

Invasive Animals Cooperative Research Centre



Public attitudes to current and proposed forms of pest animal control

Gerard Fitzgerald



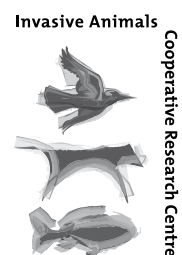
Invasive Animals CRC



Public attitudes to current and proposed forms of pest animal control

A summary and review of the Australasian and selected international research

Gerard Fitzgerald
Fitzgerald Applied Sociology



Public attitudes to current and proposed forms of pest animal control.

This review was completed for the Detection and Prevention Program's Project 12.D.8: Review on Public Attitudes to Vertebrate Pest Control.

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Summary

This report identifies and reviews Australasian and international research on public attitudes towards current and proposed forms of control for invasive animals. The review is primarily intended as an information resource for those involved in researching and managing the impacts of animal pests in Australia and New Zealand.

Animals covered in the review include: foxes, wild dogs and dingoes, rabbits, horses, pigs, cats, deer, goats, water buffalo, kangaroos, wallabies, possums, stoats and flying foxes. Coyotes, wolves and elk are also briefly discussed.

The research covered in the review shows that attitudes towards pest animal controls vary according to the:

- characteristics of the person or group — their gender, urban or rural residence, culture and value orientation
- perceptions of the pest animal and its impacts — its size, predation on livestock or other valued species, physical threat to people, impact on people's livelihood and aesthetic appeal
- environment being impacted — its proximity, accessibility, aesthetic and utilitarian appeal, public or private ownership
- features of the control strategy — safety, specificity, effectiveness, humaneness and cost.

The review suggests that discourses around current or proposed pest animal controls should recognise social and physical context. Decisions about pest controls need to be made on a case-by-case basis and be informed by systematic assessments. It is recommended that public and stakeholder involvement in pest control decision making be accompanied by well-designed, balanced information.

1. About this review

1.1 Purpose

This paper aims to provide an overview of social research on attitudes towards the control of invasive animals. In particular, it identifies and reviews the relevant primary Australasian and international research on public attitudes towards current and proposed forms of control for invasive animals. This review is a follow-up to an earlier literature review of attitudes to invasive animals and their impacts (Fitzgerald et al 2007).

The review is intended as an information resource for those involved in researching and managing the impacts of animal pests in Australia and New Zealand. As with Fitzgerald et al (2007), it was funded by the Invasive Animals Cooperative Research Centre (IA CRC) and is accompanied by an EndNote database that provides the reference details of the papers cited.

1.2 Scope

This review focuses on the research work on invasive animals of most relevance to Australia and New Zealand and especially to the work of the IA CRC. As such, the international social research literature on the management of wildlife in general has not been covered, nor studies of invasive animal species that are of little relevance to the IA CRC. However, several studies of related species have been included.

The review concentrates on primary research (published mainly in books, journals and agency reports) as recorded in library catalogues, journal databases, internet portals and publication lists from government and non-government agencies and professional associations. Searching these sources was complemented by requests for references from IA CRC participants and Australasian social scientists with an interest in the field.

The following were not systematically reviewed:

- university theses (except for significant studies recommended to us)
- literature that is essentially commentary on previous or others' studies, and/or draws on secondary data
- studies focused mainly on attitudes to pest animals rather than their control.

In general, there is a growing body of social research on public attitudes to invasive animals in Australia and New Zealand and methods for their control, although the number of studies remains quite small, and there have been relatively few in-depth studies of attitudes to particular forms of control for particular animals. This is especially true of national-level studies in Australia. While there are some excellent quantitative studies of people's attitudes towards the control of invasive animals, many of the survey-based studies covered here have significant methodological limitations. For example, they have used survey samples that are:

- too small to be representative of the population to which they refer
- drawn from limited sections of society
- purposive or self-selected samples and respondents (instead of randomly selected samples).

In addition, understanding by study participants of key concepts and control techniques is often mistakenly taken for granted by researchers. Hence, key concepts have often gone undefined or unexplained to the participants, including the idea of control itself, particular control methods (eg poisoning, trapping, biological control, fertility control) and the qualities of control/animal management techniques such as effectiveness, humaneness and specificity.

Taken together, the methodological weaknesses and potential limited understandings of key concepts by survey study participants mean that caution needs to be exercised when generalising from some of the research in this review. Researchers and wildlife managers are advised to refer to the text of particular studies before using them as a guide for decision making.

1.3 Theoretical context

1.3.1 Relevant fields

In the previous review of the research literature on attitudes to invasive animals (Fitzgerald et al 2007), the authors outlined the disciplinary context for work on people and pest animals. They noted that the field of Human Dimensions of Wildlife Management (HDWM) is broadly about understanding the 'complex interactions' between people, society and wildlife, including the social psychological factors in people's relationships with wild animals and wildlife (Nimmo and Miller 2007, Decker et al 2004). A central concern is with 'the acceptability of wildlife management practices' in order to reduce controversy around wildlife management (Nimmo and Kelly 2007). Other relevant fields of social research previously noted by Fitzgerald et al (2007) include Animals and Society, and broader work on New Social Movements.

Several other fields are relevant with respect to the use and development of techniques for managing human-wildlife interactions or, more commonly, reducing populations of wildlife that have come to be regarded locally or nationally as problematic by all or some sections of society. These fields include:

- Science Technology and Society (STS) studies — a multidisciplinary social science field that aims to understand the way in which science and technology influence society and vice versa.
- Technology Assessment — aiming to develop and apply methods for systematically identifying and evaluating the potential sustainability and impacts of proposed new technologies (Social Impact Assessment, Health Impact Assessment, Environmental Impact Assessment, and Strategic Impact Assessment are closely related fields).
- Risk — including recent social theoretical developments, such as Beck and Giddens's notion of 'the risk society', where society is increasingly concerned with safety, insecurities, and uncertainty 'introduced by modernisation itself' (Beck 1992, p21).
- Risk Perception — a multidisciplinary field aiming to understand how people and communities subjectively understand and react to risk and uncertainty, including new technologies.

Some of the studies reviewed here are directly informed by these fields and set out to make a contribution to them; hence they are more likely to have appeared in academic journals. Others are outwardly more pragmatic and designed to inform wildlife management decision making in particular situations, or more generally in relation to a particular species. These studies are more likely to have been published by agencies and advocacy groups as stand-alone reports. Both make a valuable contribution to understanding public knowledge, perceptions and attitudes towards pest animals control methods, and potentially to better informed pest animal management decision making.

1.3.2 Attitudes

According to Eagly and Chaiken (1993, p1), the term 'attitude' is used to describe one's disposition or way of thinking, or more formally 'a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour'. They note that attitudes cannot be directly observed but rather inferred from people's 'observable responses' to something, such as an animal's behaviour or a statement about an animal's behaviour (Eagly and Chaiken 1993, p2). As noted, attitudes refer to tendencies or inclinations to respond to particular things/ideas in similar ways, and may be short lived or enduring. Attitudes are also evaluative in that one's response to something is expressed in terms of a degree of goodness or badness — or in the case of the studies reviewed here, approval, acceptability, suitability and so on. Such evaluations express both direction information (good/bad) and strength information (a lot/not much). Evaluative responses may be made up of thoughts, feelings, and actions or intentions to act (Eagly and Chaiken 1993) which may be expressed in language.

Some theorists make a distinction between values and attitudes, where values are taken to be more abstract beliefs or views about what is good and true. Examples in this review include the work of Kellert (1979, 1980, 1985), who developed a method for identifying sets of views held by people about wildlife. These sets of views/attitudes are sometimes referred to as 'value orientations', with the word 'values' implying something more enduring and fundamental to a person's identity or personality. However, as leading attitude and behaviour researchers and theorists, Eagly and Chaiken (1993, p5) do not distinguish between values and attitudes, other than to note that values tend to refer to evaluations of more abstract 'objects'. In these terms, a value or an attitude can be inferred 'only when stimuli denoting an attitude object are observed to elicit responses expressing a given degree of evaluation' (1993, p3).

Ultimately, the interest in assessing people's attitudes to potentially controversial objects (such as a proposed method for killing pest animals) is in trying to predict how people might act or react so that the social, political and economic risks can be minimised. It is therefore assumed that attitudes are related to potential behaviour. This assumption is demonstrated in Ajzen and Fishbein's (1980) 'Theory of Reasoned Action', which says that likelihood of a person behaving in a particular way (eg attending a rally and protesting about shooting of wild horses in national park) is related to their attitudes towards the behaviour and their intention to act. These in turn are related to the person's view as to the social acceptability of the behaviour, whether they can perform the behaviour successfully, and the likely outcomes of the behaviour. A number of studies covered by this review (eg Wilkinson and Fitzgerald 2006), made explicit use of Ajzen and Fishbein's model of attitudes and behaviour, while most do not seem to have been informed by any particular theory.

Since many human dimensions studies are about assessing how people might react to a pest animal and/or its control, or what actually leads people to act/react, the focus is generally on the antecedent attitudes. In this respect, attitudes are used as a proxy for potential behaviour, specifically whether the members of the public or an interest group are likely to take action to oppose or support the use of a particular pest control approach or method. In the broadest sense, such attitude studies directly reflect the emergence of the risk society, and wildlife managers and policy makers' attempts to cope with its complexities.

2. Attitudes to pest animal controls

A summary of the research on acceptability of pest animal controls by species is given in Table 1. This research is described in more detail below, for pest animals in general, and for multiple and individual species studies. The studies are divided into subsections where appropriate, for attitudes of Indigenous Australians, other Australians and overseas populations.

2.1 Pest animals in general

2.1.1 Attitudes in Australia

Miller and Jones (2005, 2006) surveyed 138 wildlife managers, mostly members of the Australasian Wildlife Management Society. The questionnaire focused on the respondents' values with respect to wildlife, and used Kellert-type values orientation questions. The wildlife managers were found to be highest on the 'compassion for individual animals' and 'consultation with the community' perspectives, and rated strongly on the 'management/consumptive use of wildlife' scale. The latter indicates a belief that it is ethical and appropriate to manage wildlife by controlling introduced and pest species. The respondents also believed that hunting was a valid pastime, that wild animals may be used for food and other purposes where appropriate, and that it is ethical for wildlife managers to control pest animals using fatal methods. The fourth most common perspective was based around the 'protection of wildlife/compassion for individual animals', indicating a belief that people who use or consume wild animals should be concerned about the pain and suffering of those animals, and that human activities should be restricted to those that minimise impacts on wildlife. This study shows that while Australasian wildlife managers believe that it is necessary and/or appropriate to manage, control, and use wildlife for a variety of reasons, they also emphasise minimising pain and suffering among individual animals. This concern for humaneness was greater than that recorded for United States wildlife by Brown et al (1994). Miller (2006) also found gender differences among wildlife managers in their attitudes towards wildlife management, although these differences were small. Age was an additional factor, with older female respondents scoring higher on the 'management/consumptive' scale.

Andrew and Lee (2007) surveyed 44 visitors to the Mulligan's Flat Nature Reserve (MFNR) in the Australian Capital Territory (ACT) to learn about their understanding and use of the woodland reserve and to ask their views on its management, including fox and feral cat control. When asked if non-native animals that are not naturally a part of the environment should be excluded from the reserve, 97% of respondents said that they should be kept out. The same proportion of respondents felt it was acceptable for foxes to be controlled in the reserve. A total of 82% felt it was acceptable for ACT Government managers to use lethal baits to control foxes, and 89% felt it was acceptable to control foxes by capturing and euthanising. All the respondents believed that feral cats should be controlled in MFNR, with 82% saying that it was acceptable for ACT Government managers to use lethal baits and 89% believing it was acceptable to capture and euthanise feral cats found in the reserve. When asked whether they would prefer a veterinarian to euthanise feral animals, only 26% of the respondents said 'yes', 45% said 'no' and 29% were undecided or didn't know. Users of the reserve clearly endorsed government control of exotic animals in the reserve using lethal means.

Table 1: Summary of research on acceptability of pest animal controls by species

Authors	Population	State/ country	Position on pest/ wildlife control	(Most) acceptable methods	(Most) unacceptable methods	Key criteria
Mixed and multiple species						
Miller and Jones 2005, 2006	wildlife managers	Australia	acceptable			humaneness
Andrew and Lee 2007	public users	Australia	fatal acceptable	poison baiting scare devices		
Sanborn and Schmidt 1995	wildlife professionals	United States		capture and euthanasia fertility control	poisoning habitat manipulation	specificity humaneness /ethics
Reiter et al 1999	public	United States	acceptable	hunting	poisoning non fatal	human safety humane effectiveness
Rose 2007	indigenous people	Central Australia	limited	capture and removal methods that allow use of the animal	wastage of animal	productive participatory
Robinson et al 2005	indigenous people	NT	limited – not eradication	methods that allow use of the animal	eradication	productive participatory
Fisher et al 2007, 2008	public	Australia	acceptable	fertility control	traditional poisons	safety humaneness
Lauber et al 2007	public	United States		biological and genetic fertility control		humaneness
McIvor and Conover 1994	farmers and non farmers	United States		non lethal		lethal vs non lethal effectiveness
Bremner and Park 2007	public	Scotland	acceptable	sterilisation	poisoning trapping	
Wild dogs and dingoes						
Johnston and Marks 1997	public	Vic	eradication	shooting	perm fertility control	
Ballard 2005	public	NSW		aerial culling		
Jennens 1998	public	WA		fatal	restraint	
Allen 2006	farmers	Qld			poisoning	specificity
Lindsay et al 2005	farmers	South Africa	no			

Authors	Population	State/ country	Position on pest/ wildlife control	(Most) acceptable methods	(Most) unacceptable methods	Key criteria
Foxes						
McGeary 2005	farmers	Vic	yes	shooting	1080 poisoning	effectiveness
Fisher and Lee 2006	public and farmers	Tas	yes	cyanide baiting	trapping	
Johnston and Marks 1997	public	Vic	eradication	shooting	biological control humane toxin	
Macdonald et al 2006	farmers and game managers	United Kingdom	yes – farmers	shooting	biological control 1080 poisoning	effectiveness
Macdonald et al 2006	public	United Kingdom		non-fatal methods	trapping hunting with dogs	humaneness
Feral cats						
Johnston and Marks 1997	public	Vic	eradication	shooting	trapping	humaneness
Fraser 2001	public	New Zealand		poisoning	trapping	
Feral pigs						
Robinson et al 2005	indigenous people	NT	resource extraction	shooting and recovery	non recovery	food
Ballard 2005	public	NSW	yes	aerial culling		
Fraser 2001	public	New Zealand	manage as resource	shooting /hunting		resource use
Adams et al 2005	land managers	United States	yes – ad hoc /resource	shooting	trapping	resource use
Wild horses						
Robinson et al 2005	indigenous people	NT	yes – limited			resource use cooperation
Ballard 2005	public	NSW	managed populations	capture and relocation (urban)	poisoning	humaneness? effectiveness
Nimmo et al 2007	public	Vic		capture	heli shooting	
Fraser 2001	public	New Zealand	low priority	capture and removal?		

Rabbits												
	public	Vic	eradication	biological control	shooting	warren destruction	myxomatosis	poisoning				
Johnston and Marks 1997	public	Australia	important	GM infertility virus	shooting and hunting	warren destruction	myxomatosis	poisoning				
Roy Morgan 1995	public	New Zealand	important	shooting and hunting	GE infertility virus	poisoning	RCD	myxomatosis				cost
Polonsky et al 2004	land managers	regional Australia									community commitment	method
Sheppard and Urquhart 1991	public	New Zealand		commercial harvesting	shooting	1080 poisoning (males)	encouraging predators	gassing	1080 poisoning (females)			
Fitzgerald et al 1996	stakeholders and public	New Zealand	yes	shooting and trapping			no control	poisons/1080		social and economic benefit		
Fitzgerald et al 1996	public	New Zealand	yes	shooting	trapping	RCD	aerial poisoning 1080	other poisons	virus	social and economic benefit		
Wilkinson and Fitzgerald 1998	stakeholders and public	New Zealand	yes	shooting			1080 poisoning			humane	species specificity /safety	effectiveness
Wilkinson and Fitzgerald 1998	public	New Zealand	yes	shooting only	RCD		poisons	other methods				
Fraser	public	New Zealand	exterminate	poisoning	trapping							
Feral goats												
Ballard 2005	public	NSW	yes	aerial culling (rural only)			aerial culling (urban)					
Fraser 2001	public	New Zealand	manage as a resource	shooting								
Fraser 2001	public	New Zealand	manage as a resource									
Hughey and Watson 2005	high country landholders	New Zealand	manage as a resource	sustainable management thru hunting								

Authors	Population	State/ country	Position on pest/ wildlife control	(Most) acceptable methods	(Most) unacceptable methods	Key criteria
Wild deer						
Peacock 2007	rural landholders	SA	yes			
Finch and Baxter 2005	landholders	Qld	no – maintain or increase population	recreational hunting		
Fraser 2001	public	New Zealand	manage as a resource			
Fulton et al 2004	local public	United States	yes	lethal control		
Chase et al 2002	local public	United States	yes	reproduction control	education capture and relocate sharpshooting at bait sites licensed sport hunting archers	
Messmer et al 1997	agencies	United States		public education	sharpshooting	
Messmer et al 1997	public	United States		immuno -contraception	damage compensation immuno -contraception	
Curtis et al 1993	public	United States	yes	contraception	fencing sharp shooting	humaneness effectiveness
Lauber et al 2007	public x2	United States		fertility control	capture and relocation	hunting opportunity humaneness
Water buffalo						
Robinson et al 2005	indigenous people	NT	manage as a resource	collaborative/participatory		
Flying fox						
Ballard 2005	fruit growers	NSW	eradicate	unlimited grower shooting	subsidies for exclusion netting shooting/unlimited	banning culling
Ballard 2005	public	NSW	no	subsidies for exclusion netting	replant habitat	banning culling
Possoms						
Shepherd and Urganhart 1991	public	New Zealand		shooting	trapping	predators poisoning
Fitzgerald et al 1996	stakeholders	New Zealand	yes (+ resource)			social and econ benefit

Fitzgerald et al 1996	public	New Zealand	yes	contraception	shooting	trapping	no control	poisons	imported diseases		
Fraser 2001	public	New Zealand	extermination	poisoning			no control	biocontrol			
Wilkinson and Fitzgerald 2006	public	New Zealand	yes	interfering with fertilisation	interfering with breeding hormones	immuno-contraception in GMO plant-based bait	trapping	specific poison			
Kangaroos and wallabies											
Johnston and Marks 1997	public	Vic	manage as a resource	shooting	biocontrol	permanent fertility control	trapping	poisoning			
Ballard 2005	public	NSW					aerial shooting				
Ballard 2005	public	NSW		capture and relocate	public education						
Fraser 2001	public	New Zealand	control at low numbers								
APRC 2006	public	New Zealand	yes	hunting and shooting	trapping	exclusion	biocontrol	aerial baiting		specificity	humaneness
Stoats											
Fitzgerald et al (2005)	public	New Zealand	yes	kill and hold trapping	GE fertility virus	immuno-contraceptive	imported mustelid disease	virulent canine distemper		specificity	effectiveness
Coyote and wolves											
Arthur 1981	public	United States	yes	guard dogs	repellents	fertility control	fatal methods	trapping		humaneness	specificity
Kellert 1979	public	United States	control individual problem animal	capture and relocate			unlimited shooting and trapping	poisoning		humaneness	
Kellert 1985	livestock farmers	United States	yes	poisoning			capture and relocate				
Zinn et al 1998	public	United States	only if diseased								
Decker et al 2004	public	United States	fatal control if competition for food	non lethal control if required			lethal control				
Elk											
Chase et al 2002	public	United States	no or population increase	public education	restricting development impact on habitat	capture and relocate	shooting at bait sites	fatal methods			

GMO = genetically modified organism

2.1.2 Attitudes overseas

In the United States, Sanborn and Schmidt (1995) surveyed a representative sample of 76 female and 354 male professional members of the Wildlife Society to ascertain gender differences in attitudes to wildlife management issues. The survey questions included a rating of the ethical acceptability of various generic 'techniques for controlling growth of wildlife populations' (1995, p586). Using an 11 point scale ranging from 'not ethical' to 'very ethical', respondents were asked to rate shooting, trapping, poisoning, chemical repellents, scare devices, habitat manipulation and fertility control. No explanation was provided of the specific application of each technique, and no target animal species were specified. The female respondents gave lower scores than males on the ethical acceptability of all the control methods (Sanborn and Schmidt 1995, p586), although only poisoning was clearly rated as unacceptable. Male respondents also regarded poisoning as unacceptable. The most acceptable method to the female respondents was the use of scare devices, followed closely by fertility control and habitat manipulation, then shooting, chemical repellents and trapping. Male respondents had different views, rating shooting as the most ethical, followed by scare devices, habitat manipulation, chemical repellents, trapping, fertility control, and poisoning. In general, males and females differed little in their ratings of the ethical acceptability of each of the control methods except for poisoning and trapping. Note that Sanborn and Schmidt (1995) do not make it clear if the respondents gave the ratings according to their own ethics or what they assumed the wider public might think.

Sanborn and Schmidt (1995) also collected data on the importance of various criteria for choosing between lethal management techniques. Respondents rated the importance of the most 'cost effective', the most 'selective' (specific) for the target species, the most 'selective' for the target individual animal, the most 'fast acting' and the 'least painful' (1995, p586). Both females and males regarded species specificity of the method to be the main criterion (ie rated '9' or over on the 10-point scale of importance) followed by the two humaneness criteria (least painful and fastest acting). Cost effectiveness, which was rated moderately important by both male and female respondents, was the least important of the five criteria. These results are very consistent with those of Fitzgerald et al (2002, 2005) in their research on stoat control in New Zealand.

Reiter et al (1999) surveyed 600 adult residents of five Wildlife Service regions in the United States on the topic of federal involvement in wildlife management. Respondents tended to be older, more likely to be retired, have above-average education, be male, and urban resident than the general population. Asked about compensation for wildlife damage, 56% felt that companies should not receive compensation for wildlife damage and 54% felt that individuals should not receive compensation. These findings were similar to those of Kellert (1979) and McIvor and Conover (1994).

Reiter et al (1999) asked survey participants to rate their agreement or otherwise with nine statements about wildlife management/control. The majority of respondents generally agreed that wildlife control was acceptable (1999, p753). In particular, they agreed that:

- it is acceptable to remove wildlife that prey on livestock
- farmers have the right to control wildlife that damages crops
- wildlife should be controlled by humans
- hunting is an acceptable tool for controlling wildlife that damages crops
- predators are an inherent risk in livestock production
- predator control is acceptable
- it is acceptable to control wildlife that cause damage resulting in economic loss.

The majority (63%) of respondents felt that poisons were unacceptable for controlling wildlife populations, and were split/neutral about the acceptability of controlling native animals that prey on threatened or endangered species.

Respondents in Reiter et al's (1999) study were also asked to rate the importance of various factors (or criteria) when selecting wildlife control methods. These factors were, in order of rated importance: human safety, animal suffering, effectiveness, environmental impacts, severity of the wildlife damage problem, ability to target specific animals, cost, and public opinion. The majority of the respondents rated all the criteria as important except for public opinion (1999, p754).

Reiter et al then asked survey participants to rate the perceived humaneness of eight non-lethal and nine lethal methods for managing wildlife damage. The majority of the respondents rated all the non-lethal methods as 'humane' or 'very humane'. In order of perceived humaneness, these included: adjusting planting or grazing schedules, using human guards, exclusion fencing, scare devices, fertility control (unspecified), guard dogs/animals, chemical repellents, and live (hold) traps. All but one of the lethal methods were rated by the majority as unacceptable or very unacceptable. These methods included: 'calling and shooting', poisoning of predators, fumigation or gassing of dens, poisoning of birds, foot snares, shooting of animals from aircraft, neck snares, and leg-hold traps (the last two being considered unacceptable to 80%). The only acceptable lethal wildlife management method was 'poisoned baits for rodents'.

2.2 Multiple species

A number of studies identified in this review focused on a range of pest animals, although they did not always discriminate between species in terms of the use of particular control methods. Yet other studies covered species that are not priorities of the IA CRC or Australasia.

2.2.1 Attitudes of Indigenous Australians

Using open-ended interviews with approximately 400 Indigenous men and women from 72 communities and outstations across the Central Land Council area, Rose (2007) investigated resource and land-management issues, including the status and management of introduced pest animals, among Indigenous Australians. His research revealed that Indigenous people in Central Australia tend to have world views about introduced feral (pest) animals that were quite different from those of managers of government land and wildlife. For example, Indigenous people do not see an 'incompatibility between native animals and introduced animals using the land together'. While Rose's interviewees were concerned about physical damage to fences, gardens and so on caused by feral animals, such damage was regarded as one of the nuisances that comes from sharing the land with animals. Even when the presence of large numbers of feral animals is recognised as negatively impacting on the country (eg fouling water holes or reducing the availability of certain plants and animals), Indigenous people generally do not connect this with 'a need to carry out special forms of management' (2007, p8). Also, just because some animals were recent arrivals in the country, it does not necessarily mean that they should be managed differently from other species, and it is generally held that introduced animals (especially those that have served human beings, such as horses) have a right to live on the country now. Hence Rose notes that 'in general, Indigenous people do not understand the rationale for feral animal control programs' and do not necessarily see a direct connection between control interventions and the return of native species to the country (2007, p8). Rose also notes that in many areas, feral animals are seen by Indigenous people as a resource of their country: 'their presence confirms that the land is productive and people derive pleasure from seeing them in the wild'. Hence, Indigenous people were noted as supportive of control programs that involve harvesting pest animals as a resource, but not supportive of control programs aimed at reducing or eradicating pest animal populations without making use of the animals (Rose 2007, p89).

As part of national park planning in Northern Australia, Robinson et al (2004) conducted workshops, small group meetings, fieldtrips and interviews with knowledgeable indigenous elders. The aim was to understand the Jawoyn traditional owners' views about feral animals, their impacts and management on their country. The Jawoyn research collaborators were asked to articulate the values they associated with pigs, horses and buffalo and identify key indicators

that measured the impacts each species had on habitats within their country. In general, the Jawoyn research participants were found to be wary of extreme actions in environmental management, such as attempts to entirely eradicate feral animals. More specific findings are covered in the relevant sections below.

2.2.2 Other attitudes in Australia

In late 2007, Fisher and Cribb (2008a) initiated an internet-based panel survey designed to monitor the Australian public's awareness of pest animal issues, attitudes to various forms of pest animal control, attitudes to pest management efforts, and awareness of the IA CRC. At the time of this literature review, the 'Community Awareness Survey' (CAS) survey had been running for 12 months. The survey was administered online to a rolling panel of 40 respondents per week and was designed to achieve, over a 50-week period, a representative sample of 2000 Australians. The survey participants were recruited by an independent 'internet panel provider' with participants chosen on the basis of their access to the internet, willingness to participate, and demographic characteristics. The online survey form contained closed and open-ended questions. In each weekly survey, respondents were asked to rate, using a 10-point scale, the acceptability of various methods of invasive animals' control (Fisher and Cribb 2008a). These control methods included both established and potential forms of pest control:

- baiting with a traditional poison
- baiting with a new generation more humane poison
- destroying nests/habitats
- gassing
- exclusion
- shooting
- trapping for humane euthanasia
- biological control
- fertility control
- genetic control.

No explanation of any of these methods was provided in the questionnaire (or research reporting), so it is not clear what was specifically meant by 'a traditional poison', 'a new generation poison', and 'exclusion', or what form the 'biological control', 'fertility control', or 'genetic control' might take. Nor was it explained which pest animals might be controlled by which method. The respondents were also asked to rate:

- the importance of 'developing effective, safe and humane controls for Australia's pest animals'
- the amount of effort they believe 'Australia should put into pest animal control'
- their willingness 'to participate in community or local government programs to control pest animals' (Fisher and Cribb 2008a).

No explanatory notes were provided in the questionnaire for the terms 'effective', 'safe', or 'humane'.

The first quarterly report on the survey findings (January 2008, Fisher and Cribb 2008a) covered 433 responses, the second report (July 2008, Fisher and Cribb 2008b) covered 439 responses, and the third report (October 2008, Fisher and Cribb 2008c) covered 433 responses. The total number of individuals covered by these response sets is not known. The January report indicated that fertility control was the most acceptable form of control to the respondents (with a mean acceptability rating of approximately 9 out of 10). This was followed equally by trapping, exclusion, destroying nests, genetic control, biological control, and baiting with a new poison (all with a mean rating of 8). Shooting was rated lower (rating 6), while gassing and baiting with a traditional poison were neither acceptable nor unacceptable (with a mean rating of 5). In general, the established and most common methods for pest animal control received the lowest ratings, although none fell into the category of being 'unacceptable'. Females tended to give lower acceptability ratings to all methods than males.

The same pattern of responses on the acceptability of the various pest controls is evident in the two subsequent quarterly survey periods, July 2008 (Fisher and Cribb 2008b) and October 2008 (Fisher and Cribb 2008c). Thus, by the time of the October 2008 report, Fisher and Cribb felt that they had demonstrated 'a clear public preference' for fertility control, and 'strong support' for biological and genetic control methods, trapping for humane euthanasia and use of novel baits (2008c, p5). Despite having consistent average acceptability ratings of approximately '5' (a middle position — neither acceptable nor unacceptable), the authors argued that 'the public is distinctly hostile' towards the use of the main established control methods of 'traditional' poisons, gassing, and shooting and felt that 'pressures may rise to discontinue their use' (2008c, p5). Fisher and Cribb also reported that across the whole period of the survey to date, females were 'more hesitant about almost all forms of control' (2008c, p5) – assuming that giving a lower rating than males to the acceptability of a pest control indicates 'hesitancy'. In the October 2008 report, the authors suggested that giving such lower ratings to pest control methods is a matter of ignorance that needs to be corrected with 'education and public awareness activity' (2008c, p5).

In terms of the monitoring of national attitudes, the available findings for each reporting period and for the whole time series revealed relatively little variation in the acceptability of each control method over time, and little variation within each particular demographic group. With respect to the other relevant questionnaire items, the limited data from the Community Awareness Survey reports indicate that a consistently high level of importance was placed by the respondents on 'developing effective, safe and humane controls' (with average ratings consistently between 8 and 9 on a 10-point scale), that Australia should put a high level of effort (ie typically between 8 and 9 on a 10-point scale) into pest animal control, and that the respondents had a high level of willingness (ie between 7 and 8 on a 10-point scale) to participate in local pest control programs (Fisher and Cribb 2008c, p24).

2.2.3 Attitudes overseas

Lauber et al (2007) researched Americans' ethical positions on wildlife fertility control and other management options for invasive deer and feral cats. People involved in deer management and feral cat management were interviewed in six management sites in New Jersey, South Carolina and Illinois, and the feral cat sites in urban areas in New Jersey, Florida, and California. A total of 49 semi-structured face-to-face interviews were conducted. Of these, 20 were with people 'involved in deer management issues' and 29 were with people 'involved in feral cat management issues'. The authors found that the reasons for peoples' positions on fertility control of wildlife were 'varied', nuanced' and 'complex'. In general, the ethical arguments that people made fell into two groups: 'obligations to people' and 'obligations to animals and the environment' (2007, p124). The former group included statements about:

- standards for decision-making processes — appropriate process, stakeholder involvement and the neutrality of decision-making agencies
- public policy decisions — effectiveness, public acceptance, policy balance, resources, and equity in the distribution of costs and benefits
- management outcomes — health and safety, use of animals products from control operations, and human development issues.

Statements of obligations to animals and the environment covered:

- life, suffering and death — quality of life of the animals, killing, and hunting for recreation
- alterations to the characteristics of animals — animal behaviour and the 'wildness' of animals
- the wellbeing of individuals and communities of animals — protection of individual animals, species and ecosystems
- the impacts of invasive species — cats as predators and outdoor dwellers (Lauber et al 2007).

Lauber et al (2007) found that opponents of fertility control were more willing than supporters to accept killing animals as a solution to a variety of invasive animal problems (such as property damage, nuisance, vehicle collisions, disease transmission, and ecosystem damage). Protecting animals from being killed tended to be a lower priority concern than choosing effective actions for reducing animal-related problems. Some considered lethal methods to be more humane than chemical-based fertility control. Supporters of fertility control were found to be less willing to kill animals to solve the various animal problems, and tended to believe that killing the problem animals was justified only to alleviate their existing suffering (Lauber et al 2007, p126). In general, people's positions on the issue of fertility control for deer and feral cats were often related to the animal's perceived status as 'wildlife' and of the nature and effects of fertility controls compared with other management options.

McIvor and Conover (1994) surveyed 238 farmers and 231 non-farmers across three counties in Utah and Wyoming about their experiences of damage caused by wildlife and their preferences for control. Almost all the respondents were males. Animals covered by the study included seven animal species (common grey fox, mule deer, elk, coyote, racoon, black bear, mountain lion) and five bird species (sandhill crane, white-faced ibis, Canada goose, red-winded blackbird and yellow-headed blackbird). Farmers differed from non-farmers in their rankings of damage-causing species, and generally rated the frequency of damage by each species as greater (note that the 5-point scale used to measure 'severity' of damage/impact was actually a scale of frequency of damage, ranging from 'never' to 'frequent' with the extreme end-point on the scale being labelled 'severe'). The most clearly problematic species for farmers were, in descending order: deer, sandhill crane, elk, Canada goose and coyote, with bear and mountain lion the least problematic. Generally speaking, the non-farmers listed the same species as causing damage, though ranked them differently and generally rated them less problematic.

Respondents in the McIvor and Conover study were also asked about their preference for control methods, choosing between lethal methods, non-lethal methods, or whatever works best. Non-farmers preferred non-lethal control methods for most of the listed animals, though preferred 'whatever method works best' for the bird species. Farmers preferred 'whatever method works best' for all species except coyotes, against which they favoured lethal methods. Over two thirds of the farmers and half the non-farmers thought that sandhill cranes should be hunted in order to control crop damage.

In Scotland, Bremner and Park (2007) carried out a postal survey of 248 geographically representative members of the public to assess attitudes to conservation and the management of 15 invasive 'non native' species with the potential to have significant impacts on the economy or biodiversity of Scotland. The list of species included four mammals (grey squirrel, brown rat, American mink and European hedgehog), two birds (ruddy duck and Canada goose) and one fish (ruffe). Only the brown rat is of direct relevance to the IA CRC. Overall attitudes to wildlife control were assessed using level of agreement with five statements. Definitions of key terms (such as 'non-native species', 'native species', 'invasive', 'control' and 'eradication') were provided in the questionnaire. The majority of respondents (87%) agreed or strongly agreed that controlling some wildlife (native or non-native) is necessary to help conserve the environment, and agreed with controlling or eradicating invasive non-native species that cause economic damage, or that harm native or threatened Scottish species. Over two thirds felt that the methods used for controlling the particular animals would affect their level of support for control or eradication programs. The respondents were asked about their agreement or disagreement with the use of particular control or eradication methods for each species, with each species illustrated and its impacts on biodiversity described. The methods relating to animals, invertebrates, fish and birds were: poisoning, pesticides, trapping, shooting, lethal injection, egg destruction and sterilisation. Control measures that respondents agreed with the most were sterilisation and egg destruction. The majority disagreed with use of poisoning and trapping (Bremner and Park 2007).

2.3 Wild dogs and dingoes

2.3.1 Attitudes in Australia

Our previous literature review (Fitzgerald et al 2007) noted that 79% of Victorians surveyed by Johnston and Marks (1997) regarded wild dogs as pest animals. In terms of management options, 63% felt that wild dogs should be eradicated, 20% that they should be controlled at low numbers, 6% that they should be managed as a resource, 4% that there should be no management action and 7% were undecided. Half the respondents thought that shooting was the most appropriate control method, followed by (unspecified) biological control (12%) and poisoning and trapping (each favoured by 11%). The preference for shooting was confirmed by Ballard (2005) in his PhD research, where 54% of urban and 65% of rural New South Wales respondents felt that aerial culling of wild dogs should be permitted. When Johnston and Marks' (1997) respondents were asked to select between biological control, temporary fertility control, permanent fertility control and a humane and target-specific poison, the respondents preferred the humane poison (37%), followed by permanent fertility control (27%) and biological control (17%).

In his research on attacks by domestic dogs, Jennens (1998) refers to a survey he conducted of 337 livestock and dog owners in Perth, Western Australia. Asked how they might respond if their dog attacked livestock, 53% said they would have the dog destroyed, and 47% said they would restrain the dog at home or relocate it.

As part of an evaluation of a community-based 1080 poisoning program for wild dogs, researchers from the Queensland Department of Natural Resources interviewed 23 graziers inside the program area who were not participating in the program and a further 22 outside the program area (Allen 2006). The aim was to assess these farmers' attitudes to the use of 1080 for controlling wild dogs and their reasons for not participating. Many of those interviewed were former sheep producers forced out of the industry by poor prices and wild dog predation. Most had used 1080 baiting for dogs previously but had subsequently stopped. Among the 45 interviewees, a high proportion (42%) had had a 'bad experience' with 1080 (mostly the loss of farm dogs), and 84% said they didn't participate in the baiting out of fear of accidental poisoning of their farm dogs. Some of the interviewees (29%) also thought that baiting was ineffective, that it had a negative effect on wildlife (13%, especially increases in pest animals normally preyed on by wild dogs), that the baiting was done unprofessionally (11%), they were opposed to the use of poisons (11%), or they were too busy to get involved (7%). Some refused to bait wild dogs because they had an ongoing feud with another local person who advocated baiting. Importantly, a number of interviewees spoke of division in the community between those participating in local wild dog baiting programs and those not involved, and indicated that these divisions spilled over into other areas of rural life. The authors concluded that bad experiences with 1080, fear of poisoning working dogs, and community dissention was resulting in reduced participation in beneficial wild dog baiting programs in Queensland.

2.3.2 Attitudes overseas

Outside of Australia, Lindsey et al (2005) undertook face-to-face and telephone surveys of 209 cattle and game ranchers across three regions of South Africa, and three areas in Zimbabwe. The survey was designed to assess landowners' experiences of and attitudes to indigenous wild dogs, which are increasingly threatened in Southern Africa, and for which conservation support is being sought from private land owners. Of six listed naturally occurring predator species (wild dogs, cheetahs, jackals, leopards, lions and hyenas), wild dogs were rated the least favourably. This was mainly because wild dogs are seen as making a negative or nil contribution to ranch income, kill too much game, kill livestock, chase game and make it wild and/or chase it into fences, and that there is insufficient space for them. Attitudes varied according to cultural background, region, land use (ecotourism, cattle ranching and consumptive wildlife utilisation), whether the property was within a wildlife conservancy area or not, and whether the landholder already had wild dogs on their property. Regardless of the dominance of negative attitudes, the survey found that just over half the landholders were willing to consider having wild dogs on their ranches for the purposes of conservation.

2.4 Foxes

2.4.1 Attitudes in Australia

McGeary (2005) conducted a telephone survey of farmers as part of planning for the Victorian Enhanced Fox Management Program. Interviews were conducted with 503 managers of private agricultural properties with an area greater than 10 hectares in four sheep producing regions of Victoria where there are fox problems. The main reason given by the respondents for controlling foxes on their properties was predation on lambs. The most common control method used was shooting, followed by 1080 poison baiting and den destruction (used by 89%, 41%, and 38% respectively). Asked to rate the level of effectiveness of the various methods they used, shooting was considered the most effective (rating 3.8 on a 5-point scale), with 1080 baiting the next most effective (rating 3.5). Of the land managers who said they used baiting as a control method, 88% did so in combination with at least one other method, mostly shooting.

McGeary (2005) also found that the main reason for no longer using baiting to control foxes was the risks that 1080 poison posed to dogs, followed by a lack of confidence in the effectiveness of baits, the excessive amount of red tape required to do a poisoning and not being able to purchase bait without a licence. Likelihood of using baiting to control foxes was found to be directly related to farm size, level of involvement in farming on the property, whether livestock was being bred on the property, and involvement in a landholder group. Male land managers were significantly more likely than females to have used baiting to control foxes. Following the McGeary study, Riethmuller et al (2005) monitored and evaluated a community-based fox baiting program in 2004 in some of the areas where the McGeary survey had been conducted. They found a low level of participation by the landholders in the fox baiting program (18% in the autumn and 3% in the spring) despite there being fox problems, and that the barriers to higher level of participation were as McGeary (2005) had identified earlier.

As part of a campaign to detect and eradicate foxes in Tasmania, Fisher et al (2006) conducted an internet-based survey of 506 members of the public and 40 farmers to ascertain 'the views of the Tasmanian community about foxes, their presence in Tasmania and what, if anything, should be done about them'. Among other things, the respondents were asked to indicate (using multiple response questions) who should be responsible for addressing the problem of foxes in Tasmania, and what methods should be used 'for controlling foxes'. The limited published results from this study indicate that over 60% of the respondents felt the Tasmanian state government should be responsible for dealing with the fox problem, and about a third thought local and/or federal government should take the responsibility (Fisher et al 2006). Just over half of the respondents thought 'everyone' should be responsible for dealing with the problem. Respondents were also asked which of six possible fox control methods were agreeable to them. Only two methods were agreeable to more than half of the respondents: 'cyanide baiting' was agreeable to over 60% and 'education programs' to about 58%. Baiting with 1080 (the main form of fox control used in the Tasmanian campaign to that point) and 'humane toxins' were agreeable to about a third of the respondents, and 'shooting' and 'catching with dart guns' were agreeable to just over a fifth of respondents. The least agreeable methods were 'trapping' (about one seventh of respondents) and 'biological control' (about 2%). No explanatory details of each of the control methods were provided to the respondents and it is not clear how many of them, if any, understood what was involved with each method.

In Johnston and Marks' 1997 study in Victoria, 53% of the respondents felt that fox control should be focused on eradication, 26% felt fox should be controlled at low numbers, 13% felt they should be managed as a resource, 2% felt that there should be no control, and 6% were undecided. Over a third (35%) favoured shooting as the most appropriate control technique, followed by biological control (22%), trapping (16%) and poisoning (12%). Only 5% felt there was no suitable technique and 10% were undecided. In a further question on control methods,

respondents were asked to rank four specific methods. These were ranked as follows, in order of preference:

- a humane and target-specific toxin, where 'a bait is used with a poison that will kill only the intended species without subjecting it to any suffering' (31%)
- permanent fertility control, where 'the animal is normally living in the wild but is unable to reproduce for its entire life' (25%)
- biological control, which is 'a disease or other biological control agent that kills only the pest species eg myxomatosis in wild rabbits' (21%)
- temporary fertility control, which is 'where infertility is caused but is temporary or reversible' (16%).

Note that poisoning in general was considered less appropriate than biological control for foxes, but a specific and humane poison was preferred over a fatal biological control or a non-fatal fertility control. Johnston and Marks (1997) found no significant variation in attitudes to control methods by respondent characteristics.

2.4.2 Attitudes overseas

MacDonald et al (2006), in a major review of hunting with dogs in the United Kingdom, examined studies of farmers' and others' attitudes to foxes. Drawing on findings from a 1981 survey and three more recent surveys of farmers (conducted between 1992 and 2000), the authors note that most British farmers consider the fox to be a pest animal and generally rate it the third worst pest behind rabbits and badgers. Livestock farmers tend to rate the fox problem higher than other types of farmers. Regardless of type of farming, most farmers feel that foxes should be controlled in both the countryside and in towns. In the 1981 survey, involving over 800 farmers in eight counties where fox hunting occurs, 70% of respondents said they mainly culled fox to reduce or prevent loss of stock and/or to reduce a perceived excess population of foxes (67%; MacDonald et al 2006, p24).

An associated study by Heydon and Reynolds (2000) of farmers in Wales, the Midlands and East Anglia found that fox culling was done on 88% of properties, with the main reasons for culling/killing foxes being to protect stock, to protect game animals/birds, to be a good neighbour, for sport, and to prevent animal diseases. MacDonald et al (2006) report that the ranked order of reasons for culling foxes varied, according to the predominant land use in the particular region. In three surveys done in the 1990s, British game keepers consistently and almost universally rated fox as a major pest and indicated that fox control was necessary to limit damage to game (especially birds) and other wildlife. Other resource managers/interest groups, such as foresters and conservationists (except those trying to protect endangered ground-nesting birds) seem to be less concerned about foxes (MacDonald et al 2006, p57).

The main methods used for fox control in the United Kingdom seem to be closely related to sport/recreational hunting of foxes with or without dogs, such as organised horseback or foot hunts, use of terriers to flush out fox earths, spotlighting/shooting, and organised standing shoots with beaters (MacDonald et al 2006). Night shooting, hold trapping, and snaring is also done by game keepers and other wildlife managers. MacDonald et al (2006) note that 'in recent years, ethical and conservation concerns over culling have led to increasing interest in non-lethal methods of population and damage control', including fertility control, use of repellents and other methods to change fox behaviour, exclusion fencing, and changes in stock management (2006, p76). With respect to attitudes to control methods, especially hunting with dogs, the authors also report that national surveys (eg the 1997 and 1999 MORI polls) have commonly found that hunting foxes and other wild animals with dogs is considered unacceptable to the United Kingdom public, and is not regarded as necessary to control the numbers of such animals. Surveys of farmers (eg the 1981 study) noted that shooting was consistently regarded (by 69%) as the most humane method of fox control, followed by hunting with dogs (55%). The rating of humaneness of some methods was related to the farmer's experience of stock loss to fox.

2.5 Feral cats

Two studies have looked at attitudes to feral cat control: Johnston and Marks in Victoria and Fraser in New Zealand.

2.5.1 Attitudes in Australia

Johnston and Marks (1997) found that most (96%) Victorians regarded feral cats as pests, but did not see domestic cats the same way (only 34% regarding them as pests). The clear preference of respondents was for eradication of feral cats (84%). There was no clear preference for a particular control method: 30% preferred shooting, 24% trapping, 23% biological control and 11% poisoning. When asked to rank four particular feral cat pest control methods in terms of preference, 40% indicated 'a humane and target specific toxin', followed by 'permanent fertility control' (32%), 'biological control' (19%), and 'temporary fertility control' (4%).

2.5.2 Attitudes overseas

Fraser (2001) found that most New Zealanders (90% of those surveyed) regarded feral cats as a pest and would not like to encounter them in the high country or bush. However, New Zealanders are more in favour than Victorians of poisoning as a control method, 44% finding it the most acceptable control method, followed by shooting (27%), trapping (20%) and biological control (9%).

2.6 Feral pigs

Attitudes to feral pig control have been studied by Robinson et al (2004) among Indigenous Australians, by Oliver and Walton (2004) in Queensland, Fraser (2001) in New Zealand and Adams et al (2005) in Texas, United States.

2.6.1 Attitudes of Indigenous Australians

Working with the Jawoyn people of Northern Australia, Robinson et al (2004) found that wild pigs are seen as making 'a big mess', damaging country, sacred sites, bush tucker and waterholes, eating wildlife, spreading unwanted seeds, and chasing out other species and people. As such, wild pigs threaten people's connection with the land. As with other pest species, Jawoyn people were uncomfortable with shooting pigs if the dead animals are wasted, and expressed a desire to explore other management and control options such as hunting pigs for meat. At the same time, Jawoyn men who regularly hunt wildlife reported that pigs are hard to hunt, and that threat of disease, fear of being attacked, and abundance of better game have reduced the value of this animal as a food source.

2.6.2 Other attitudes in Australia

In Oliver and Walton's Queensland survey (2004), feral pigs were found to be the second most problematic pest animal for primary producers (especially in the North and Central West of the state), but barely rated as pests among the residents of regional centres and country towns. Ballard's PhD research (2005) provides us with the only concrete data on preferences for pig control. In his survey of the New South Wales public, 66% of the urban respondents and 76% of the rural respondents felt that aerial culling (shooting) of wild pig should be permitted.

2.6.3 Attitudes overseas

In New Zealand, Fraser (2001) found that the public saw feral pigs as both a resource (76% of respondents) and a pest (65%). About 20% of the survey respondents regarded pigs as only a pest. Hence, people's preferences for controlling feral pigs were: management as a resource (54%), control at low numbers (30%), extermination (10%) and doing nothing (5%). The vast majority of people felt that where control was necessary, animals such as pigs should be used for a commercial purpose. When asked to choose between shooting, poisoning and hunting using dogs, a clear majority (75%) felt that shooting was the most suitable control method for feral pigs.

In the United States, Adams et al (2005) surveyed a representative sample of 775 land managers in Texas about their experience of, and attitudes to, feral pigs ('hogs') and their control. Respondents reported largely negative attitudes to feral pigs, seeing them as an agricultural pest (89%), a disease hazard (34%) and an environmental (45%) and economic (50%) liability. Unlike in Australia and New Zealand, relatively few respondents (30%) considered feral pigs to be a recreational hunting resource, although the percentage varied by region. For 61% of the respondents, pig control was incidental/ad hoc and only 23% had specific intensive control programs. The main control methods were shooting (87%) and trapping (75%), while less than 13% used fencing, aerial hunting or guard animals. Most of the pig control work was undertaken by the land managers themselves and/or by recreational hunters. The authors concluded that more Texan landholders should regard feral pigs as a recreational hunting asset, income from which could help offset losses and the costs of control.

2.7 Feral horses

2.7.1 Attitudes of Indigenous Australians

Robinson et al (2004) found that feral horses are historically important to the Jawoyn and other Indigenous groups in Northern Australia. Because they were used as transport and for station work, feral horses are seen as connected to the Jawoyn forebears, and so present-day local people have a respect for and attachment to feral horses. In general, the Jawoyn were aware of damage that horses can do to some vulnerable areas, and felt that control was necessary in some areas. However, they felt that such control should be done cooperatively and with restrictions or limits.

2.7.2 Other attitudes in Australia

Nimmo and Miller (2007), in reviewing the literature on feral horse management in Australia, noted that despite public controversies surrounding feral horse management, little applied social research appears in the academic peer reviewed literature. However, there have been several recent localised studies (Dawson et al 2006). Nimmo and Miller (2007) summarise the results of studies they are aware of, although only two studies examine attitudes to feral horse control/management, these being Nimmo's and Ballard's theses (both published in 2005).

Ballard (2005) conducted a case study of community experiences, beliefs and management preferences relating to feral horse management in the Guy Fawkes River National Park in New South Wales. The study included a postal survey of 877 members of the rural and urban publics in the New England Electoral District (adjacent to the park). When asked about an overall strategy, only 11% of the urban and 16% of the rural respondents wanted to have no wild horses at all in New South Wales, while most of the remainder were prepared to have wild horses in national parks and/or on private land but as 'managed populations' (2005, p74). A total of 42% of the urban respondents and 56% of the rural respondents supported aerial

culling of wild horses in New South Wales' national parks. However, among urban respondents the preferred control methods were capture and removal to private property (53%), capture and removal for consumption by people or pets (44%) and contraception (30%). Rural people preferred removal for consumption (48%), removal to private property (47%) and ground shooting (34%). Both groups of respondents regarded poisoning as the least acceptable control option for wild horses (approximately 75% opposed), followed by no control (56%) and aerial shooting (46%) (2005, p77–78). Ballard noted that the variation between urban and rural people in New South Wales needed to be taken into account in future feral horse management actions.

Nimmo, Miller and Adams (2007) undertook a postal survey of 105 urban and rural Victorians 'to identify factors which influence people's perceptions of feral horses and their management and to highlight social preferences for available management techniques' (2007, p238). The survey participants were asked to rank, according to preference, four horse 'management techniques': immobilisation, mustering and trapping, shooting from the ground, and shooting from helicopters. The respondents were also asked to indicate if any of the four methods were 'never acceptable' (Nimmo et al 2007, p239). The wording of the questions is not known, nor if each control method was explained. Mustering and trapping was the most preferred lethal management method (44% giving it as first preference), followed by immobilisation (31.2%), ground shooting (20%) and aerial shooting (4.3%). Approximately half of the respondents felt that helicopter shooting of feral horses was never acceptable. The authors note that, as might be expected, people's view on whether feral horses are a pest or not, and whether feral horses caused environmental damage, influenced their acceptance of lethal forms of management (Nimmo et al 2007).

2.7.3 Attitudes overseas

Fraser (2001) found that approximately 49% of respondents to his 1994 survey regarded feral horses as a pest in New Zealand, and 73% saw them as a resource. Consequently, the participants felt that feral horse control should be given low priority for funding. Asked if they would prefer to see wild horses or native plants protected in the Kaimanawa Ranges of the Central North Island, the majority (60%) said they would prefer to see both protected, while 30% preferred to see the plants protected (which would require the removal of feral horses from the area or a reduction in their numbers).

2.8 Rabbits

Since 1990, there have been several investigations of attitudes to rabbit controls in Australia and in New Zealand, the latter being national-level studies.

2.8.1 Attitudes in Australia

In Australia, Johnston and Marks (1997) surveyed Victorians' attitudes and found that 95% considered wild rabbits to be pests and 56% felt they should be eradicated. However, 22% felt that they should be managed as a resource, and 19% that they should be controlled at low numbers. Almost no one felt that there should be no management intervention/control. Just under half the respondents (46%) thought that biological control was the most appropriate control method, followed by shooting (18%), poisoning (15%) and trapping (11%). When asked to choose between biological control, temporary fertility control, permanent fertility control and a humane target-specific poison, biological control was the most preferred (by 41%), followed by permanent fertility control (24%), poisoning with a specific and humane toxin (23%) and temporary fertility control. The popularity of biological control for rabbits in this survey was essentially an endorsement of the use of rabbit haemorrhagic disease (RHD, also known as rabbit calicivirus disease or RCD) and other rabbit-specific diseases. Attitudes to control methods did not seem to vary significantly by sociodemographic characteristics.

The Roy Morgan Research Centre (1995) surveyed 1537 Australians and 360 New Zealanders (see below) about their awareness of and attitudes to a range of rabbit control methods, especially RCD/RHD. Over 90% of respondents felt it was important to control rabbit numbers. Awareness of the main rabbit control methods in use at the time, except for warren destruction, was high, although the majority were not aware of proposed controls (RCD and 'a virus that causes infertility'). Respondents were asked to indicate the acceptability of the following six control methods, each of which was explained:

- poisoning (which takes between two and four hours for rabbits to die)
- shooting and hunting (using dogs or ferrets)
- warren destruction (such as ploughing up warrens)
- biological control using myxomatosis (a natural virus which causes rabbits to die within 2 to 3 weeks)
- proposed biological control using RCD (a natural virus which causes rabbits to die within 48 hours)
- proposed biological control using a genetically engineered (GE) virus that causes infertility.

Among the Australian respondents, the methods acceptable to the majority were a GE infertility virus (acceptable to 84%), shooting and hunting (70%), RCD (62%) and warren destruction (60%). Myxomatosis and poisoning were not acceptable to the majority. All the control methods were more acceptable to rural respondents than urban respondents. When RCD was specified in more detail, its acceptability rose to 68% among Australians. 13% of Australians said they were not able to decide. The authors of the study noted that females aged between 16 and 50 were the most likely to oppose RCD (Roy Morgan Research Centre 1995).

Polonsky, Binney and Hall (2004) examined stakeholder involvement in rabbit control as part of a study about public policy development. Three key sets of issues were identified through four stakeholder focus groups: community responsibilities in pest control, control program implementation issues (especially control methods used and funding) and issues to do with the governmental bodies that developed and implemented policy and control programs. A subsequent telephone survey of 566 land managers was conducted in an unnamed region of Australia where there are rabbit problems to obtain their views on the key aspects of rabbit management. Sixty factors relating to rabbits in the area were rated for their importance. Factor analysis grouped these into 11 factors, which were in turn grouped into three categories: community responsibilities, implementation issues and governmental issues. The most important individual issues overall were community commitment to the control program (not just land managers), budget priorities, control techniques and presence of the species. The authors believe these results suggest that the design of pest management programs and policies requires a broad-based and integrated approach (Polonsky et al 2004).

2.8.2 Attitudes overseas

As mentioned above, the Roy Morgan Research Centre (1995) surveyed 360 New Zealanders about their awareness of and attitudes to a range of rabbit control methods. Over 90% of respondents felt it was important to control rabbit numbers and awareness of the main rabbit control methods in use at the time, except for warren destruction, was high. However, most New Zealander respondents were not aware of RCD and 'a virus that causes infertility'. The respondents were asked to indicate the acceptability of the six control methods listed above.

Among the New Zealand respondents, methods acceptable to the majority were shooting and hunting (acceptable to 86%), an infertility virus (73%), poisoning (58%) and warren destruction (55%), while RCD and myxomatosis were seen as unacceptable. All the control methods were more acceptable to rural respondents than urban respondents. When RCD was specified in more detail, its acceptability rose to 50% among New Zealanders. New Zealanders were more likely than Australians to equivocate, with 28% saying they were not able to decide. The authors of the study noted that females aged between 16 and 50 were the most likely to oppose RCD (Roy Morgan Research Centre 1995).

Also in New Zealand, Sheppard and Urquhart (1991) conducted a national telephone survey of 1000 members of the public about attitudes to, among other things, the control of rabbits. Respondents were asked to rate the 'suitability' of:

- shooting
- 1080 poisoning
- poisonous gassing
- commercial harvesting
- introduction of a rabbit-specific disease (eg myxomatosis)
- encouraging predators that will kill rabbits (eg ferrets).

Only commercial harvesting and shooting were regarded as suitable by the majority (respectively by 74% and 68%; Sheppard and Urquhart 1991). Encouraging predators and poisonous gassing were considered unsuitable. Males and female respondents differed in their attitudes to the various methods, with males rating all methods as more acceptable than females. Importantly, the majority of males felt that 1080 poisoning and a rabbit-specific disease were suitable control methods whereas the majority of females did not. For the most part, the respondent's age and place of residence (rural, town or city) were not factors in ratings of suitability. It is worth noting that the acceptability of biological control increased when it was specified as being natural, for rabbits and affecting only rabbits. When asked about myxomatosis, the vast majority said they had heard of it and were able to say how it affected rabbits, 49% felt it was a 'good idea' or 'okay' to introduce it to New Zealand, and 45% said they were 'opposed' to its introduction (1991, p56). When asked about introducing another kind of rabbit disease such as Spanish flu virus (ie RCD/RHD), only 27% said it was okay or a good idea, 49% were opposed and importantly, 23% did not know. From this study it seems that the acceptability of a disease-based biological control for rabbits depends on the degree to which the control is specified (target animal, target specificity, type of organism, name of the organism and its known effects) and whether it is known to the public (Sheppard and Urquhart 1991).

Fitzgerald, Saunders and Wilkinson (1996) undertook national-level research in New Zealand into stakeholder and public attitudes to the control of rabbits and possums in 1994. They conducted 11 focus groups (three with members of the public and eight with sectoral and interest groups) and a telephone survey of 1127 randomly selected members of the public. The focus groups revealed a preference for manpower-based rabbit controls, such as shooting and trapping, and this preference was based on a desire to create employment and commercial opportunities as well as practical, environmental and ethical concerns over the use of 1080 and biological controls. The focus groups also revealed a dislike of poisons, with the urban public groups not convinced of 1080's safety. The authors note, however, that as discussions progressed in the groups, doubts tended to arise about the effectiveness and cost of manpower methods and about the uncertainties and risks of biological controls, which generally resulted in a reluctant acceptance of the continued need for 1080 poisoning (Fitzgerald et al 1996). When asked about the possible introduction of the RCD/RHD virus, most groups were initially uncertain or neutral, with discussion centering on the humaneness of the disease and the long and short-term risks and uncertainties. As discussion proceeded about these risks, most groups moved from neutral to a negative position on RCD/RHD (Fitzgerald et al 1996).

In the associated national telephone survey by Fitzgerald and colleagues (1996), respondents were asked to rate, on a 5-point scale, the acceptability of the following four current and two potential methods for 'killing rabbits':

- trapping
- shooting
- aerial use of 1080 poison bait
- use of other poisons (such as Pindone)
- an imported naturally occurring virus which is specific to rabbits
- an organism that has been genetically engineered or modified to kill only rabbits.

No other details or explanations of the control methods were provided. Of these methods, shooting and trapping (the manual methods that would also facilitate commercial exploitation of the rabbit) were the most acceptable, respectively to 83% and 66% of the respondents. No other method was acceptable to the majority, although the proposed biological controls (ie a rabbit-specific genetically modified organism [GMO] and a rabbit-specific virus) were more acceptable than aerial baiting with 1080 and use of other poisons. Males were significantly more accepting than females of poisons and biological controls. When asked specifically about RCD (with explanation provided), 51% said it should be introduced to New Zealand. However, based on a detailed analysis of the reasons people gave for accepting or rejecting RCD, Fitzgerald et al concluded that only about a third of the public would support the introduction of RCD, while a further third might support it if their information needs were met and their risk concerns resolved. This is similar to the position the focus groups' participants reached after discussion of the pros and cons of RCD and other biological controls, and in this respect the study points out the importance of exploring attitudes in more depth in surveys.

In a follow-up study in 1996, at the time when RCD was being evaluated for its introduction to New Zealand to control rabbits, the Fitzgerald research team looked again at public attitudes to the various methods for 'killing rabbits'. Seven focus groups were conducted, followed by a national telephone survey of 600 members of the public – 289 having been interviewed in the earlier study in 1994 (Wilkinson and Fitzgerald 1998). In this second survey the key features of each of the control methods was explained. In the focus groups shooting was the most preferred, being seen as quick and humane but expensive, and 1080 was seen as effective but also a risk to non-target species and to human health (1998, p17). Control methods were regarded as acceptable if they were effective, cheap, humane, safe for non-target species and the environment, provided employment, understood, controllable, and if the target animal does not develop a resistance (as in the case of a biocontrol organism). Unlike in the earlier survey, shooting was the only method that was clearly acceptable to the majority of the respondents (77%). The least acceptable methods were the poisons (30%). Shooting, trapping, aerial baiting with 1080 and the use of other poisons were all more acceptable to males than females, and people aged 40 and over were more accepting than younger people of poisons and biological control. Trapping was much less acceptable to the public in this survey than in the previous survey (48% versus 66%).

The respondents in the survey were also asked to rate the risks to the environment, economy and people's health of the various rabbit control methods. 'Not controlling rabbits' was rated the most risky for the environment and the economy (Wilkinson and Fitzgerald 1998). Of the rabbit control technologies listed, the two poisoning methods were seen as the riskiest in each of the three risk domains, and females rated the risks of the manual and poisoning methods higher than males. The differences between females' and males' ratings were greatest with respect to the perceived risk to peoples' health. Asked about whether RCD should be introduced to New Zealand, similar proportions supported and rejected it as in 1994. As previously, respondents were classified into six groups or segments, based on their reasons for accepting or rejecting RCD. Together, the 'supporters' and 'concerned supporters' (those most likely to actually support its introduction) made up 56% of the respondents, the 'cautious', 'worriers' and ecologically concerned made up 37%, and the outright 'rejectors' made up 7%. There was a strong correlation between people's position on RCD as a specific biological control organism and their attitudes to poisons, a rabbit GMO and a rabbit virus.

Fraser's survey of 845 New Zealanders in 1994 briefly covered attitudes to rabbit control. The majority (approximately 62%) of respondents thought that rabbits should be exterminated, 25% that they should be controlled at low numbers and 12% that they should be managed as a resource (Fraser 2001). 'Poisoning' (unspecified) was the preferred control method of 48% of respondents, followed by shooting (26%), unspecified biological control (17%) and trapping (5%). As with the surveys by Sheppard and Urquhart (1991), Fitzgerald et al (1996), and Wilkinson and Fitzgerald (1998), there were significant gender differences in the level of acceptability of different control methods. For example, females were far less in favour than males of poisoning and biological control, and consequently more in favour of shooting and trapping.

2.9 Feral goats

2.9.1 Attitudes in Australia

In the Queensland survey conducted by Johnston and Marks (1997), 5% of the 822 respondents listed feral goats as a pest species, although the authors did not investigate attitudes to goats and their control in the study. The only research-based Australian data on public preferences for goat control comes from Ballard (2005), who notes that in a survey of the New South Wales public, 42% of urban and 52% of rural respondents felt that aerial culling (shooting) of wild goats should be permitted.

2.9.2 Attitudes overseas

Fraser (2001) asked about feral goats as part of his survey on attitudes to introduced wildlife in New Zealand. Of the 76% of respondents who had visited a national park or large forest area in the previous five years, an unexpectedly high percentage (30%) said they had seen feral goats. Of these, 42% said that seeing the goats had added to their enjoyment of the visit to the park or forest, while 31% said it detracted from their enjoyment. Approximately 54% felt they would enjoy seeing feral goats in the 'bush or high country' if they encountered them. Nevertheless, the majority of the respondents (73%) regarded feral goats as a pest animal. At the same time, approximately 71% of respondents saw feral goats as a recreational, aesthetic or commercial resource. Almost all respondents (98%) thought feral goats should be managed, with 47% wanting them managed as a resource, 36% wanting control at low numbers, and approximately 15% supporting extermination. Shooting was the most acceptable control method (supported by 85%), followed by hunting with dogs (7%) and poisoning (5%). Asked to prioritise pest control resources, feral goat control was allocated one eleventh of a theoretical pest control budget, behind possums, rabbits and wasps.

Himalayan thar (*Heitragus jemlahicus*) is a wild goat originating from Asia, which was introduced to New Zealand in 1904 and subsequently became regarded as an environmental pest. Several attitude surveys have been conducted about thar and their management. For example, Fraser (2001) found that 33% of the New Zealand public regarded thar as an aesthetic, recreational or commercial resource, 11% as a pest, and 24% as both pest and resource. The public therefore tend to see thar more as a resource rather than a pest (ie 57% versus 35%) and management preferences reflected this, with 47% wanting thar managed as a resource, 25% wanting them controlled at low numbers, 5% supporting extermination, 5% wanting nothing to be done, and 18% not knowing what should be done. Attitudes to the use of particular control methods for thar were not explored in the survey.

Hughie and Wason (2005) surveyed 43 New Zealand high country run holders (farmers) on the management of thar on their properties. Most run holders (84%) saw thar as a valuable recreational hunting and commercial resource rather than a threat or problem, and their preferences for management reflect this. More than 90% placed a value on thar on their properties — mainly recreational value for hunters and commercial value for hunting guides and safari hunting operations — and just under 60% accommodated professionally guided hunting on their properties. Almost 75% of the respondents felt that enough was being done to manage thar numbers in the high country, and nearly all respondents thought enough was being done to manage thar on their own properties. In terms of control and management, 92% of the respondents opted for 'sustainable management' of thar populations, with the property owners themselves being responsible for control, with or without the help of conservation and/or hunting organisations.

2.10 Wild deer

A search of the literature revealed Australian, New Zealand, American and British studies of attitudes to deer and deer management techniques.

2.10.1 Attitudes in Australia

In Australia in 2006, the former South Australian Department of Water, Land and Biodiversity Conservation undertook a postal survey of 507 rural landholders in the southeast of South Australia, where there had been increasing reported impacts from a range of feral deer species (Peacock 2007). The survey asked about deer species encountered, impacts, landholder control efforts, issues and attitudes. Half of the respondents reported they had no feral deer on their property, although two thirds of respondents saw deer as a 'pest' or 'potential pest'. Just under half of the landholders listed various barriers to feral deer control, the most common being 'lack of time' and feral deer not being seen to be a problem. Asked to indicate their desired level of deer control, almost half of the landholders thought that deer numbers should be reduced by '76%–100%'. Landholder attitudes towards feral deer in the principal deer area in southeast South Australia appear to be somewhat contrary, and more negative towards deer, than those of Queensland landholders (Finch and Baxter 2007).

Finch and Baxter (2005) surveyed 583 landowners and managers in three regions of Queensland about their attitudes to wild deer on their properties. Over half the respondents did not believe that deer had a negative environmental impact, were an agricultural pest, or were a management problem for them. Only 29% rated wild deer as a significant or very significant agricultural or environmental pest in Queensland. More than half of the respondents (56%) expressed a preference for maintaining the deer population or increasing it slightly, while 27% wanted complete removal of the deer. The most favoured 'mode of population management' was game meat harvesting (51%), followed by recreational hunting (42%), no management intervention (29%), trapping (17%) and poisoning (<5%).

2.10.2 Attitudes overseas

In New Zealand, Fraser (2001) found that only about 5% of those he surveyed regarded wild deer purely as a pest, while 45% saw them as a resource and 50% as both pest and resource. The predominant view of wild deer in New Zealand, therefore, is as a recreational, aesthetic or commercial resource. Accordingly, almost 80% thought that deer should be managed as a resource, while approximately 17% thought they should be exterminated or controlled at low numbers. Where control was required, the only really acceptable method was shooting (acceptable to 97%).

White-tailed deer (*Odocoileus virginianus*) are native to North America and following near extermination in the United States in the 19th century, have gradually recovered such that by the late 20th century they began to be associated with crop and property damage, motor vehicle collisions, transmission of disease and damage to valued ecosystems (Conover 1997). Management of deer, especially white-tailed deer, has been the subject of considerable attitudinal research in the United States. Some of the available studies are reviewed here.

Fulton et al (2004) surveyed 681 residents of northeast Ohio in the United States, in the vicinity of the Cuyahoga Valley National Park (CVNP), about their attitudes to two approaches to the control of the Parks' rapidly increasing and problematic white-tailed deer population. The sample was geographically stratified into those living within 10km of the CVNP and those living further afield. A clear majority of the close and further-afield respondents (75% and 72% respectively) felt that taking no action to control deer was unacceptable and that controlling

deer within the CVNP was acceptable. The majority of the respondents from both areas were also in favour of the use of lethal forms of deer control (71% and 62% respectively). There was a strong inverse correlation between the acceptability of no control and perceived likelihood of negative effects of deer (such as increased road collisions, increased damage to gardens and crops, greater risks of animal diseases, more damage to native plants and increased loss of biodiversity). Similarly, there was a clear distinction between those who felt that lethal control was acceptable and those that didn't, with respect to beliefs about the outcomes; the former group believing that lethal control would result in fewer negative effects and have the benefit of maintaining a healthy deer population. Those who were accepting of lethal forms of control were also found to be more accepting and trusting of National Park staff and decision makers. In general, the research shows that the acceptability of animal management actions is related to beliefs about the outcomes of such actions, especially the consequences for people and their property.

Research by Chase et al (2002) into stakeholder involvement in wildlife management included a survey of 438 residents of a New York community about deer management options. The majority of the respondents (54%) reported that they enjoyed the presence of deer but worried about their impact, while 34% did not enjoy having deer around. A total of 81% wanted to see a decrease in the deer population. Respondents were asked to rate the acceptability of six deer management options. The most acceptable control technique (indicated by the percentage who rated it 'very acceptable' or 'moderately acceptable') was 'reproduction control' (83%), followed by trapping and relocation (77%), education about living with deer (72%) and restricting development to preserve deer habitat (63%). Fatal techniques, such as the use of sharpshooters to kill deer at bait sites and archery hunting by licensed hunters, were not acceptable to the majority.

To ascertain the level of concurrence between wildlife management stakeholders and the public about deer management, Messmer et al (1997) surveyed 133 United States public and private agencies and organisations representing potential urban deer management stakeholders. Those surveyed included federal government agencies, state-level wildlife management and agricultural departments, and non-governmental animal activist, environmental professional and resource-user groups and societies. The management techniques, which were rated for their acceptability on a scale ranging from 'always acceptable' to 'never acceptable', included public education on minimising negative human-deer interactions, controlled hunting, immunocontraception, fencing, live capture and relocation, damage compensation and shooting individual offending animals (sharpshooting). The stakeholder organisations' acceptability ratings for the various deer management techniques were compared with those of 600 members of the public recorded by Reiter et al (1999). Based on average acceptability ratings, the most acceptable deer management technique to the public was immunocontraception, followed equally by public education and fencing, then live capture and controlled hunting (all rated more acceptable than unacceptable). Compensation for deer damage and sharpshooting were rated unacceptable.

In comparison, respondents from all agencies and organisations, with the exception of the animal welfare groups, rated public education and controlled hunting as acceptable. Fencing was acceptable to all organisations except the environmental groups and professional societies. Sharpshooting was acceptable only to the federal agencies, professional societies and animal resource users. Live capture and relocation, compensation for deer damage, and immunocontraception were rated unacceptable by all agencies and organisations. The authors note that the American public's views on the use of lethal deer control techniques generally concurs with the preferences of relevant government agencies, although the public's support for live capture/relocation and immunocontraception is not shared by United States government agencies, animal welfare and environmental organisations. The authors therefore advocate for greater public involvement in deer management decision making.

Under the banner of 'Deer, People, and Parks', Chase et al (2002) at the Human Dimensions Research Unit (HDRU) of Cornell University in the United States undertook a series of studies of the perspectives and attitudes of people living adjacent to six national parks and reserves where white-tailed deer are present or are emerging as a problem. The surveys found that residents are commonly concerned about the negative impacts of deer, especially road collisions, the potential for spread of diseases, damage to crops and gardens, and damage to vegetation within the parks and reserves. Generally, the surveys found that the majority of the public in each study area want to see active management of deer numbers and want to be consulted over how this is achieved. Data is not available from these studies on the acceptability of particular control methods.

Several American studies have included assessments of the acceptability to the public of fertility control of deer. Curtis et al (1993) conducted a postal survey of 750 suburban residents of Rochester, New York to assess public attitudes to deer, deer management, and the acceptability of various management options (1993, p252). The majority of the respondents selected contraceptive methods, managed hunting, or trapping and relocating as their preferred option for wild deer management. People who supported contraception indicated that they were interested in minimising the suffering of deer (ie the humaneness of the control) whereas those opposed to contraception were mainly concerned about maximising deer hunting opportunities and minimising economic costs to society. Approximately half of the respondents thought that minimising human health and safety risks or maintaining a healthy deer population were the most important considerations for deer management, regardless of whether contraception was supported or opposed. The researchers did not define the deer contraception method/technology or delivery system being assessed, and thought that responses may have varied depending on attitudes to specific technologies and delivery systems. Consequently, they advise that 'when examining attitudes and beliefs of people toward contraception in wildlife management, it will be extremely important to identify both the specific material and delivery system that will be used and to be certain that stakeholders understand how they work' (Curtis et al 1993, p253).

In a closely related study, Lauber and Knuth (2004) examined the effect of information provision on the public's attitudes to the use of contraception for deer control in suburban areas in the United States. The authors conducted a postal survey of 882 residents of New York State in 1997, with a follow-up survey in 1998. The survey divided the sample into a treatment group and a control group, with the treatment group receiving information on the effectiveness and humaneness of contraception (including immunocontraception). A total of 509 responses were received. Previous research by the authors had shown that effectiveness and humaneness were the two most important factors in the acceptability of deer control techniques. Acceptability of contraceptive (fertility) control was measured using a four-point scale (ranging from 'not at all acceptable' to 'very acceptable'), and its appropriateness for use at the particular site was measured by asking respondents to choose the most suitable control technique from a list of 17 techniques.

Lauber and Knuth (2004) found that providing information on effectiveness or humaneness of the control method had no influence on ratings of acceptability of deer contraception, although it decreased the perceived appropriateness of contraception. Provision of effectiveness information appeared to have some influence on the views of those who initially did not support contraception, while provision of humaneness information had little influence on them. The reverse was true for those who initially supported contraception. From this, the authors concluded that humaneness is a key perceived quality of contraception/fertility control. Provision of humaneness information was also found to be associated with a change in attitude towards contraception between the first and second surveys. The authors conclude that the people's positions on control techniques are not fixed, although provision of information about control techniques is only likely to influence people when the information addresses outcomes they consider important, such as humaneness or effectiveness.

2.11 Water buffalo

2.11.1 Attitudes of Indigenous Australians

In Northern Australia, the Jawoyn people have a history of involvement in buffalo management (hunting and herding) and buffalo are seen as belonging to the country and important bush tucker (Robinson et al 2005). At the same time, buffalo are seen as causing negative impacts, especially when in large numbers. For example, they damage waterholes, pollute the water thus causing health problems, trample swamps and cause erosion of sacred sites. As with other feral animal species, Jawoyn see buffalo as a resource and would prefer that they are utilised rather than wasted or exterminated. Associated research by Bowman et al (2002) looked at present-day buffalo hunting among Indigenous groups in Arnhem Land and argued for a more active role for Indigenous people in buffalo control programs.

2.12 Flying foxes

2.12.1 Attitudes in Australia

Ballard (2005) looked at flying fox issues and management in New South Wales as part of his doctoral research. In addition to conducting public and stakeholder discussion groups, he surveyed 120 members of commercial fruit growers' organisations in New South Wales and 1588 members of the public living in three coastal areas of the state. Growers had a more negative perception than the public of flying foxes, and it appears that the more interaction people had with flying foxes and with the rural community, the less positive was their attitude towards flying foxes. Attitudes to flying fox management were assessed by asking respondents the extent to which they agreed or disagreed with a series of statements. The survey found that:

- Most fruit growers (53%) agreed that flying foxes should be eradicated from fruit growing areas; 30% of the public did not agree.
- A clear majority of the fruit growers (74%) were in favour of allowing any grower with a firearms license to shoot flying fox to protect their crop; 32% of the public were not in agreement with this.
- The majority of the growers (65%) felt that there should be no restriction on the number of flying foxes that commercial growers can shoot to protect their crop, while only 25% of the public agreed with this.
- The growers and the public both disagreed with the proposition that killing of flying foxes should be completely banned in New South Wales (with 10% and 29% respectively agreeing) — this was related to the growers' disagreement, and the public's uncertainty about flying fox being listed as a vulnerable species.
- Both the public and fruit growers were in favour of governments offering subsidies for fruit crop-protection methods, such as netting, that do not harm flying foxes (acceptable to 83% and 72% respectively).
- 41% of the fruit growers versus 62% of the public felt that to stop flying foxes eating commercial crops, native foods and important habitat should be replanted for them.

New South Wales fruit growers therefore have a view of flying fox control that is different from that of the public, especially the more urban public found in the southern zone of the state (which includes Sydney). Non-fatal flying fox management, such as exclusion netting, appears to be favoured by both the public and the growers, while habitat and food plant replacement was mainly supported by the public.

2.13 Possums

2.13.1 Attitudes in Australia

In Australia, possums are protected native animals, although they are occasionally mentioned in surveys as nuisance animals. Public attitudes to possums have been studied by Johnston and Marks (1997) and Miller et al (1999) in Victoria, by Oliver and Walton (2004) and Fitzgibbon and Jones (2006) in Queensland, and nationally by Franklin (2007). However, none of these studies looked at attitudes to possum control or management.

2.13.2 Attitudes overseas

In New Zealand, where the Australian brush-tailed possum (*Trichosurus vulpecula*) is a major environmental and animal health pest, there have been several significant studies of stakeholder and public attitudes to existing and proposed forms of control. These include national-level multi-method studies by Fitzgerald et al (1996) and Wilkinson and Fitzgerald (2006), and coverage in multispecies studies by Sheppard and Urquhart (1991) and Fraser (2001). The New Zealand Parliamentary Commissioner for the Environment also reviewed issues relating to possum management in 1994 and 2000. Anthony Fraser reviewed these various studies for the Department of Conservation in 2006, focusing on attitudes to control methods.

The details of these various studies are as follows:

- Sheppard and Urquhart (1991) telephone surveyed a representative sample of 1000 members of the New Zealand public in 1991 about the control of various pests, especially rabbits, possums and wasps.
- Fitzgerald et al (1996) telephone surveyed a nationally representative sample of 1127 members of the public in 1994 about possum and rabbit control options. This was preceded by 11 focus groups nationally — seven with stakeholder groups and agencies and four with the urban and rural publics.
- Fraser (2001) postal surveyed 859 members of the New Zealand public in 1994 about their views on introduced wildlife and its management, including possums.
- Wilkinson and Fitzgerald (2006) telephone surveyed a nationally representative sample of 1002 members of the public in 2001 about their views on the fertility control of possums and the use of genetic modification to achieve it. The survey was preceded by a series of exploratory focus groups, three with the public and six with stakeholder groups. In addition to helping design the survey, the focus group findings informed a review of possum control options by the New Zealand Parliamentary Commissioner for the Environment. The design of the survey drew on Ajzen and Fishbein's (1980) theory of attitudes.

Overall control strategy

The participants in the focus groups conducted by Fitzgerald et al (1996) had mixed views on the goal of possum control. For the most part, the interest groups and the public wanted to see vigorous control of possums in order to protect the natural environment, though there was considerable doubt that possums could ever be eradicated. Most people wanted to see social and economic benefits (such as employment) for communities from the government's investment in control efforts. There was also some minority support for stopping conservation-based possum control and allowing the possum population, and ecological systems of which they are a part, to stabilise naturally. However, overall support for active possum control was high, with 82% rating the risk of 'no control' as very high to the environment and 63% rating it as very high to the economy.

In Fraser's (2001) study, approximately 72% of the New Zealand public were in favour of exterminating possums, compared to controlling them at low numbers (21%) and managing them as a resource (6%). There was virtually no support for not controlling possums.

Attitudes to manual possum control methods

Table 2 includes the results of the various national-level New Zealand studies for manual methods. Note that Sheppard and Urquhart (1991) asked people to rate the suitability of various methods for 'reducing the number of possums' rather than their acceptability for 'killing' (Fitzgerald et al 1996) or 'controlling' (Fraser 2001) possums. However, acceptability and suitability are not necessarily the same thing. Also note that Fraser (2001), rather than asking his respondents to rate each of four control methods, asked them to choose the single most acceptable method. Only Wilkinson and Fitzgerald (2006) provided respondents with an explanation of the control method and its effect. Poisoning with 1080 was explained as 'the possum eats a fatal dose of the poison and dies from heart or lung failure within 12 hours', while trapping was explained as 'the possum is attracted by a lure and caught in a smooth-jawed leg trap. It is then killed within 24 hours'.

The results of the various studies suggest that shooting is the only manual control method that is clearly acceptable to the majority of New Zealanders. Poisoning is possibly acceptable to the majority providing it is specific to possums and does not involve using 1080 or cyanide. Like poisoning, the more that people understand what is involved in trapping the less acceptable they find it.

Attitudes to biological control and fertility control methods

The New Zealand studies included questions on various forms of biological control of possums, ranging from the use of diseases through to various forms of fertility control. The latter are listed separately in Table 2. Fitzgerald et al (1996) also asked follow-up questions on the acceptability of different ways in which biological control might work (ie by stopping possums from breeding, by killing young in the pouch, or by making the possum more susceptible to natural disease), while Wilkinson and Fitzgerald (2006) explained 'interfering with fertilisation' and 'interfering with breeding hormone' (the fertility controls) in some depth. The findings from the various studies suggest that fertility control in the form of some kind of contraception or sterilisation is the most acceptable form of biological control for possums in New Zealand — possibly using a GMO — and is the most acceptable form of possum control overall.

Perceived attributes of the control methods

Wilkinson and Fitzgerald (2006) also asked respondents to rate the perceived humaneness, specificity and effectiveness of possum hold trapping, 1080 poisoning, interfering with fertilisation and interfering with breeding hormones. Humaneness, specificity and effectiveness were the attributes of controls that had been previously found by the authors to be of most importance to the public, and in the survey interviews, each of these attributes was explained. Interfering with fertilisation was rated by the respondents as the most humane form of control, followed by interfering with breeding hormones; both of these being considered humane by the majority of respondents. These two control methods were also judged by the majority to be the most specific to possums and the most effective in reducing possum numbers. The perceived humaneness of a control method was found to be the best predictor of people's ratings of the method's acceptability, followed by specificity, then effectiveness.

Table 2: Summary of studies of attitudes to possum control methods in New Zealand

Methods specified	Sheppard and Urquhart (1991) n=1000 % suitable or very suitable	Fitzgerald et al (1996) n=1127 % acceptable or very acceptable	Wilkinson and Fitzgerald (2006) n=1002 % acceptable or very acceptable	Fraser (2001) n=859 % the most acceptable
<i>Manual methods:</i>				
shooting	69	82		20
trapping	57	67	30	18
<i>Poisoning:</i>				
poisoning				52
possum-specific poison		69		
1080	44		31	
1080 ground laid		37		
1080 aerial dropped		37		
cyanide	44			
other poison		38		
<i>Biological controls:</i>				
encouraging predators	16			
biological control (eg diseases and parasites)				10
possum-specific genetically engineered organism		50		
imported possum-specific parasite		41		
imported possum-specific bacteria		34		
imported possum-specific virus	49	33		
<i>Fertility control:</i>				
method that stops possum breeding		85		
method that kills young in the pouch		48		
method that makes the animal more susceptible to natural disease		40		
interfering with fertilisation			78	
interfering with breeding hormones			71	

Note: Blank spaces indicate that the study did not specifically address that control method

Attitudes to possum fertility control delivery methods

Wilkinson and Fitzgerald (2006) assessed respondents' attitudes to four possible methods for 'producing the fertility control substance and getting it into the possum'. The methods, which were explained to the respondents and assessed for their expected specificity, effectiveness, and acceptability, included a bait made from a dead genetically modified (GM) plant, a bait containing the remains of a dead GM bacterium, a live GM possum-specific parasitic gut worm, and a live GM possum-specific virus.

The most acceptable of the methods for transferring a fertility control to possums were, equally, a GM plant bait and a GM parasitic worm. However, neither of these was acceptable to a majority of the respondents, with up to a fifth of respondents indicating a neutral (ambivalent) position. The GM parasite worm was seen as the most specific, followed by the GM possum virus, and these two methods were rated the most effective. Specificity of the method to possums seemed to account most for people's ratings of the acceptability of the method (Wilkinson and Fitzgerald 2006).

Wilkinson and Fitzgerald (2006) also examined the acceptability of a possible possum fertility-control 'package' (made up of an immunocontraceptive protein delivered in a GM plant-based bait). This package was deemed to be acceptable to 61% of the respondents. The form of delivery of the control was found to be more important than the type of control in terms of people's acceptance of the proposed fertility control, hence the authors concluded that the acceptability of a future fertility-control package for possums in New Zealand 'is likely to be determined by the acceptability of the delivery method used' (Wilkinson and Fitzgerald 2006, p26).

2.14 Kangaroos

2.14.1 Attitudes in Australia

As noted in the previous review, kangaroos are considered by some, especially those involved in farming, to be a pest that requires management. For example, in the survey by Johnston and Marks (1997) of the Victorian public, the majority of the respondents thought some form of management of kangaroos was needed. The most favoured option was to manage kangaroos as a resource (51% of respondents), followed by controlling them at low numbers (27%). The most favoured control method was shooting (44%), followed by biological control (18%). There was almost no support for trapping and poisoning, while 17% thought there was no appropriate form of control (presumably, they were opposed to control) and 17% were undecided. When asked to rank particular control methods, 58% of respondents chose permanent fertility control as their preferred method, followed by 'a humane and target-specific toxin' (16%).

Ballard (2005), when looking at the acceptability of aerial shooting of wild horses, collected survey data on the New South Wales public's position on the aerial culling of kangaroos. He found that the majority of both the urban and rural respondents felt that such aerial culling of kangaroos should not be permitted.

Ballard (2005) also looked at the experiences and attitudes to kangaroos of people in 514 households in six residential communities in northeastern coastal New South Wales where kangaroos are found. The study included public meetings, followed by a questionnaire survey. Asked what should happen if a kangaroo in the area has been aggressive towards people, approximately 60% of the survey respondents favoured relocating the animal, 17% favoured killing it and 15% thought it should be left alone. Asked what should be done with culled kangaroos where culling proved necessary, 48% felt the animals should be used (eg for pet food or leather), 16% had no preference and 27% were opposed to culling. To reduce the chance of animal-human conflicts (especially road accidents, which are a source of considerable concern), more than 90% felt that when people move into an area with kangaroos, they should be provided with information on how best to live with them.

2.15 Wallabies

The studies related to controlling wallabies as pests were done in New Zealand.

2.15.1 Attitudes overseas

In New Zealand, wallabies are considered to be exotic pest animals, although they are largely confined to the Bay of Plenty, Waikato, and South Canterbury. Fraser (2001) surveyed New Zealanders from throughout the country about the management of wallabies. His respondents tended to see wallabies as a pest rather than a resource; hence they favoured control at low numbers (38%) or extermination (26%), rather than management as a resource (20%) or no control at all (5%).

In a subsequent New Zealand study, APR Consultants (APRC) conducted telephone surveys to assess agency and public attitudes to introduced wallabies in the Bay of Plenty (BOP) and Waikato regions of New Zealand (APRC 2006). No particular species of wallaby of the four established was noted as being the subject of the survey, although dama wallabies are present in the region. The first survey was of 20 selected representatives of relevant organisations in BOP. The second was of a random sample of 666 members of the public in BOP and Waikato. In addition to questions about people's awareness of wallabies and their impacts, the APRC asked the respondents to indicate their level of 'support' for wallaby control in general and for 10 listed forms of control. The control methods rated by the public included:

- aerial dispersal of bait
- hand dispersal of bait
- bait stations
- night shooting
- ground hunting
- ground hunting (with dogs)
- trapping
- exclusion fencing
- biocontrol
- radio telemetry (using Judas wallaby).

The APRC research report (2006) explained each of these control methods, although these explanations were not provided to the respondents at the time of the survey. For example, it was not explained that 'bait' referred to poisoned bait, 'trapping' referred to hold trapping, or that 'biocontrol' actually referred to fertility control.

APRC (2006) found that general unprompted awareness of wallaby as a pest was low (just under 10%) while prompted awareness was much higher (66%). With regard to wallaby population control, 46% felt there should be 'some control' (such as culling) and 38% felt there should be total control (ie eradication). Of the particular control methods, hunting and shooting were the most acceptable. All but two of the methods (ie biocontrol and aerial dispersal of bait) were supported by the majority of the respondents. The authors noted the limitation of respondents' understanding of biocontrol. Opposition was greatest for use of aerial baiting (64%), hand baiting (38%) and trapping (33%), with opposition to the former seemingly based on concerns about 1080 and non-target kills. Analysis of additional (open-ended) comments suggested that humaneness and specificity were key factors in peoples' support or opposition to particular control methods (APRC 2006). The report provides no breakdown of attitudes to wallaby control by gender, age or other social characteristics.

2.16 Stoats

The only significant studies of attitudes to stoats, their impacts and their control were conducted by Fitzgerald et al (2002 and 2005) in New Zealand, where stoats are a major introduced threat to indigenous wildlife.

2.16.1 Attitudes overseas

A series of focus groups with the public and stakeholder groups were conducted (Fitzgerald et al 2002) and a telephone survey of a nationally and regionally representative sample of 1002 members of the public was done (Fitzgerald et al 2005).

In the telephone survey, the respondents were asked to rate the acceptability of 12 existing and proposed stoat control options covering: no control at all, two forms of trapping (one fatal), two fatal forms of poisoning, four fatal forms of biological control and three non-fatal forms of fertility control, each of which involved the use of GMOs. Each of the control methods was explained in detail. The control methods acceptable to the majority of respondents were trapping and fertility control. Some details of the results are:

- kill trapping and hold trapping were acceptable to 74% and 66% of respondents respectively
- a GM live stoat-specific virus that attacks the part of the stoat's brain that controls reproduction was acceptable to 53% of respondents
- a bait containing a GM protein that acts as an immunocontraceptive was acceptable to 52% of respondents
- a live stoat-specific bacteria genetically engineered to contain a protein that acts as an immunocontraceptive was acceptable to 50% of respondents (Fitzgerald et al 2005).

Not controlling stoats was almost universally unacceptable, as was an unspecified mustelid-specific disease (naturally occurring but fatal) that has been imported into New Zealand, and a virulent strain of the canine distemper virus. Gender was found to be a significant factor in the ratings of acceptability of control methods, with females less likely than males to accept all methods (Fitzgerald et al 2005).

The survey respondents were also asked to rate six features of a possible stoat control in terms of their importance to selection of the control method, then to indicate the single most important feature. Two features emerged as essential for most of the respondents: specificity (ie not affecting animals other than stoats, ferrets and weasels) and effectiveness (ie very effective in reducing stoat numbers). Humaneness and not using live GMOs were less important, but still important to a majority. A third of the respondents selected specificity as the single most important feature of a proposed control, followed equally by humaneness and effectiveness (23%). There was a significant difference between males and females in their ratings of the importance of humaneness, with females rating it higher. Overall, the survey found that there was reluctance by New Zealanders to agree to the use of genetic engineering in a stoat control, especially one that involved releasing live organisms into the environment. The survey also found agreement that, of the existing methods of control, trapping was preferable to poisoning (Fitzgerald et al 2005).

2.17 Other animals

2.17.1 Coyotes and wolves

In various countries, coyotes and wolves are seen as agricultural pests due to their tendency to prey on sheep and other stock. Studies in the United States of attitudes to these animals and their control reveal similar issues and preferences for control as for wild dogs and dingoes.

In 1976, when conservationists and sheep farmers in the United States mid-west were in conflict about how to deal with coyote predation on sheep, the United States Department of Agriculture conducted a nationwide telephone survey of 2041 households to assess public attitudes to the control of coyote (Arthur 1981). The survey respondents generally considered non-lethal methods to be more acceptable than lethal methods. Using guard dogs for sheep was considered the most acceptable (mean rating 7.1 on a 10-point scale), followed by repellent chemicals (rating 7.0) and coyote birth/fertility control (rating 5.8). None of the other methods had an acceptability rating higher than 5.0, and the clearly least acceptable methods were the use of slow-acting poisons and steel leg-hold traps. The most acceptable lethal controls were shooting and fast-acting poisons (both rating 4.3). In terms of the criteria for selecting control methods, respondents rated humaneness as most important, followed by specificity, then cost (in a respective weighting of 0.57, 0.32, and 0.16; Arthur 1981).

All respondents in this study were asked to rate (on a 10-point scale) the amount of suffering they thought was involved in various animal management practices. Of the various practices, 'trapping wild animals with steel leg-hold traps' was seen as causing the most suffering (mean rating of 9.0), followed by 'using poisons that kill in a few hours' (rating 8.7), and 'using poisons that kill in less than a minute' (Arthur 1981, p14). 'Killing instantly with guns' (with an average rating of 3.1) was seen as causing the least amount of suffering to animals. With respect to a farmer's right to kill wild animals that predate on farm stock, 73% felt it was acceptable for the farmers to kill the particular animal, while only 43% felt it was acceptable for the farmer 'to kill other animals of the same type to prevent future losses' (Arthur 1981). Arthur felt that disapproval of fatal predator population control reflected 'a more general disapproval of the killing of any animal', as gauged by attitudes to game hunting and killing of animals for food. Among the two thirds of respondents who had heard of the coyote control controversy, equal proportions were concerned about the killing of coyotes for control purposes and to stop predatory killing of sheep by coyote. However, the proportion of those supporting widespread culling of coyote (with some loss of non-target animals) increased as the level of sheep loss increased, such that at a 40% loss, 61% of the respondents supported widespread coyote culling.

Kellert (1979, 1985) reports on the results of a multistate random sample telephone survey of 3107 Americans conducted in 1978. This survey was supplemented by a national postal survey of a random sample of 388 cattlemen, sheep producers and trappers. The interview schedule covered a wide variety of topics including critical issues involving wildlife. Respondents were asked to rate (on a 7-point scale) their approval or disapproval for various methods for managing coyote predation on sheep. These methods included:

- shooting or trapping as many coyotes as possible
- poisoning (described as least expensive but least specific)
- hunting of individual animals known to have killed livestock
- capture and relocation (described as very expensive).

The majority of the public respondents disapproved of shooting or trapping as many coyotes as possible and over 90% objected to poisoning. The more informed the respondent was about coyotes, the less likely they were to agree with shooting and trapping. In contrast, the sheep producers and cattlemen strongly supported shooting or trapping as many coyotes as possible. The author notes that livestock producers were the only group in this study who clearly favoured the use of poisons as a control strategy. The general public tended to favour methods that provided for control of the particular animal responsible for the livestock loss, and strongly supported capture and relocation of coyotes away from livestock areas; this being perceived as a more humane solution. Sheep producers and cattlemen were opposed to capture and relocation as a control strategy (Kellert 1979, 1985).

Zinn et al (1998) conducted a postal survey of 457 residents in a recreation district on the southern edge of Denver, Colorado, to examine the relationship between people's values and various options for the management of coyote. Respondents were asked to rate the extent to which they agreed with 'destroying' a coyote under each of four situations: when the animal was seen in a public open space, when it was seen in a residential area, when it was seen in 'your' yard, and when it carried a disease harmful to humans. The only case where the majority of the respondents deemed it acceptable to destroy a coyote was when it carried a disease harmful to humans. Those who had a 'wildlife use' orientation were more accepting of destruction of the animal than those who did not.

Decker et al (2006) surveyed the Alaskan public's attitudes to controlling wolf and grizzly bear predation on caribou and moose, which are valued game species. Respondents were asked to indicate the acceptability to them of 'no action', 'non-lethal control', or 'lethal control' in six situations. These situations varied only in terms of who was being affected by wolf and grizzly bear predation and the extent of the effect on their livelihoods. Taken as a set, the various

situations being evaluated represented a continuum of impact severity. The authors found that the proportion of people who supported lethal control of wolves was directly related to who was being affected and the severity of the impact, with the highest level of acceptability of lethal control (64%) given to controlling wolves in a situation where predation meant that 'local residents who rely on game for food are unable to find moose or caribou to hunt', followed by a situation where 'some Alaskans from outside the local area who rely on game for food are unable to find moose or caribou to hunt' (56%). The majority of respondents were unwilling to support lethal control of wolves in situations where locals or outsiders did not rely on the game for their food supply. Where people felt lethal control was not acceptable, they tended to opt for no control rather than non-lethal control. However, in all the situations under evaluation in the study, the majority of respondents opted for some form of control (lethal or non-lethal) rather than no control. The same pattern of responses was evident for grizzly bear control, although lethal control was generally less acceptable for grizzly bear than for wolves.

2.17.2 Elk

In addition to studying attitudes to deer, Chase et al (2002) researched stakeholder involvement in elk management in Colorado, United States. The study included a postal survey to assess 342 residential property owners' views of elk and their management, and property holders' participation in wildlife management. Most survey respondents saw the presence of elk quite positively, 65% enjoying elk 'without reservation', while 44% wanted no change in the population and 17% wanted an increase in elk numbers (Chase et al 2002, p941). The acceptability of six forms of 'management' was also assessed. The most acceptable forms of elk management were education of the public (very acceptable to 72%) and restricting development to preserve habitat (very acceptable to 59%). The most unacceptable option was shooting of elk at baiting sites ('not at all acceptable' to 69%). Only education of the public, habitat preservation, archery hunting, and relocation were acceptable to the majority of the respondents. The study suggests that among the public, the acceptability of animal management methods is directly related to prevailing attitudes about the presence of the animal and the perceived need for population control. Results also indicate that fatal control methods are much less acceptable than non-fatal methods.

3. Summary of attitudes, by stakeholder group and control method

3.1 Attitudes of particular stakeholder groups

3.1.1 Farmers

Invasive animals are a problem to farmers primarily due to the potential or actual negative effects on their stock, crops and other wildlife in and around their properties. While not all feral animals are seen as 'pests' by farmers, there is an underlying theme that all such animals need to be controlled in some way. The reasons given for control typically include the risk of predation on livestock, depredation of crops and pasture, the spread of disease (to both to animals and humans), damage to indigenous species, the physical environment, and to ecosystems, and/or the economic costs that arise from all of these. Farmers commonly say what is needed is sustainable management of problem animals, rather than their complete eradication.

While Australian farmers and the Australian public tend to agree about which animals are the most problematic, there is often a difference of view as to the extent of the problems and how to best tackle them. An example of the latter is that farmers often perceive the damage from some indigenous animals to be greater than the public perceive it, probably because farmers see the impacts first hand and experience the losses personally. For example, farmers feel that flying foxes should be eradicated from fruit-growing areas, whereas the public would prefer non-lethal controls, such as exclusion netting subsidised by the government. Similarly, opinion on whether an animal should be managed or eradicated differs between farmers and the public.

Generally among farmers, the acceptability of a particular approach to feral animal management and particular control methods depends on whether the animal is seen as have a resource value or not. Hence, a common position of farmers is that some feral animals are a hunting resource rather than a pest, and as such, eradication is not preferred. For example, in New Zealand, high country farmers view Himalayan thar and deer as valuable hunting species, so much so that 'hunting safaris' operate on farm properties. Organised commercial sport hunting not only helps control numbers but also provides an income to farmers and others. Elsewhere, deer and pig hunting provides recreation and supplemental income, such as from the 'wild boar meat' market in Australia. Feral goats are seen as a resource rather than a pest by Australian farmers, and are often rounded up and sold live.

The commercial and recreational value of feral animals to some extent holds for pests that may be in greater numbers but difficult to control, such as rabbits, fox, and in New Zealand, possums. Where commercial return or recreation is not a factor, farmers have tended to use poisoning with 1080, strychnine and cyanide as an important means of controlling and eradicating pest animals. Some farmers have issues with using 1080 baits for pest control because of the potential to inadvertently poison farm dogs and stock. Indeed, Australian research suggests that this is one of the main reasons why farmers opt out of collective or community-based poisoning campaigns for wild dogs. Such safety concerns, doubts about the efficacy and safety of poisons, and the various regulatory demands seem to lie behind poisons becoming less acceptable to farmers than shooting and other control methods. As with other sections of the population, farmers are increasingly concerned with the humaneness of pest controls and have a growing interest in biological controls, especially fertility control. In general, biologically based pest control methods tend to be acceptable to farmers and are seen as potentially non-fatal, effective and humane.

3.1.2 Indigenous Australians

Studies of Indigenous Australians' relationships with invasive animals have generally been qualitative rather than quantitative. Indigenous people tend to have different world views than wildlife managers and government agencies, and this includes views about the nature and status of introduced animals. Such animals are not necessarily seen as undesirable, invaders or pests, nor are they necessarily incompatible with native animals. Some studies note that even where introduced animals are a nuisance and damaging important sites and resources, Indigenous people still tend to look upon such animals as a resource (eg buffalo and wild pigs for food). Hence, they prefer control efforts that do not result in wastage of the animals, or aim to achieve eradication. The notion of a feral introduced animal as being an unwelcome 'pest' does not hold true among Indigenous groups studied to date. Future choice of pest control methods needs to recognise that many introduced animals have acquired value in Indigenous ways of life.

3.1.3 Wildlife managers

Wildlife managers seem to be very aware of the need to occasionally intervene to control the numbers of introduced and indigenous animals in various environments and contexts. However, views on the 'best' approach to achieving population control vary according to the values of the wildlife manager/s and the particular management situation; for example, to reduce human-animal interaction or conflict. Among wildlife managers and professionals, the key criteria for determining which method should be used are: cost, effectiveness, specificity and humaneness. Having said this, wildlife managers generally believe that hunting is a valid pastime and thus an acceptable way to control pest animals.

A further issue that arises (and could cause difficulties when determining the most appropriate approach) is the difference between male and female wildlife managers over the acceptability of various control methods. Female wildlife managers are less likely than males to accept any lethal form of pest animal control as ethical. Hence, females prefer non-fatal methods such as scaring, fertility control/contraception and habitat manipulation. Males on the other hand, regard shooting, especially sharpshooting, as the most ethical, followed by the non-fatal methods. Poisoning and trapping are generally seen as less unacceptable, but often necessary, methods for controlling pests. Wildlife managers seem to regard capture and relocation as expensive and impractical, but find themselves forced into it through public and pressure group opinion.

3.1.4 The public

Most of the studies in this literature review study public attitudes to particular animals and control methods as their main subject. Where surveys are employed, the researchers have generally aimed for random and geographically representative samples, although such representation has not always been achieved, and in a number of cases the soundness of the survey methodology can't be guaranteed. Further, we cannot assume that members of the lay public understood what they were being asked about when they were rating a particular pest control method. Research reports and papers reviewed here often do not satisfactorily explain the control methods being studied. Unfortunately, lack of detail about pest control methods is a feature of some of the key studies. For example, the biggest Australian study to date on public attitudes to pest animals and their control (Fisher and Cribb 2008) found that Australians consider fertility control to be the most acceptable method, but it is not clear whether this meant immunocontraception, chemical or biologically induced sterility, or even castration. It is also not clear whether 'humane trapping' means kill trapping (where the animal is killed

the moment the trap is triggered) or hold trapping (where the animal is held in the trap until the trapper comes along and kills it swiftly, or removes it alive for relocation). In contrast, the study by Wilkinson and Fitzgerald (2006) of public attitudes to fertility control of possums in New Zealand explained each potential form of fertility control, as well as the means by which the control would be transferred into the target animal. Likewise, the survey carried out by Fitzgerald et al (2005) of public attitudes to stoat control explained different kinds of trapping and poisoning and how they work.

Some studies report single results for 'the public' – assuming some degree of homogeneity of the general population. The better-designed studies covered by this review, however, disaggregate results by gender, residence, and age group, and show the differences between groups, which suggests that one cannot assume 'the public' is singular in its view. This said, it is possible to note some overall positions of the public on pest animal controls.

As discussed above, the views of the public are often in contrast to those of other interest groups, especially farmers/land managers and wildlife managers. Overall, there seems to be a pattern of preference for non-lethal approaches to pest animal control by the public, although eradication of some animals is favoured over population control as a general aim. For example, the general Australian public seems to favour eradication of introduced predatory animals such as wild dogs, foxes and feral cats, and potentially very destructive species such as rabbits. However, population management is favoured for larger introduced species that are also seen as having resource value, such as feral pigs, feral goats, wild deer, buffalo and wild horses, and, in New Zealand, Himalayan thar and other game species.

Taking the various studies together, the public believes that the key criteria for deciding between different forms of animal control should be, in general order of importance:

- humaneness
- ability to generate economic and social benefits (eg jobs, incomes, food etc)
- specificity and safety (ie not affecting other animals, especially humans)
- effectiveness.

Cost is generally not a key consideration for the public.

The acceptability of various control methods seems to vary according to species and individual studies. Shooting (unspecified) appears to be the most acceptable method for controlling wild dogs, pigs, rabbits, goats, kangaroos and wallabies, and is the most acceptable pest animal control method overall. This is probably because shooting is assumed to be 'quick' (ie humane) and highly specific to the target animal. It also has the advantage of creating work for hunters, providing recreational opportunities and enabling the target animal to be recovered for food or other products if desired.

Fertility control seems to be the second most acceptable pest control method to the public, and one that is particularly acceptable to females. However, in practice, fertility control of feral animals is not common, and many of the technologies are still only ideas or are under research, including immunocontraception (the most acceptable method to New Zealanders), which is a form of biological control likely to use GMOs. Other endorsed forms of fertility control are an infertility virus for rabbits, and in America, live capture of problem animals, which are then dosed with contraceptive or sterility drugs and released back into the wild.

The third most acceptable control method to the public seems to be live capture and relocation. This method is the most acceptable for controlling wild horses in national parks and kangaroos in suburban areas. The next most acceptable methods to the public are trapping, especially 'humane' trapping of smaller animals such as wild rabbits, cats and stoats, then 'humane' poisoning of the same smaller species and foxes and wild dogs.

The increasing preference for non-lethal control methods seems to reflect an increasing preoccupation with animal welfare, especially among the urban public that tends to be removed from the daily realities of farming and land management. This comes through in the relatively high level of acceptability of campaigns to educate the public about living with wildlife (eg deer and kangaroos), the use of exclusion fencing and netting, chemical repellents, scarers, and the practice of habitat restoration. The latter seems to be most acceptable where native animals are involved, such as flying foxes.

Several studies seem to indicate that the Australian public finds biocontrols, including those employing microorganisms, to be acceptable. However, other studies, especially those from New Zealand, suggest that the public is concerned about the specificity of such organisms, especially those that have been genetically modified and/or have been introduced from another country, and it is loathe to endorse their use. In general, the New Zealand public seems to be more unsure about and less accepting of actual and proposed pest animal biological controls than the Australian public. This may reflect different experiences with such controls, such as the use of myxomatosis for controlling rabbits in Australia.

3.2 Attitudes to particular control methods

3.2.1 Shooting

Shooting is probably the most acceptable fatal form of pest control among the public and other stakeholder groups. It is largely seen as comparatively humane and specific if carried out with skill. It is also compatible with the goal of maximising the benefits of pest control efforts (eg employment and resource recovery) and is the most acceptable method to the public for controlling foxes, wild cats, wild pigs and rabbits. In the United Kingdom, there is controversy surrounding hunting foxes with dogs, with the public being strongly against such an approach, while farmers (and recreational hunters) are for it.

The Australian public regards 'aerial culling' as acceptable for wild dog and dingo control. When it comes to larger non-predatory animals, such as wild horses and goats, the rural public regard shooting as acceptable, although this view is not shared by the urban public. Shooting tends to be the method of choice of farmers and other land managers for most pest animals. Because farmers are often concerned with pest management rather than eradication, shooting provides the ability to control pest numbers while enabling a recreational activity. Farmers also regard shooting as effective and relatively quick (ie humane). It also reduces the risk of accidental death of livestock and farm animals, which can be a perceived problem with poisoning. Hunting enables 'sustainable management' (ie harvesting) of pests as well as providing a recreational activity.

Wildlife managers accept hunting as a valid pastime and a valid means of controlling pests. There are, however, different views between male and female wildlife managers with respect to shooting and trapping, with female wildlife managers being less accepting than males of shooting and trapping as means of controlling pest numbers. Whether they are wildlife managers or members of other stakeholder groups, females tend to prefer non-lethal pest animal controls.

3.2.2 Trapping

Stakeholder views of trapping are quite mixed. The public and some other groups generally view it as acceptable for pests such as wild cats, rabbits and rats, but consider it unacceptable for other animals such as wild dogs. The degree of 'pestiness' of the target animal may be a factor in the acceptability of trapping. Traditional hold traps are increasingly seen as inhumane, and kill traps have been found to be more acceptable. New Zealand studies of attitudes to stoats showed that people were keen to see more research and development in trapping, especially to make kill traps more specific to the target species.

3.2.3 Exclusion and repulsion

Exclusion methods such as netting, scarers, chemical repellents and fencing are very acceptable to the public primarily because they are not lethal, are seen as very humane, and are safe for people, livestock and other animals. For pests such as wild deer, flying fox and various bird species, these forms of control are the most acceptable, perhaps complemented by public education. However, the public seems to be sceptical of extensive exclusion fencing for animals such as rabbits and wild dogs.

Wildlife managers also feel that exclusion methods are ethically acceptable, although expensive, for controlling pest numbers. They are also aware of the dangers of fencing to protected wildlife. These non-lethal and passive forms of control tend to be well accepted by female wildlife managers. Male wildlife managers also find these methods acceptable, but prefer shooting and trapping.

There is little research on farmers' views about exclusion methods, although horticulturalists, fruit growers and the like tend to find them less acceptable than other methods because of the cost (eg for controlling birds and flying fox). Loud bird scarers can also be unpopular in areas adjacent to towns and suburbs.

3.2.4 Capture and relocation

The public, especially the urban public, find capture and relocation an acceptable means of controlling some pest animals, mainly because it is seen as humane, non-fatal and specific. This is certainly the case for wild horses in Australian and New Zealand national parks. Available Australian studies show that the rural public, who are perhaps more acquainted with animals and tend to have a more utilitarian view of them than their urban counterparts, prefer wild horse and other larger animals be captured, killed and processed for consumption rather than relocated. Studies of horses, deer and other larger animals indicate that wildlife managers tend not to be in favour of capture and relocation, seeing it as both inhumane and expensive.

3.2.5 Poisoning

Anthony Fraser, in his 2006 review of the New Zealand literature, noted that poisons are 'the least acceptable of all methods reviewed', and 'fail to satisfy any of the three key criteria that influence acceptability'; that is, they are not regarded as humane, specific and safe. The current review also found that poisoning is one of the least publicly acceptable forms of pest control. Even theoretical 'humane poisons' do not rate particularly highly, although the available literature shows that if the humaneness can be guaranteed, public attitudes to the use of poisons for wild cats and rabbits become more positive. There are also species (eg kangaroos, wild horses) where the public view poisoning as unacceptable, irrespective of how humane. Successive and interlinked research surveys, such as those conducted between 1994 and 2005 by Fitzgerald and Wilkinson on attitudes to possum, rabbit and stoat controls, reveal a decreasing public acceptability over time of 1080 and other poisons and that females are consistently less accepting of poisons than males.

In Australia, poisoning using 1080 baits is still the major form of wild dog, fox and rabbit control on public and private lands. While accepting its cost effectiveness and necessity for control of some pest animals, Australian farmers appear to be increasingly concerned about the risk 1080 presents to their livestock and farm animals, as well as the local environmental impacts. Much of this concern relates to the accuracy of aerial distribution of 1080 baits, rather than ground baiting. Animal pesticides, especially 1080, have become increasingly contentious in western societies.

3.2.6 Biological control

The majority of the literature on attitudes to biological controls focuses on the public. This literature indicates that the public generally finds the idea of biological controls acceptable. This can be seen in the support for unspecified biological and genetic control methods found by Fisher and Cribb (2007, 2008) in their internet surveys, and the moderate support in state-level surveys on wild dog, fox and rabbit control. However, the New Zealand research that explored attitudes to biological control of animal pests in considerable detail has found that particular biocontrol microorganisms (eg myxomatosis and RCD/RHD virus for rabbits and canine distemper virus for stoats) tend to be less acceptable to the public than theoretical or unspecified controls (eg an imported rabbit-specific virus, or an unspecified biological control; Sheppard and Urquhart 1991; Fitzgerald et al 1996, 2005; Wilkinson and Fitzgerald 1998, 2006). Close examination of attitudes to particular biological controls shows people are often concerned about the unforeseen risks of introducing exotic or modified organisms into the environment for the purpose of controlling introduced animals that have become undesirable and destructive pests. Microbiological forms of control designed to kill pest animals tend to be seen as cost effective, although there can be underlying uncertainty about their specificity and safety. People seem to require a high level of guarantee or certainty about the species-specificity/safety and humaneness of a microbiological control, especially one that has been genetically modified.

3.2.7 Fertility control

Fertility control could be classed as the 'up and coming' method of pest control for wildlife. It is commonly seen as a very humane approach to reducing pest numbers and is strongly favoured by those averse to lethal forms of control, especially females. Fertility controls, especially self-perpetuating immunocontraceptive organisms, have been found, at least in theory, to be acceptable methods to the public for a range of pest animals. Fertility control is also among the most acceptable of approaches among wildlife managers, particularly because it does not involve the death of individual animals.

Chemical or drug-based contraceptives and sterilisation have been developed and used for some animals, but so far no fertility-based biocontrols have been developed and released for use. Public and stakeholder groups have therefore been giving consideration in attitude studies to theoretical immunocontraceptive controls based on organisms that would be genetically modified to have the desired properties of species specificity, humaneness and effectiveness. Theoretical controls that fulfil these requirements tend to be acceptable to a majority of the public, but not to everyone.

In none of the literature does any one group emerge as adamantly against fertility control as a means of controlling pest numbers. However, particular stakeholder groups have expressed scepticism about the ethics of using genetic modification in pest control, the feasibility of developing such controls, and their likely effectiveness. Uncertainty, lack of knowledge, and demands for low levels of risk also feature in public attitudes to the technology.

4. Conclusions

The research reviewed in this report shows that attitudes towards pest controls vary according to the:

- characteristics of the person or group
- perceptions of the pest animal and its impacts
- environment being impacted
- features of the control method.

Relevant personal characteristics include gender, urban or rural residence, culture and (related to these) value orientation. Characteristics of the pest animal that seem to be relevant to peoples' attitudes are: whether the animal presents a direct physical threat to people, its size, whether it predated on livestock or other valued species, whether it impacts negatively on people's livelihoods, and to a lesser extent, its aesthetic appeal. The status of the area affected also seems to be relevant, such its proximity and accessibility, aesthetic and utilitarian appeal, and ownership (eg public or private). Features of pest controls that have been found to be important to peoples' attitudes are the control's perceived safety (especially for people), specificity with respect to individual animals and the target species, its humaneness and effectiveness, and whether it is lethal to the target animal. For some stakeholders, cost and timeliness are also important features of a pest control method.

Taken together, these various factors mean that discourses around current or proposed pest controls need to recognise their social and physical context, including the social constructions of the target animal as a 'pest' and the values being impacted by it, and of the various risks or threats involved. In practice, it means that decisions about pest animal controls cannot be made in a formulaic manner, but need to be made on a case-by-case basis and informed by systematic assessments. Crucially, public and stakeholder involvement in pest control decision making needs to be accompanied by balanced information delivered in well-designed and resourced public education programs.

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