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

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NSW DEPARTMENT OF PRIMARY INDUSTRIES

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

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Feral cat (*Felis catus*) (photo by Robert Brandle)
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Rabbit (*Oryctolagus cuniculus*) (photo by NSW Department of Primary Industries)

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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

Acknowledgements

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Contents

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 focussed 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 base 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.

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 feed back 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.
- 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.

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?

A2.1 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.

A2.2 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

A4.1 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 animals '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).

A4.2 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/malnutrition[1];
- 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.

A4.3 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).

A4.4 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 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

A5.1 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 × mild trauma it is classified overall as mild, if it receives 1 × moderate or 3 × mild traumas, it is classified overall as moderate, if it receives 1 × moderately severe trauma, 2 × moderate traumas or 5 × 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.

A5.2 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.

A5.3 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.

A5.4 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.

A5.5 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.

A5.6 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:

1. 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).

A5.7 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).

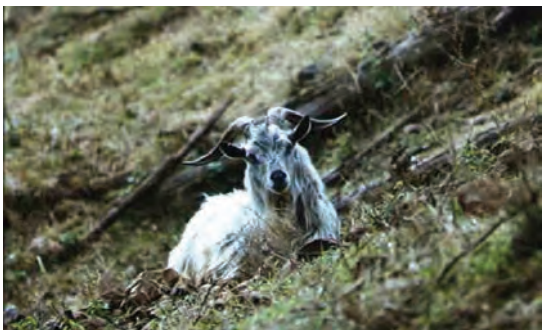
Multi-criteria decision analysis (MCDA) is a procedure used to analyse complex problems whereby the relative merit of different alternatives can be compared using a range of criteria. The procedure involves dividing the decision problems into smaller more understandable parts; analysing each part; and 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):

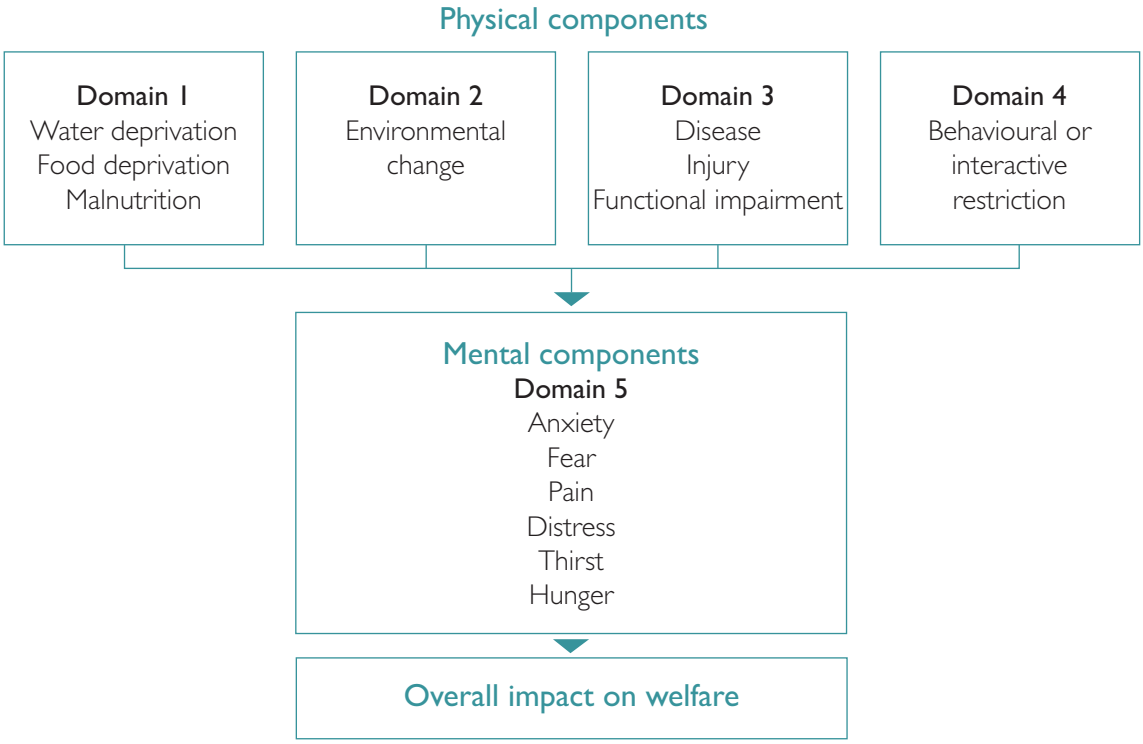
- Domain 1: Water deprivation/food deprivation/malnutrition;
- Domain 2: Environmental challenge;
- Domain 3: Disease/injury/functional impairment;
- Domain 4: Behavioural or interactive restriction; and
- Domain 5: Anxiety/fear/pain/distress.

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 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. Steps in assessing the humaneness of a method

Part A: Assessment of overall welfare impact

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 there may need to be extrapolations from human cases.

2. Using the impact scales as a guide, assign a grade to reflect the level of impact of the control method in each of the five domains (no impact, mild, moderate, severe or extreme impact). 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 overall welfare impact from the scoring matrix (scores range from 1 to 8, with 1 being the most humane and 8 the least humane).

6. List the references/evidence used to conduct the assessment.

Part B: Assessment of killing technique

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 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 (scores range from A to H, with A being the most humane and H being the least humane).

5. List the references/evidence used to conduct the assessment.

The overall humaneness of a lethal control method is obtained by combining the scores from Part A and Part B. The most humane method would score 1A, whilst the least humane would score 8H.

B5. Descriptions and examples of grades on the impact scales

Part A: Assessment of overall welfare impact

DOMAIN 1: 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.

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 (e.g. mustering).
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.

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 sickness or functional impairment (e.g. mild vomiting/ retching, diarrhoea, lethargy/ weakness).
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 sickness or functional impairment (e.g. moderate vomiting/ retching, diarrhoea, lethargy/weakness, slight breathlessness, moderate haemorrhages, convulsions whilst unconscious).
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 sickness or functional impairment (e.g. severe vomiting/ retching, diarrhoea, lethargy/weakness, abnormal breathing, severe haemorrhages, intermittent 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 sickness or functional impairment (e.g. extreme persistent vomiting/retching, diarrhoea, lethargy/ weakness, laboured breathing, convulsions whilst conscious, blindness, immobility/ prostration, excessive and prolonged haemorrhaging).

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.

DOMAIN 5: ANXIETY, FEAR, PAIN, DISTRESS

Impact category	Description of impact	Examples
NO IMPACT	Anxiety, fear, pain, distress, sickness or greater than normal thirst and/or hunger are not a feature of or consequence of the mode of action.	
MILD IMPACT	Mild discomfort or pain, low-level anxiety or apprehension or mild unsatisfied thirst and/or hunger.	Limited human contact with no physical handling.
MODERATE IMPACT	Moderate anxiety, fear, pain or distress, or moderate unsatisfied thirst and/or hunger.	Moderate level of human contact with minimum of physical handling.
SEVERE IMPACT	Severe anxiety, fear, pain, distress, thirst and/or hunger.	High level of human contact with a degree of physical handling.
EXTREME IMPACT	Extreme inescapable or unrelieved anxiety, fear, pain, distress, thirst and/or hunger 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.

Part B: Assessment of mode of death

Impact category	Description of impact	Examples
NO SUFFERING	No suffering before death. There is immediate death or immediate loss of consciousness lasting until death. *Note that components of suffering include (but are not limited to) fear, anxiety, pain, distress, apprehension, sickness, fatigue, thirst, hunger.* *Aversion refers to the avoidance or attempted avoidance of unpleasant, noxious stimuli and distressing stimuli*	Direct destruction/concussion of brain tissue resulting in rapid unconsciousness e.g. accurate shooting in the head. Inhaled vapour with no irritant effect that induces unconsciousness without pain or discernable discomfort. Does not involve physical handling or restraint
MILD SUFFERING	Loss of consciousness is not immediate and there is no or only minimal aversion and no or only mild suffering before death.	Inhaled vapour causing mild irritancy and mild pain and/or distress. Mild degree of sickness e.g. vomiting/ retching, diarrhoea, lethargy/weakness etc. Does not involve physical handling or restraint.

MODERATE SUFFERING	Loss of consciousness is not immediate and there is moderate aversion and suffering before death.	Inhaled vapour causing moderate irritancy and moderate pain and/or distress. Moderate degree of sickness e.g. vomiting/retching, diarrhoea, lethargy/weakness etc. 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.
SEVERE SUFFERING	Loss of consciousness is not immediate and there is severe suffering before death.	Inhaled vapour causing severe irritancy and severe pain and/or distress. Convulsions occurring during unconsciousness when animal recovers consciousness prior to death (i.e. muscle spasms with periods of relaxation as in clonic convulsions). Severance of major arteries resulting in rapid blood loss, hypovolaemia and shock. Severe degree of sickness e.g. vomiting/retching, diarrhoea, lethargy/weakness etc. 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).
EXTREME SUFFERING	Loss of consciousness is not immediate and there is extreme suffering before death.	Inhaled vapour causing extreme irritancy and extreme pain and/or distress. Partial or full paralysis whilst conscious. Convulsions whilst conscious (i.e. prolonged muscle spasm without periods of relaxation as in tonic convulsions). Extreme degree of sickness e.g. vomiting/retching, diarrhoea, lethargy/weakness etc. Intense dyspnoea caused by asphyxia (e.g. during strangulation, smothering, chest compression etc.) or hypercapnia (increased CO2 level). Severe internal haemorrhages causing swelling within confined spaces. May involve physical handling and restraint.

B6. Worksheet for humaneness assessments

A worksheet is used to record the humaneness assessments for each control method. The worksheet contains instructions for use, the impact scales for Parts A and B, the scoring matrices and areas to record results of assessment.

Refer to Appendix for the complete worksheet.

B7. 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.

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