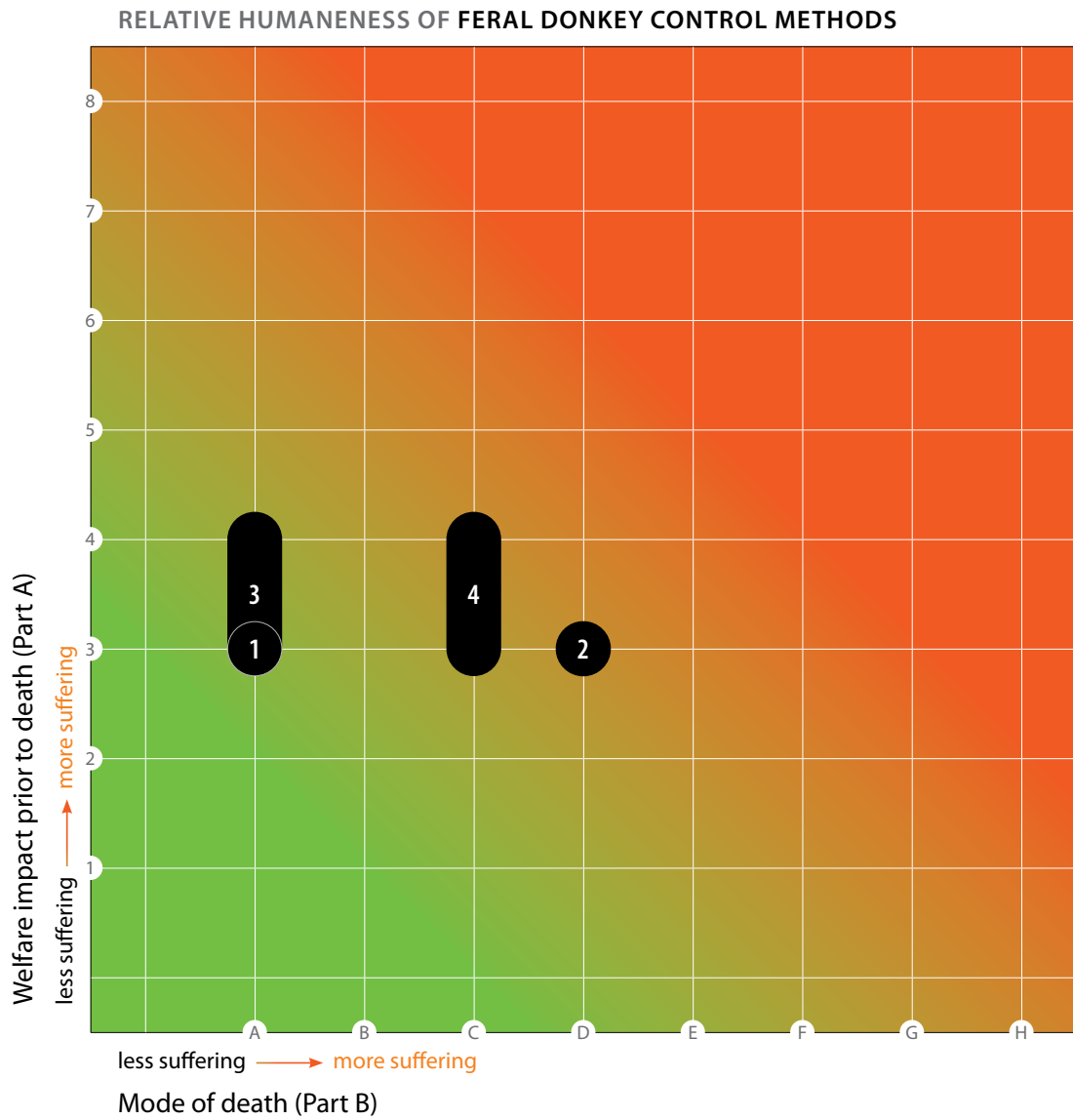
- ① ground shooting – head [3A]
 - ② ground shooting – chest [3D]
 - ③ aerial shooting [4C]
 - ④ mustering – without mixing social groups* [4]
 - ⑤ mustering – with mixing social groups* [5]
 - ⑥ trapping* [5]
- non-lethal method ● lethal method

*Note: the humaneness of mustering or trapping is highly dependent on how the subsequent stages (i.e. holding in the yards, drafting, shooting or transport) are conducted. The cumulative effects of these stages will compound welfare impact.

Appendix 12 (cont'd)



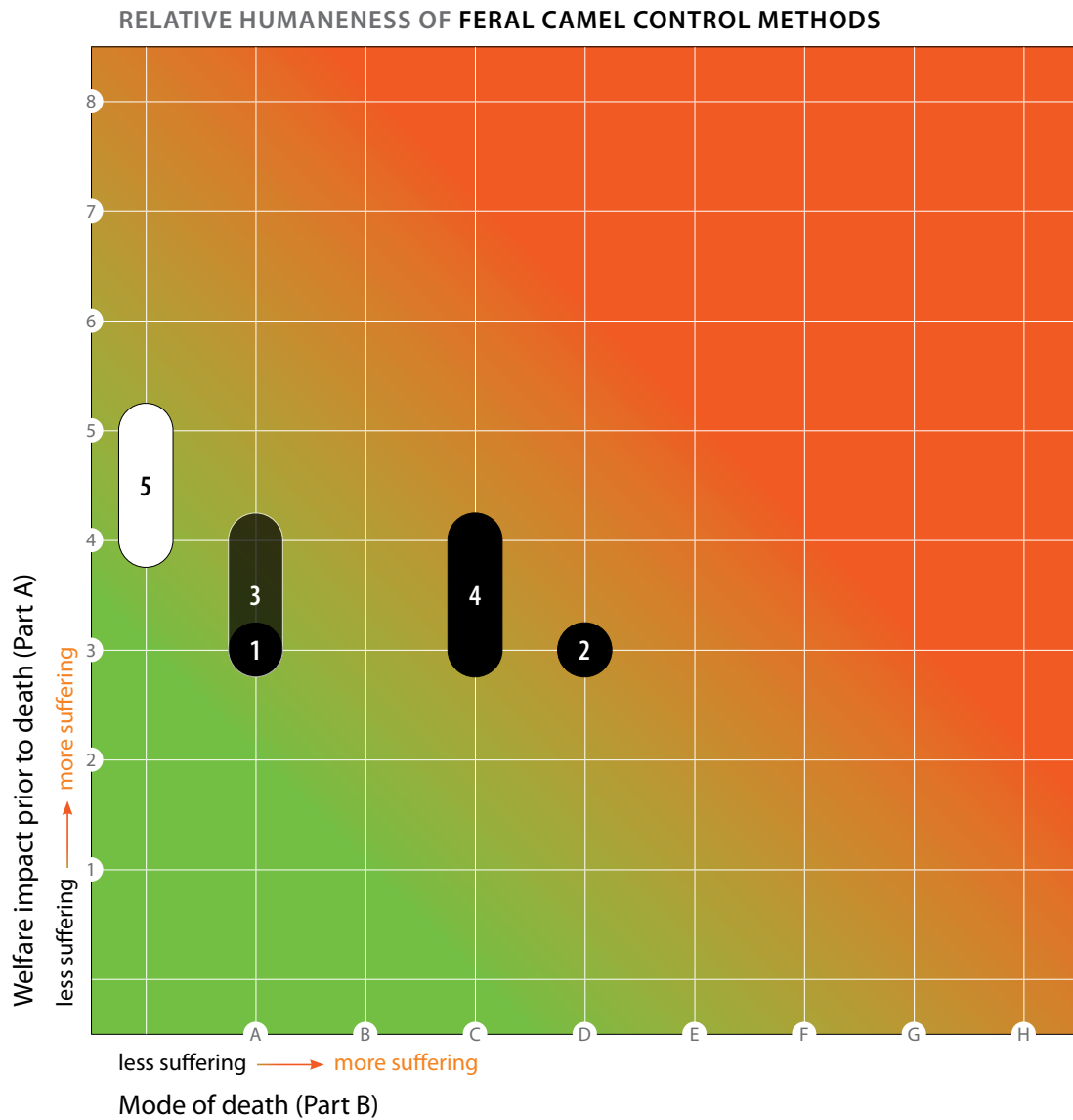
Appendix 12 (cont'd)



KEY

- ❶ ground shooting – head [3A]
- ❷ ground shooting – chest [3D]
- ❸ aerial shooting – head [3A – 4A]
- ❹ aerial shooting – chest [3C – 4C]

Appendix I2 (cont'd)



KEY

- ① ground shooting – head [3A] ⑤ mustering* [4–5]
- ② ground shooting – chest [3D]
- ③ aerial shooting – head [3A–4A] ○ non-lethal method ● lethal method
- ④ aerial shooting – chest [3C–4C]

*Note: the humaneness of mustering is highly dependent on how the subsequent stages (i.e. holding in the yards, drafting, shooting or transport) are conducted. The cumulative effects of these stages will compound welfare impact.