



awi

Australian
Wool Innovation
Limited

Project Name	Wild dog management in Australia
Project No.	WP525
Contract No.(s)	C4722
AWI Project Manager	Jane Littlejohn
Contractor Name	ABARES
Prepared by:	Heather Aslin

Social impacts of wild dogs—a review of literature

Lyndal-Joy Thompson, Heather Aslin, Saan Ecker, Patty Please &
Charlene Trestrail

October 2013

This publication (and any material sourced from it) should be attributed as:
Thompson, L-J, Aslin, H, Ecker, S, Please, P & Trestrail, C 2013, *Social impacts of wild dogs—a review of literature*,
ABARES, Canberra, prepared for AWI Ltd.

Table of contents

Executive summary	v
1 Purpose and scope of this review	1
2 Introduction and background to wild dog management in Australia.....	3
History of the wild dog.....	3
History of wild dog management in Australia—a wool producer’s perspective.....	3
Wild dog issues and management methods.....	4
Attitudes to management and management methods.....	10
Media representations of wild dog issues.....	13
Tensions in managing wild dogs identified from the wider literature.....	14
3 Social impacts of wild dogs.....	23
Social Impact Assessment.....	23
Assessing the social impacts of wild dogs—review of recent studies.....	24
Social impacts on livestock enterprises.....	26
Psychological impacts on individuals involved in livestock enterprises.....	28
Public health impacts.....	29
4 Gaps in knowledge about social and psychological impacts of wild dog attacks.....	31
Persistent issues.....	31
5 Governance and structure of current wild dog management programs.....	33
Wild dog management by jurisdiction.....	33
6 Barriers to effective and coordinated action to manage wild dogs.....	40
Value and attitudinal differences between stakeholders.....	40
Legislative and jurisdictional barriers.....	40
Tenure-related barriers.....	41
Overcoming the barriers.....	41
7 Wild dog management groups’ key support needs.....	52
Addressing the needs of wild dog management groups.....	53
Appendix 1 Media content analysis methods and issues identified.....	54
Glossary.....	58
References.....	61

Figures

Figure 1 Distribution of wild dogs and dingoes in Australia. Source: Invasive Animals Cooperative Research Centre (map prepared 2012)..... 4

Figure 2 Impact of wild dogs on farmers—percentage of survey responses falling into different impact categories (sample size = 423) (from ABARES in preparation 2013)..... 27

Figure 3 Example of an adaptive management cycle (after Walters 1986; Allan 2007)..... 41

Figure 4 Stakeholder analysis matrix (from Start & Hovland 2004)..... 43

Figure 5 A flow chart for a strategic, adaptive approach to wild dog management (after Allen et al. 2011)..... 51

Tables

Table 1 Situations in which a nil tenure strategy may be appropriate or inappropriate..... 6

Table 2 Current and potential wild dog control methods and incentives (after Appleton et al. 2011)..... 7

Table 3 Dimensions of a social impact analysis and corresponding questions..... 23

Table 4 Social impacts of wild dog attacks recorded in recent studies..... 24

Table 5 Legislation directly relevant to wild dog management in different jurisdictions..... 34

Table 6 Declaration of the status of dingoes and other dogs under the Western Australian *Agriculture and Related Resources Protection Act 1976*..... 38

Table 7 Managing stakeholders according to their power and interest classification (from Start & Hovland 2004)..... 43

Executive summary

This literature review forms part of a larger social research project, 'Wild dog management in Australia—a landscape approach to management including pests, people and place', funded by Australian Wool Innovation Ltd (AWI). The larger project aims to understand how wild dog management can support wool producers to remain in the industry. Specifically the project aims to examine the social impediments to managing wild dogs (here defined as covering all dogs living in the wild in Australia, including dingoes), and the support needed to implement coordinated and effective wild dog management plans.

This literature review has several key objectives in support of the broader project:

- 1) define the social impacts of wild dog attacks, particularly on livestock enterprises and wool producers
- 2) outline the governance and structure of current wild dog management, and identify potential barriers to coordinated stakeholder action
- 3) identify factors supporting effective collaboration between relevant stakeholders.

This review of literature, governance arrangements and actions relating to wild dog management is designed to support the development of a social science research approach that can meet AWI's objectives for increasing wool growers' confidence in the sheep industry. This document identifies and reviews social aspects of wild dog management issues considered in published peer-reviewed literature, 'grey' literature, and media reports, as well as legislation directly relevant to wild dog management. This broad approach to the review acknowledges the relative lack of formal scientific literature, particularly peer-reviewed literature, about the human and social impacts of wild dogs and wild dog management in Australia.

Several key tensions relate to differing perspectives on wild dog management. These tensions are primarily over:

- wildlife conservation objectives versus agricultural production objectives. Some conservationists and wildlife managers view dingoes as a native species deserving protection. This can conflict with farmers' views that dingoes and other wild dogs need to be managed to protect their livestock. However, some wildlife managers also believe that managing the numbers of wild dogs, including dingoes, can help conserve native animals, particularly small- to medium-sized native mammals. So some conservationists' views about managing wild dogs can align with those of farmers, while the views of others do not
- animal welfare concerns versus the need for effective management. Community viewpoints relating to animal welfare can range from seeing no current management techniques (or at least no lethal control methods) as being acceptable and humane, through to varying degrees of acceptance of current techniques. For example, use of the poison sodium fluoroacetate or 1080 is often seen as inhumane, but some stakeholders directly affected by wild dog attacks on their livestock accept it as being the only practical and effective management technique currently available, while other stakeholders maintain that it is humane
- local management versus government-controlled management. Tensions have arisen about the perceived 'top-down', government-controlled approach to wild dog management that is seen by some to disempower local people and their knowledge and create legislative and regulatory barriers to effective management. The current approach is seen to differ from the historical one in which local landowners had primary responsibility for pest management

- scientific knowledge versus local knowledge—including the differences between scientists who distinguish between dingoes and other wild dogs and advocate different management for them, versus local people who want all wild dogs effectively managed; controversies about the predatory effects of wild dogs (such as the ‘meso-predator’ hypothesis); differing interpretations of the impacts of wild dogs; and differing views on the validity of evidence of impacts (in whatever form) from woolgrowers.

Developing effective multi-stakeholder consultation and decision-making processes about wild dog management, and developing the capacity of woolgrowers and other stakeholders to engage in these processes, is likely to be critical in achieving successful outcomes for the sheep industry. This is partly due to the need to implement ‘nil tenure’ or ‘whole of landscape’ approaches to wild dog management that cross jurisdictions, land tenures and land uses, and therefore need to involve a range of landowners.

There is a need to investigate the usefulness of various possible approaches and options for these processes, as well as options to develop stakeholders’ capacity to engage in them. These approaches could include applying community engagement principles and practices; stakeholder analyses; social impact assessments; participatory action research approaches; and monitoring and evaluation methods. Using these approaches can in itself build capacity, and specific communication or education products and training could be developed. Using spatial and map-based tools, including Public Participation Geographic Information Systems (PPGIS), or the Multi-Criteria Analysis Shell for Spatial Decision Support (MCAS-S), can also contribute to multi-stakeholder consultation and decision-making processes.

AWI and the ABARES’ research team will use these findings to further develop the overall social research methods to address AWI’s objectives.

1 Purpose and scope of this review

This review forms part of a larger social research project, 'Wild dog management in Australia—a landscape approach to management including pests, people and place', funded by AWI. The larger project aims to understand how wild dog management can occur in a way that helps wool producers to remain in the industry. Specifically, the project aims to examine the social impacts of wild dog attacks, and the impediments and the support needed for stakeholders to implement coordinated and effective wild dog management plans. For the purposes of this review, and particularly in the context of reviewing the social impacts of wild dog attacks, 'social' is being used in a broad sense to cover all kinds of impacts on individuals, groups and organisations, including their health and wellbeing. 'Stakeholders', as the term is used here, are the individuals, groups or organisations who have an interest in ('stake'), and the potential to influence the aims and actions of organisations, projects or policies dealing with wild dogs and how they are managed (Brugha & Varvasovszky 2000).

This review has several key objectives supporting the broader project. They are to:

- define the social impacts of wild dog attacks, particularly on livestock enterprises and wool producers
- outline the governance and structure of current wild dog management, and identify potential barriers to coordinated stakeholder action
- identify factors supporting effective collaboration between stakeholders.

In addition, these broader objectives relate to several key research questions developed in consultation with AWI:

- How do we define social impacts and how is an understanding of social impacts used in designing effective actions?
- What is the most effective form of management for wild dogs; specifically, is collective action the best approach for individuals and groups?
- How can an understanding of perceptions of multi-stakeholders contribute to negotiation of cooperative management?
- What forms of extension are effective and what paradigms of extension are we considering?
- How can a landscape-level approach, based on the 'nil tenure' model, and employing Geographic Information Systems (GIS)-related tools, contribute to effective management?

This review covers literature (peer-reviewed and 'grey' literature, media reports) and jurisdictional and governance arrangements directly relevant to the social aspects of wild dog management in Australia. It also covers methods and approaches seen as being relevant to designing a research approach for the overall project that can meet AWI's objectives to develop effective wild dog management that allows wool growers to have confidence in remaining in the sheep industry. This broad approach to the review acknowledges the relative lack of literature, particularly peer-reviewed literature, about the social impacts of wild dogs and wild dog management in Australia.

The review provides a brief background to wild dog management in Australia, highlighting tensions that affect the ability to manage the problem effectively. It then outlines methods currently being used to manage wild dogs. This is followed by an analysis of existing literature on

social and psychological impacts of wild dog attacks on livestock. The review then outlines the current jurisdictional and governance arrangements in place to manage wild dogs around Australia. This is followed by an overview of what appear to be the major barriers to coordinated action based on reviewing the literature. Finally this review attempts to identify what is required to achieve more collaborative and effective action in which all parties have an important role to play, and have the capacity to play this role.

2 Introduction and background to wild dog management in Australia

History of the ‘wild dog’

The dingo, Australia’s original ‘wild dog’, is thought to have arrived in Australia from southern Asia approximately 4,000–4,500 years ago (Corbett 2001; Oskarsson et al. 2011). Since then, dingoes have spread across mainland Australia (they are absent from Tasmania), and are often considered to have become a functional component of many ecosystems. At the time it arrived in Australia, the dingo was probably a domesticated dog that accompanied Indigenous people, who used it as a camp companion and possibly as a source of food (Litchfield & Smith 2009). Today, dingoes share the Australian landscape with domestic dogs introduced more recently by European settlers. Wild-living European domestic dogs (sometimes called ‘feral dogs’) are now present and readily interbreed with dingoes, creating hybrids. It can be difficult to distinguish between ‘pure’ dingoes and hybrids as they usually have strikingly similar appearance, and all are considered to be subspecies of the grey wolf (*Canis lupus*). In this report the term ‘wild dog’ is used to describe all dogs living in the wild in Australia, including dingoes (*Canis lupus dingo*), feral European domestic dogs (*Canis lupus familiaris*) and dingo–domestic dog hybrids (*Canis lupus dingo* x *Canis lupus familiaris*).

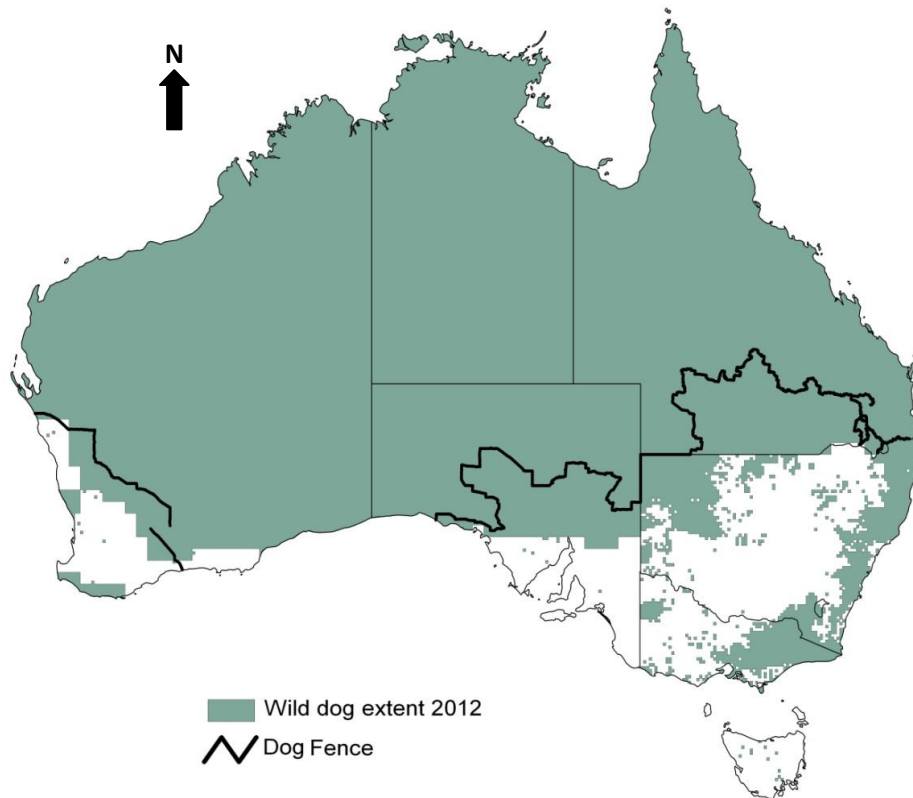
Wild dogs occur across a range of landscapes, from national parks to farming areas and urban environments. Behavioural studies show that individual wild dogs can have extensive ranges, with the ranges of wild dogs in eastern agri-ecosystems variously estimated as covering 27 km², 10–100 km², and 42.5–124.3 km² (Claridge et al. 2009; Harden 1985; Robley et al. 2009). Studies in arid and semi-arid zones have yielded home ranges of 79–999 km² for independent dingoes (Newsome et al. 2013), pack territory ranges of 44.5–113.2 km² (Thomson 1992), and very small home ranges (<12 km²) for those dependent on human provided food from rubbish tips (Newsome et al. 2013). Figure 1 shows the distribution of wild dogs and dingoes in Australia, recognising that this distribution is constantly changing and the map lacks local detail.

History of wild dog management in Australia—a wool producer’s perspective

Franklin (2012) has described the history of wild dogs from the a wool producer’s perspective. Her account tracks the historical interactions of dingoes and wool producers from the time sheep were first introduced to New South Wales and the perception at that time of dingoes as agricultural pests. She describes how the early period of wild dog management in sheep country was characterised by a reliance on independent, localised and coordinated efforts by wool producers. Franklin further describes her view that the rise of environmentalism and the creation of state and national parks and reserve systems have seen wider public perceptions of the dingo change from that of pest to that of native animal deserving protection under state and territory legislation—while still remaining a pest to producers. Franklin sees these changing perceptions as heralding the introduction of a new governance structure that removed responsibilities for wild dog management from local hands to state or territory ones, or even to national ones. In this account, not only have wool producers lost control over wild dog management, they have even been criticised as being killers of a ‘national icon’.

While Franklin’s perspective represents only one of many, in the context of this project—which is focused on wool producers—it is an important perspective and highlights some of the tensions inherent or presumed, and sometimes unacknowledged, in wild dog management today. These tensions are discussed in more detail below, including via a media content analysis. The tensions identified relate closely to the approaches and methods currently being used to manage wild dogs.

Figure 1 Distribution of wild dogs and dingoes in Australia. Source: Invasive Animals Cooperative Research Centre (map prepared 2012)*



*Please note that this map has been prepared using datasets from state-based atlas systems and related mapping work, the former National Land and Water Resources Audit work in 2006, and more recent data from Wild Dog Scan via the Invasive Animals CRC. Every care has been taken to report wild dog occurrence data accurately but further evidence gathering is required

Wild dog issues and management methods

The predatory behaviour of wild dogs can have social, economic and environmental consequences (Fitzgerald & Wilkinson 2009). Traditionally, wild dogs have been considered a problem in farming areas where they prey on livestock. Sheep, lambs, goats and calves, being smaller in size than adult cattle, are particularly susceptible to wild dog attacks (Fleming & Korn 1989). McLeod (2004) estimated that wild dogs cause damage to the Australian economy of the order of \$66.3 million annually. This amount relates to loss of sheep and cattle and costs of control measures. Because of the problems wild dog attacks cause to sheep producers, wild dog management has generally been more intensive in sheep country than cattle country. Supporting this, Newsome (2001) and Allen & West (2013) suggest that the presence and effects of wild dogs are a major deciding factor in whether landholders decide to stock sheep or not, and hence of the distribution of the sheep flock.

Australia's peri-urban population also comes into contact with wild dogs, whether dingoes encroaching closer to urban areas or domesticated pets roaming wild (Fleming et al. 2012). Wild dogs in these areas prey on domestic animals and can occasionally attack people, although this is rare (Newsome 2001). Aside from the obvious impacts on pets or humans from bites, wild dogs are a potential source of zoonotic infections (infections that can be spread from other animals to humans), and their presence may reduce the attractiveness of public reserves; cause people to avoid affected areas; and cause people psychological and emotional trauma due to the attacks either on them or their pets. These attacks can be distressing and often receive media attention. Fleming et al. (2012) suggest that these attacks may be on the rise in areas like remote communities and coastal cities in eastern Australia. The impact of peri-urban wild dogs on urban wildlife is considered to be understudied. Fleming et al. (2012) also indicate that the attacks on

stock from free-ranging wild dogs are difficult to distinguish from free-ranging domestic dog attacks, including those by owned domestic dogs.

A number of techniques are used to control wild dog populations and are elaborated later in this report. Responsibility for management varies by state and territory, as well as by land ownership. Wild dog management has a long history in Australia. However, because of the lack of knowledge about the social impacts of wild dog attacks, and a lack of methods for assessing these impacts (Fitzgerald and Wilkinson 2009; McLeod 2004), government and industry are not always able to respond in a way that addresses the social dimensions of the wild dog problem.

The methods and techniques used to control wild dogs can themselves give rise to tensions between and within different wild dog management stakeholder groups (Franklin 2012). Wild dog management programs have also been developed at different geographical and jurisdictional scales, typically for regions, and involve a range of stakeholders from individual farmers to public land managers. In any complex resource management issue, involvement of a range of stakeholders may mean defended social boundaries and social fragmentation, leading to actions that are not coordinated and mis-communications (Brown 2008). Franklin (2012) argues that wild dog management is affected by the disproportionate control of decision making in urban versus rural areas, leading to a lack of communication between decision-makers in the local community and those who are located far away. The idea of 'nil tenure' (Buller et al. 2005) has been used in communities to try to enhance cooperation amongst stakeholders with varying objectives and obligations. Using a management strategy based on the nil tenure concept can potentially help communities work together. However, there are issues and tensions in groups reaching an agreement to try a nil-tenure strategy, as they often have varying objectives and jurisdictions (Chudleigh et al. 2011).

A nil tenure strategy can be described as the collective identification of an invasive animal problem at the scale appropriate to the invasive animal's home range size and habitat use, irrespective of tenure boundaries and differing legal obligations, and a stakeholder-community commitment to implementing a solution (Buller et al. 2005; Fleming et al. in press 2013). A nil tenure-based strategy can help build stakeholder commitment as it can avoid blame being allocated to particular landholders or types of landholders. A nil tenure-based strategy was adopted by the Brindabella/Wee Jasper wild dog/fox control group in 2005 and has been reported as being 'amongst the most successful, documented, examples of district canid control' (Buller et al. 2005, p. 28). In considering the potential for nil tenure approaches to be more widely adopted, Buller et al. (2005) identified benefits and drawbacks shown in Table 1.

The local or regional success of a nil tenure strategy is likely to require careful and explicit recognition of the social dimensions of wild dog predation, given that the approach relies on successful stakeholder engagement across tenure and jurisdictions. Aspects of this are explored further in this report.

Several wild dog control methods are currently used in Australia, and more are being developed (see Table 2). The use of many methods, particularly lethal ones, is controlled by legislation and regulations in each jurisdiction, as these techniques can potentially harm people (such as people on neighbouring properties), and non-target species. Additionally, decisions about the approaches allowed are made at the local level, adding an extra layer of complexity to management.

Table 1 Situations in which a nil tenure strategy may be appropriate or inappropriate. Generally, a nil-tenure strategy can be used to help develop ownership of the issue across tenures and define the issue from all stakeholders' perspectives.

Where nil tenure may be appropriate	Where likely to be inappropriate or impractical
Problem species exhibits clear and repeated cross-tenure behaviour (e.g. large home ranges)	Problem species exhibit no clear predictable pattern of activity or problem highly localised (e.g. rabbits)
Impacts acknowledged by all tenure holders (or a sufficient majority)	Problem most effectively handled on each affected property Not all affected tenure holders accept there is a major problem (e.g. wild dog attacks in mixed grazing regions likely to affect lambing rates more than calving, so cattle farmers may be less affected than wool growers). However, by using a nil tenure strategy, non-affected land holders may be absorbed into the wider understanding of the issues, improving the landscape scale approach
Recruitment process not so fast that management is impractical	Recruitment/re-invasion pace too fast or unpredictable (e.g. insect swarms)
Stakeholders have different obligations relating to tenure	Stakeholders have uniform objectives and obligations across tenure
Tenure boundaries are unrelated to strong geographical features (e.g. public/ private boundaries mid forest)	Tenure boundaries are geographically obvious (e.g. tenure defined by cliffs and broad rivers)
Practical solutions available	No large-scale practical solution available (e.g. for cane toads)

Source: Buller et al. (2005, p. 31), and Fleming et al. (in press 2013)

Table 2 Current and potential wild dog control methods and incentives (after Appleton et al. 2011)

Control method	Description	Advantages	Disadvantages
Trapping	Mechanical traps are set and checked regularly to ensure dogs are not left in traps for extended periods; trapped dogs are destroyed. Trap types include: box (cage) trap, nets, snares, and leg-hold traps (which includes padded leg-hold traps)	Captures are demonstrable, which may drive participation because of physical evidence of a kill, particularly when of identifiable individuals held responsible for damage	Can be expensive Dogs can become 'trap shy' Insufficient skilled trappers available Traps need to be checked regularly Not a population reduction tool High numbers of scalps being obtained can reduce trapping efforts
1080 baits	The poison sodium mono-fluoroacetate, commonly known as '1080' is used in ground or aerial baits. 1080 is odourless, biodegradable and occurs naturally in some Australian native plants	Population level method Biodegradable, non-residual or cumulative poison, considered very species-specific at the low doses required for wild dogs and foxes (birds and reptiles unaffected) Comparatively humane because of mode of action Some native animals (not all) have evolved tolerance Sub-lethal doses are metabolised and excreted as harmless products	Kills rarely found because of the latent period between ingestion and intoxication, so no physical evidence of a kill No antidote; accidental ingestion can kill pets and working dogs Biodegradable: dosage declines with time of exposure to humid and wet conditions, which can cause ingestion of sub-lethal doses Physical effects disturbing to watch

Lethal

Control method	Description	Advantages	Disadvantages
PAPP poison* baits	Para-aminopropiophenone (PAPP) baits were developed in New Zealand to control stoats and feral cats. PAPP acts by rapidly forming methaemoglobin, which is unable to release bound oxygen. This creates a lethal deficit of oxygen in the animal's cardiac muscle and brain	Antidote is available Shorter period between ingestion and death than 1080 Less dramatic physical effects than 1080 Can be used as an alternative toxin where 1080 is not permitted Sub-lethal doses are metabolised and excreted as harmless products	Goannas and quolls are susceptible. An antidote, BlueHealer®, has been developed, which when administered early enough will reverse the effects of PAPP. Goannas, bandicoots and quolls are susceptible, whereas they are not affected by the 1080 doses used for dogs and foxes
M-44/Canid Pest ejector	A mechanical device that, upon pulling by a wild dog or fox, ejects a standard lethal dose of toxin (1080, cyanide or PAPP) into its mouth. Currently not available in all jurisdictions	Considered target-specific for wild dogs and foxes Amount of toxin does not decline with exposure and doses remains lethal Does not require regular checking	May require special authority for use Attractant can be removed by ants
Shooting	Conducted by experienced, licensed shooters. This technique is usually opportunistic, although 'bateaus' are sometimes used for troublesome dogs. Shooting from helicopters is used in some states	Captures are demonstrable which may drive participation because of evidence of a kill Can target individual animals	Can result in dogs becoming 'gun-shy' Expert activity requiring training Not a population reduction tool
Lethal Trapping Devices	A lethal poison device can be attached to the trap in order to avoid prolonged suffering of a trapped animal. This is usually in the form of a cloth laced with strychnine; however a new option in development is a small tube containing a cyanide paste that can be cable tied to the device.	Lethal Trapping Devices reduce the risk of animals being left alive in traps for unreasonable periods of time. This can increase the humaneness of trapping (RSPCA 2010)	The devices are not discriminating and may trap and kill non-target and, potentially, threatened species

Control method	Description	Advantages	Disadvantages
Exclusion fencing	Electric and netting fences are used to exclude wild dogs from livestock producing regions or individual properties and conservation reserves	Provides first line of defence against new incursions Gives producers a stronger sense of 'protection' Reduces required vigilance by producers Provides a feature on which to focus or delineate other management actions	Requires regular maintenance to be effective High establishment costs Can be damaged by feral pigs, kangaroos and wombats
Guardian animals	Animals that are aggressive to wild dogs (e.g. livestock guarding dogs, llamas and donkeys) are placed with stock to deter wild dog attacks	Provide first line of defence against new incursions Give producers a sense of 'round the clock protection' Reduces required vigilance by producers	Livestock guarding dogs require large investment in training and acclimatisation with stock Guardian dogs can attack stock and wildlife if trained incorrectly Some guardian animals are not suitable for certain land types Often requires concurrent lethal methods on adjacent lands

Non-lethal

Note: *indicates methods currently being developed

Both lethal and non-lethal methods contribute to the suite of techniques available or in development to help manage wild dog predation. The wild dog predation issue and factors leading to these techniques being implemented are described by a number of researchers including Allen & West (2013), and are further elaborated throughout this paper. A report by Southwell et al. (2011) examining the drivers and barriers to particular control techniques being adopted indicates that the major barriers include concerns about non-target species, humaneness, cost and effectiveness. The authors conclude there is a need for control methods to be developed that pose fewer risks to non-target species (for example, goannas are vulnerable to PAPP), fewer risks of contamination of natural resources (although this may not be an issue with 1080, depending on the concentrations involved, as it is a naturally-occurring substance in some areas), and that are and are perceived to be humane. How control methods are perceived is very important. However, new management tools need to be demonstrated to be more humane than existing ones, on the basis of reliable scientific evidence, before being used in their place. The development of the chemical para-aminopropiophenone (PAPP) and its antidote, BlueHealer®, are indicated as potentially resolving some of these problems, provided that landholders are advised about their respective advantages and disadvantages, use and attributes, in an open and participatory manner. Southwell et al. (2013) further elaborate on the data used in the 2011 study, noting that relative advantage is among a range of factors influencing decisions about wild dog management. For example, they observe that neighbour participation in wild dog management will influence whether particular land managers participate themselves. They also found many survey respondents who did not manage wild canids because they believed they played a beneficial role in reducing other pest animals.

Attitudes to management and management methods

Research on public attitudes to wild dog management is not extensive. A broader review of Australian and international research about public attitudes to pest animal management by Fitzgerald (2009), identified three Australian studies specifically about wild dogs (including a PhD thesis), and one about domestic dogs attacking livestock in Western Australia.

A survey of the Victorian public undertaken by Johnston & Marks (1997) found that 79 per cent of those surveyed saw wild dogs as a pest animal, with 63 per cent believing they should be eradicated. (The definition of wild dogs in this study did not include a reference to dingoes, so it is likely that people responding to the survey differentiated between dingoes and other wild dogs, and were responding in relation to the latter.) When asked about the type of control method, respondents to the survey perceived shooting as the most appropriate method (50 per cent), followed by unspecified biological control (12 per cent), and poisoning and trapping (11 per cent each). Ballard (2005), in a survey of the New South Wales public that asked about the acceptability of aerial culling to manage a range of possible pest animals, found that 54 per cent of urban and 65 per cent of rural respondents supported this technique for wild dogs.

A review of a 1080 poisoning program in Queensland undertaken by Allen (2006), found that grazier attitudes to poisoning were mixed. Of 45 interviews undertaken to examine lack of participation in controlling wild dogs using 1080, 42 per cent of those interviewed reported having had a 'bad experience' with 1080 (due to impact on non-target animals), and 84 per cent indicated they did not participate in baiting due to the risk of accidentally poisoning their farm dogs (Allen, in Fitzgerald 2009).

Research by Fenton (2009) identified a number of factors that affect decisions to participate in wild dog management, including the economic impact of wild dogs; relationships with neighbours; perceptions about amount of time required for management; the nature of business undertaken by neighbours e.g. whether sheep or cattle grazing; and ownership of neighbouring properties e.g. whether there was 'caretaker management' or whether properties were unoccupied. Other factors identified included the size and physical characteristics of properties,

and their locations, particularly how close they were to national parks; beliefs about the environmental impacts of wild dogs; uncertainty about the classification of dingoes versus other wild dogs; and perceived costs of wild dog control methods.

Keen (2011) undertook a study to identify whether attitudes towards dingoes and wild dogs varied across stakeholders in two study regions of Victoria (the Grampians and the north-east), and what factors might be influencing these attitudes. An online, postal survey was developed and data acquired through face-to-face and telephone interviews. Stakeholder groups that participated were farmers, non-farmers and wildlife managers. Key findings included that:

- farmers and non-farmers in the north-east held more strongly negative attitudes towards wild dogs than those in the Grampians, demonstrating that there were varying attitudes across the regions
- there was scepticism that 'pure' dingoes remained in Victoria
- an attitude that wild dogs should be eradicated in the state was prevalent.

A related issue is that of the attitudes of Indigenous Australians to wild dogs and the methods used to control them. Research undertaken by Rose (2007) found that Indigenous Australians in the Central Land Council area of the Northern Territory did not see any incompatibility between native animals and introduced animals using the land together (Fitzgerald 2009). Indigenous perspectives differ significantly from the rationale for feral animal control programs since Indigenous people do not necessarily believe newly-introduced species should be managed differently from any other species (Rose 2007). This conflict of perspectives has the potential to affect wild dog management programs in central Australia. Other research by Robinson et al. (2005) in northern Australia revealed Indigenous perspectives about feral animals similar to those found in central Australia. More recent research by ABARES (in preparation 2013), found Indigenous land managers and pastoralists differed in their views about wild dog management.

Litchfield & Smith (2009) examined the relationship between Indigenous Australians and dingoes, finding that the dog (first the dingo and now the European domestic dog) featured heavily in 'Dreaming' stories. Despite its place in Indigenous mythology, the authors also found that there was an awareness of the problems associated with dingoes or dogs in general, including disruption to camp life and religious ceremonies, the burden of feeding placed on camp supplies and implications for food storage, and the potential for diseases to be transmitted.

Two papers by Trigger and his colleagues (Trigger 2008; Trigger et al. 2008) have investigated cultural understandings of 'nativeness', 'belonging' and 'alien', finding that for the dingo in particular there were many cultural interpretations of its 'value' and 'purity'. Trigger et al. (2008) suggest the 'Australian dingo is thus distinctively caught up in the negotiation of nativeness and cultural belonging' (p. 1280), due to the ambiguity Australians as a whole feel about whether it 'belongs' here or not. This ambiguity undoubtedly affects management approaches and the tensions between diverse groups that value the dingo differently. Trigger et al. (2008, p. 1279) contrast, for example, the views of the Australian Native Dog Conservation Society, which is 'dedicated to preserving the genetic purity of the dingo', and those of sheep producers, who view the animal as a pest.

Recognition of the complexity of wild dog management, particularly the need for a strategic approach involving multiple stakeholders across different land tenures, resulted in the National Wild Dog Facilitator (NWDF) project being established within the Invasive Animals CRC. The facilitator project recognised that 'producers and the wider community working cooperatively is required to effectively manage wild dogs and their impacts' (Chudleigh et al. 2011) and was designed to help communities establish local and regional management plans. An economic

analysis of this project was undertaken to try and estimate the return on investment in the facilitator role, and indicated that:

The expected return was 8.6 to 1 when benefits are measured over 15 years from the first year of investment (at a 5% discount rate). If the benefits are considered over a 30-year timeframe, then the benefit-cost ratio increases to 11.3 to 1. A break-even analysis showed that the NWDF would only need to reduce the wild dog impact by 4.9% over 15 years in the areas where the project is active in order for the investment to break-even (Chudleigh et al. 2011, p. 3).

These results suggest that the facilitator project had a high return on investment and was a valuable contributor to managing what is increasingly thought of as a 'human' rather than an 'animal' problem.

Fenton (2009) took a different social science approach, focusing on understanding landholders' beliefs and attitudes to wild dog control. This study looked specifically at:

- why landholders chose to control wild dogs
- what determined their decision to adopt a specific control method.

The study was prompted by the understanding that many landholders did not adopt wild dog control methods. The study's methods involved unstructured group discussions with landholders in western Queensland at five locations. A key finding was that landholders' decision-making about wild dog management very much depended upon whether the landholder was a cattle or sheep producer. A conceptual framework was developed based on this finding, as well as four primary belief factors being identified:

- beliefs about the economic impact of wild dogs—i.e. loss of calves or lambs
- beliefs about the role of neighbours—i.e. the ability to undertake coordinated action
- beliefs about the time required to manage wild dogs—some methods more time consuming
- beliefs about wild dog behaviour—access to expert knowledge in this area.

And four secondary factors were identified:

- property and employment characteristics—e.g. proximity to national parks
- beliefs about the environmental impacts of wild dogs—e.g. eradication leading to problems with native species
- beliefs about wild dog breeds—some landholders had different views depending on whether they thought 'pure' dingoes or crossbreed dogs were involved
- beliefs about the costs of wild dog control methods—although most costs were minimal.

These factors also fed into decisions about whether to adopt particular control methods.

The Fenton (2009) study, discussed further later in this report, was undertaken as part of a broader community engagement program managed by AgForce Queensland under the Queensland Government's 'Blueprint for the Bush' Pest Offensive Program, entitled 'Raising Awareness of Coordinated Wild Dog Control' (Agforce 2010). The Fenton study identified a number of factors that affect the decision to participate in wild dog management, and these findings contributed to developing a structured producer survey used to quantitatively assess

decision-making factors in wild dog control among relevant producers in Queensland (Agforce 2010).

Media representations of wild dog issues

As wild dogs are mainly a problem for regional and rural communities, it is not surprising that they are often mentioned in regional newspapers and regional radio segments. This media content analysis used the database 'Mediaportal' (supplied by Media Monitors) which was purposively sampled between May and August 2012 to identify newspaper articles and radio segments that contained the words 'dingo' or 'wild dog' (see Appendix 1 for the methods used). It was found that wild dog management issues rarely featured in publications distributed to urban populations. Media representation is important as it can be both a reflection of public opinion and an influence on public opinion, and is therefore relevant to wild dog management overall and the tensions it raises.

Table A1 in Appendix 1 details the themes identified in the media analysis. Many articles provided general information about workshops teaching wild dog management skills, such as baiting techniques. The wild dog issues that received media attention varied between jurisdictions, but there were three common themes across jurisdictions: government action, stakeholder tension, and human health and wellbeing.

Government action

Publications in several states focused on government involvement (at all levels) in wild dog management. Issues affecting the effectiveness of wild dog management identified in the media search included:

- lack of government funding or its uneven distribution ('segmentation') e.g. the reported redirection of wild dog management funding in Victoria to study 'big cat' sightings, and government-imposed barriers to effective management including legislative barriers impacting on the ability of landowners to manage wild dogs on their property
- the former Australian Government Department of Sustainability, Environment, Water, Population and Communities' (SEWPaC) policy for aerial baiting approval in Victoria, due to concerns about possible effects on native animals.

Actions viewed as government contributions to wild dog management efforts, such as recruiting additional wild dog officers or reducing management restrictions, received positive coverage. Chapter 5 of this report details government legislation and roles in wild dog management.

Stakeholder tensions

Several media articles identified stakeholder tensions that were considered to have hindered the effectiveness of wild dog management. For example, New South Wales landholders who were unwilling to participate in wild dog management activities received general media attention; also specific issues were identified by media in other states.

The Victorian media reported on what was perceived to be limited communication between stakeholders. In particular, the lack of communication between coal seam gas companies and local residents was said to feed local people's concerns that the companies were not contributing sufficiently to wild dog management on their land.

Limited cooperation between stakeholders was also reported. In Victoria, for example, it was reported that samba deer shooters left carcasses where they fell. This practice was said to occur predominantly during the wild dog breeding season and provided wild dogs with a food source. In Tasmania, some inadequately restrained pet dogs were reported as savaging livestock on farms bordering urban areas.

Human health and wellbeing

Several media reports portrayed the human health impacts of wild dogs. Reports on emotive issues, such as attacks on pets, were mixed with reports of general concerns about the physical safety of peri-urban residents in areas where wild dogs roamed. For example, a description of campers who were attacked by wild dogs in a Northern Territory national park was published.

Several articles focused on potential future impacts of wild dogs. A media item from New South Wales described general concerns for human safety as wild dog populations increased in future. One article described concerns for future human wellbeing, citing suggestions that the northern wild dog population could facilitate the spread of rabies from Indonesia, and that the interconnectedness of wild dog populations could spread the disease throughout Australia.

Tensions in managing wild dogs identified from the wider literature

Supported by the media review above, four main sources of underlying tension related to managing wild dogs that can be identified through the literature reviewed here are:

- wildlife conservation objectives versus agricultural production objectives (including tensions within these objectives—see further commentary below)
- animal welfare concerns versus the need for effective management
- local management versus government-controlled management
- scientific knowledge versus local knowledge.

These tensions in wild dog management are apparent in the media and also in the discussion amongst multi-stakeholder wild dog management groups. They are discussed in more detail in the following pages.

Wildlife conservation objectives versus agricultural production objectives

Wild dogs themselves can have effects on achieving wildlife conservation objectives, as can the management techniques used to control them. Wild dogs are a predator and are sometimes considered to present a danger to the survival of remnant populations of endangered fauna, though not more abundant wildlife species (Allen & Fleming 2012; Fleming et al. 2001; Robertshaw & Harden 1989). The argument here is that wild dogs are not a problem to populations of native species that are abundant, but they are a threat to endangered populations, particularly of small and medium-sized animals such as native mice, dunnarts, bandicoots and wallabies (Allen & Fleming 2012). Allen & Fleming's (2012) study indicated that 94% of extant species in western NSW were potentially at risk from wild dog predation and predation by wild dogs as been listed as a Key Threatening Process for some 14 species, for which there exist national-level recovery plans.

As well as the threat from wild dog predation, control techniques, like baiting, can have an impact on non-target species that inadvertently eat the bait. However, this has not been demonstrated for 1080 baits placed for wild dog control (Claridge & Mills 2007).

The consequences of the predatory role of wild dogs are disputed (Department of Primary Industries, Victorian Government 2011). Some people argue that because wild dogs are feral animals any impact they have is 'unnatural'. Others assert that wild dogs perform the natural function of 'apex predator', co-existing with (or replacing) pure-bred dingoes (Johnson et al. 2007). These opposing views create tensions about managing wild dog populations.

Wild dog predation on native fauna, threatening the survival of remnant populations of endangered native species, was acknowledged in 2009 when wild dogs were listed under the *NSW Threatened Species Conservation Act 1995* as a 'Key Threatening Process' for remnant populations of several endangered species. Similarly, an Australian Senate Inquiry identified wild dog predation as a significant contributor to the decline of koala populations (Environment and Communications Reference Committee 2011). Not surprisingly, the effect of wild dogs on this iconic species has received media attention (see Appendix 1).

Some evidence suggests that high densities of wild dogs adversely affect species diversity (Rural Management Partners 2004). Conversely, wild dog predation on native herbivores might be important in reducing over-grazing by these herbivores in arid and semi-arid ecosystems (Pople et al. 2000), and might also be beneficial in managing small local populations of introduced animals like rabbits and feral pigs (Department of Primary Industries, New South Wales Government 2012), although no population-level effects have been demonstrated.

It has been suggested that reducing the numbers of wild dogs could lead to other predators (like foxes and feral cats (Johnson & Van Der Wal 2009) increasing in numbers (Glen et al. 2007; Fleming et al. 2001; Soulé et al. 1988). This is sometimes referred to as this as the 'meso-predator release' hypothesis. The evidence for this is circumstantial and the studies used to support the concept that lethal control of dogs 'releases' foxes (and feral cat) populations from suppression by wild dogs are not strong (Allen et al. 2011, 2013). In the only study in arid and semi-arid landscapes that has experimentally manipulated wild dog populations by baiting, fox and feral cat populations did not show release (Allen et al. 2013). Evidence to support this hypothesis is not accumulating and the processes involved are unclear. Nonetheless, the meso-predator release hypothesis has gained great traction with some ecologists, and the possible benefits of meso-predator suppression by wild dogs for native animal populations as documented by Johnson et al. (2007) may have broad community appeal. Consequently, there are tensions among ecologists and among managers about the best actions to conserve wildlife threatened by predation, and this creates further uncertainty in the broader community.

Dingoes and wild dogs readily hybridise (they are members of the same species), and this process may be decreasing the population of 'genetically pure' dingoes. Many dingo populations contain some hybrids and hybridisation is common along the eastern Australian coast and where there is an interface between human dwellings and bushland (Feral.org 2012; Stephens 2011). The perceived threat of hybridisation to the long-term conservation of dingo populations has led to the dingo's classification as 'Vulnerable' on the IUCN Red list of Endangered Species (Corbett 2008).

Hybridisation and the existence of hybrids between dingoes and other wild dogs have resulted in scientific and public debate. Those who want to promote the dingo as an iconic native animal may want to emphasise the differences between dingoes and other dogs, and stress their conservation significance. On the other hand, those who regard wild dogs generally as a pest may want to de-emphasise these differences or dismiss them as being insignificant. Additionally, some who regard wild dogs as pests want to emphasise the differences: they believe that demonstrating differences with genetics would require greater control effort from public land managers because of the differences in the legal status of dingoes and other wild dogs and the consequent obligations for different management. However, those affected by wild dog predation may consider the scientific debate immaterial because of the impacts this predation has on their livestock and livelihoods.

Terrestrial and aerial baiting with 1080 is used in several states to control wild dog populations. Although better bait placement may reduce the risk of 1080 being eaten by non-target animals, including native wildlife, the general public and graziers may still have concerns about this method. According to media reports examined in this review, concerns that endangered native

animals would eat baits prevented aerial baiting from occurring in Victoria in the 2011–12 summer season. However, as stated before, the evidence does not support these fears and some non-target animals could even benefit from such programs (Claridge & Mills 2007; Glen & Dickman 2008).

Animal welfare concerns versus the need for effective management

The methods used to control wild dog populations and reduce the frequency of attacks on livestock raise animal welfare issues, as do the attacks themselves and the suffering they cause livestock. These issues are probably even more contentious today than previously because of the raised profile of animal welfare issues in the Australian community generally, and the active role of non-government animal welfare advocacy groups. Some livestock producers and wild dog controllers are concerned that new animal welfare measures will compromise their ability to manage wild dogs and lessen the damage they do.

The methods currently used to control wild dogs in Australia have been listed in Table 2. Other possible control methods that could be used in future include fertility control (permanent or temporary) and biological control. Livestock collars and scent deterrents are also being developed, as indicated in Table 2. However, it is important to note the complex issues surrounding the development of new control techniques. Biological control in the presence of both domestic dogs and dingoes is very difficult to develop and implement, and is likely to meet with extensive resistance from the wider community. Livestock collars have been trialled on wolves and coyotes in areas very different from those of sheep enterprises in Australia. There has not yet been extensive research into their effectiveness for wild dogs in Australia.

Leg-hold and foot-hold traps are part of a larger class of ‘restraining’ traps (as opposed to ‘kill’ traps that kill the trapped animal immediately). Using them raises a number of animal welfare issues. There are current scoring or rating systems in place to assess the performance of restraining traps, particularly in terms of their humaneness (e.g. Fleming et al. 1998), and the following factors need to be taken into account in any comprehensive assessment (Sharp & Saunders 2004):

- restraint time—the length of time the animal is restrained. Trapped animals may be exposed to the elements, become dehydrated, be subject to attack by other animals, suffer pain from injuries incurred in being trapped, and may further injure themselves trying to escape. The likelihood of these factors causing unacceptable suffering is directly related to the time the animal is in the trap
- method of euthanasia—how the animal is killed after being trapped. Even when the trapping itself is relatively humane, the killing must also be humane
- effects of exposure or dehydration—trapping systems that provide some protection from the elements are likely to be more humane than those that do not provide any protection
- pain—the pressure of the trap on the restrained limb will cause some level of pain and sometimes more serious injuries due to the traps, or struggles to escape them, will cause severe pain. However, broken limbs are rare in padded-jaw leg hold traps)
- anxiety/fear/stress—anxiety caused by restraint, physical exertion and attempts to escape will cause distress to the animal, and exacerbate any actual injury caused by the trap
- long-term impact of injuries—animals that escape from a trap may sustain damage or injuries that have a long-term impact on their welfare and survival (for example, their ability to catch prey may be reduced).

A further consideration is that if bitches with dependent pups are trapped or killed, their pups may die a slow death from starvation or dehydration unless they are found and killed promptly. This can be avoided by not trapping during spring when pups are dependent.

All Australian states and territories have animal welfare legislation and, in some cases, other specific legislation, regulation or policy that relates to the use of traps. In most states and territories, leg- or foot-holding traps must have rubber or other padding fitted to the jaws to minimise damage and pain in the trapped limb. In some cases, states and territories also have other relevant legislation, including legislation relating to how strychnine is used (Sharp & Saunders 2004). Most, but not all, states prohibit the use of steel jaw traps (i.e. those without padding on the jaws).

Using cage traps can raise similar animal welfare issues to those raised by leg-hold traps. Cage traps may expose the caged animals to restraint stress and the elements and lead to the trapped animal dying from dehydration or starvation if not serviced regularly. They raise similar concerns about the method used to kill the animals; and similar issues arise about the welfare of any dependent pups.

One of the most respected non-government animal welfare groups is the RSPCA. The RSPCA's view about managing wild dogs is that:

The RSPCA is not opposed to the use of lethal control methods for pest animals provided that there is justification for such killing and there is no effective, humane non-lethal alternative method available. However, the RSPCA is opposed to any method of control that does not result in a humane death. Current methods of trapping do not meet this requirement, as animals that are caught in traps can suffer greatly for a considerable time before they are finally killed (RSPCA 2011).

The RSPCA further states its view that all toothed steel-jawed leg-hold traps and snares should be banned throughout Australia, as they cause serious physical injury and suffering to trapped animals and this view is supported by the findings of Fleming et al. (1998).

1080 has been used widely in Australia since the 1960s to control invasive animals, particularly foxes and wild dogs. 1080 blocks the major metabolic pathway in the body, starving cells of energy and causes central nervous system failure in carnivores (Australian Pesticides & Veterinary Medicines Authority 2008). This failure can cause howling, disorientation, depression, emesis (vomiting) and convulsions while the animal is unconscious. All jurisdictions have guidelines for using 1080 baits, partly because of concerns about their effects on non-target species, including domestic animals.

The RSPCA's view is that 1080 is not a humane poison but there may be no other effective control methods available (RSPCA 2011). However, new types of lethal bait containing PAPP may be an adjunct, but not necessarily a replacement for 1080 (Murphy et al. 2007; Staples, pers. comm. 2013). PAPP kills by preventing red blood cells from carrying oxygen. It leads to hypoxia (lack of oxygen), seizures, coma and death due to cell failure. Murphy et al. (2007) claim that the response of dogs that died after ingesting PAPP 'appeared relatively free of the suffering that accompanies the use of some other toxins' (p. 470).

The RSPCA's views about the humaneness of 1080 are not necessarily shared by other stakeholders, and the humaneness of 1080 as a control technique is a source of tension among stakeholders. The Western Australian and Tasmanian Government departments responsible for regulating 1080, for example, indicate that it is the most effective and humane poison that can be used (the alternative being strychnine), with the Tasmanian Department indicating that it is 'relatively species specific' (Department of Primary Industry, Parks, Water and the Environment, Tasmanian Government 2013). A fact sheet about 1080 produced by the Queensland Government states 'If 1080 were not available for use to control vertebrate pests, then many less

specific and less humane products may be used in an irresponsible way' (Biosecurity Queensland 2010). Linton Staples, a long-time researcher in this field and managing director of Animal Control Technologies (Australia) Pty Ltd, a manufacturer of invasive animal control technologies, has suggested that because the biochemical mechanism of toxins like 1080 closely emulates natural processes for metabolising sugar, the effects are most likely relatively unfelt by animals. The visible signs of distress are indicated as being due more to dysfunction in the animals' nervous system than a pain response (Staples, pers. comm. 2013).

Fitzgerald & Wilkinson (2009) have reviewed public attitudes to wild dog and dingo control in Australia, including findings of a previous survey of Victorians' attitudes (Johnston & Marks 1997), and the doctoral research by Ballard (2005). Members of the public generally favoured shooting as a way of controlling wild dogs rather than biological control, poisoning or trapping. How much these preferences are influenced by animal welfare concerns is uncertain. However, other studies, for example the report by TNS Social Research (2006), for the former Australian Government Department of Agriculture, Fisheries and Forestry (DAFF), suggests that the general public is highly engaged with animal welfare issues and is particularly concerned to prevent animal cruelty. The Australian Animal Welfare Strategy developed by the Australian Government jointly with the states and territories contains, under its second goal (p. 14), the activity of 'Promot[ing] the development and use of humane and effective methods to control pest animals in Australia' (Department of Agriculture, Fisheries and Forestry, Australian Government 2008).

However, the concerns for the welfare of wild dogs discussed here need to be balanced against concerns for the welfare of livestock, and knowledge of the suffering that wild dog attacks may cause to domestic animals for whom people are directly responsible (Fitzgerald & Wilkinson 2009; Franklin 2012; Southwell et al. 2011; Mitchell & Balogh 2007). The last authors, for example, list impacts on livestock as including death, injury, and stress, impacts on weight gain and wool growth, and mis-mothering. Media reports and personal descriptions of the consequences of attacks by wild dogs are often described quite graphically by producers who witness the results of these attacks. Dogs do not always kill animals cleanly and attacked animals often suffer from loss of body parts (e.g. limbs or ears) or are left with open wounds following an attack. Media reports describe some attacks as 'slaughters', and landholders may describe the attacks as more about 'fun' for the dogs than about obtaining food, based on the number of animals maimed but then left uneaten. Landholders' descriptions are detailed further in the section on psychological impacts.

In the study by ABARES (in preparation 2013), landholders reported that they were very concerned that animal welfare groups did not recognise how horrific were the injuries wild dogs could inflict on sheep and cattle. Some landholders also expressed the opinion that there was little public recognition of the fact that wild dogs kill and eat native wildlife as well as livestock. Victorian and Queensland landholders interviewed in the study indicated they were frustrated because animal welfare groups 'attack every tool' landholders use to control wild dogs. These landholders thought that increasing restrictions on use of particular poisons and traps made it more difficult for them to manage wild dogs. One landholder's response to a question about animal welfare issues and the humaneness of control methods for wild dogs was to ask 'How humane is it when the dogs maim and kill their livestock and then the farmers have to go out and kill the maimed livestock who are suffering with guts ripped open and hanging out?' One Queensland landholder said:

This is our job. We have a passion for animals. We don't want that dog to suffer any longer than anything else ... We don't like killing. So anything that you've got to kill, you kill it as humanely as you can ... but dogs are very hard to do that to ... the restrictions that we get placed on these [tools] makes it harder and harder for us to control these animals.

A recent study commissioned by Meat and Livestock Australia has provided an up-to-date overview of a range of impacts from wild dog predation on cattle. Fleming et al. (2013) note that wild dog predation can have a negative effect on the cattle industry at three major levels, including on-farm, during selling, and during processing. On-farm direct impacts include direct predation causing death and mauling injuries to cattle and predation on calves, with 'secondary losses including reduced weight gains or the delayed onset of oestrus as a result of increased vigilance and anti-predator behaviour' (Fleming et al. 2013, p. 20). Diseases spread by wild dogs to cattle can also cause losses on-farm and during processing, while cattle buyers may undervalue stock due to perceived carcass damage.

Local management versus government-controlled management

Management of wild dogs varies between states and territories in Australia (further details are provided in Chapter 5). However, despite the legislative differences, there has been a similar trend across the states and territories for government agencies to become involved in vertebrate pest management. Pest management is generally considered to be the responsibility of individual landholders (Franklin 2012). However, over time, the extent of the issue and an increasing environmental awareness and stronger conservation ethic among the Australian population may have led to greater government involvement. In New South Wales, for example, Franklin notes that the introduction of regulations to manage pests occurred in the late 1890s via the formation of locally-based Pasture Protection Boards (PPBs). Originally designed to assist with controlling sheep scab disease, they were given responsibility for pest control in 1901. The PPBs have since undergone several name and responsibility changes and are now called Livestock Health and Pest Authorities (LHPAs). These are multi-stakeholder groups from a defined area. This metamorphosis can be seen as representing a shift from individual landholder control to greater government control, to a recognition now of the need for multi-stakeholder collaboration.

The states and territories have primary responsibility for pest management legislation (Braysher & Saunders 2003). However, the Australian Government also has responsibilities for biodiversity protection at the national level under the *Environment Protection and Biodiversity Conservation Act 1999*, and for ensuring Australia fulfils any relevant responsibilities under international treaties and conventions (e.g. the Ramsar Convention and the Convention on International Trade in Endangered Species—CITES). The Australian Government also has responsibilities for managing pests on land it owns or manages (for example, Commonwealth-owned national parks and Defence land), under its overseas trade responsibilities, and under its national responsibilities for exotic disease prevention or management.

Several landholders, such as Franklin (2012), believe that there has been a lessening of local control of and responsibility for pest animal management in recent times, and this has worsened the problem. This, they believe, is due to decisions being made by agencies not always familiar with the situation 'on the ground' and not in the time frame needed by landholders. Furthermore, conflicts between different pieces of legislation, and different stakeholder objectives, sometimes impede coordinated action. However, it is important to note that direct control is still the responsibility of the owner or occupier of the land. Problems and conflicts can arise when public land managers do not have the resources or motivation to control animals they do not perceive as pests or that do not affect their interests.

However, it is now recognised that local management alone is also not a solution to invasive animal problems as effective management requires coordination between land managers across multiple tenures, locations and scales. This is evidenced through programs like the National Wild Dog Facilitator Project and the North-eastern NSW Wild Canid Management Demonstration Site implemented through the IACRC. The first project aimed to examine how useful it would be to have a national-level position to facilitate coordination between all relevant stakeholders at

different jurisdictional levels (particularly with landholders). The second project helped management groups with their local and regional plans, and supported the planning process with relevant research on baiting program effectiveness. In some cases a long standing impasse between private and public land managers was broken by facilitation and agreement reached after nine years (pers. comm., Bruce Moore, representation to National Wild Dog Management Advisory Group).

Landholders have also been investigating and initiating their own collective action models, with the Rural Lands Protection Board (RLPB) in Yass, New South Wales, being the first to independently implement this type of coordinated program to manage wild dogs, and the instigator of the nil-tenure strategy. The model was a joint public/private land partnership with signatories being the New South Wales National Parks and Wildlife Service, Yass RLPB and Forests NSW. It was the first plan resulting from the Southern New South Wales and Australian Capital Territory Wild Dog Management Project (P. Fleming, pers. comm., 2013). Landholders in the Paroo region of Queensland also initiated an approach to wild dog management coordinated across stakeholders (Paroo Shire Council 2011). Mr Jim McKenzie, Vice-President of Wool Producers Australia, for example, was recently reported as calling for a national strategy for wild dog management (Bancroft 2013). He was quoted as saying 'One of the problems is that every state jurisdiction has different regulations on poisons and trapping, so it's that sort of thing that we would like to do something about. It's a landscape problem, not a state boundary problem' (Bancroft 2013). Mr McKenzie further referred to the current approach to wild dog control as being 'piecemeal'.

The collective action model of management is increasingly being adopted in NRM-related problems due to the complexity, or 'wickedness' of these issues. According to collective action researchers like Poteete & Ostrom (2004), NRM problems are characterised by requiring a multi-stakeholder, collective action approach. These researchers, along with others, such as Marshall in Australia, have specifically examined the value of collective action approaches to resource management problems and have developed frameworks and approaches that attempt to guide management of these processes (Oliver 1984; Dawes et al. 1986; Rydin & Pennington 2000; Lubell et al. 2002; Adger 2003; Poteete & Ostrom 2004; Hargrave & Van De Ven 2006; Marshall 2005, 2008, 2013).

This means that a diversity of stakeholders needs to be represented, including private landholders with different kinds of enterprises, and different needs and issues; Indigenous landholders; community groups (e.g. Landcare); and government landholders, including those with a conservation focus, with their attendant legislative and policy constraints. The Australian Pest Management Strategy provides a detailed overview of the roles and responsibilities of various stakeholders in pest animal management (Natural Resource Management Ministerial Council 2007).

An example of community-based wild dog management

Recognition of the importance of community involvement and commitment to wild dog management has resulted in several models of community-based management being implemented in different states. In Queensland, the 'Paroo Model' is held up as a model of best practice and is described in more detail below.

The Paroo Model of wild dog control came about due to the sudden appearance of wild dogs and their subsequent predation on livestock in Queensland's Paroo Shire in 2002 (Paroo Shire Council 2011). Mr Peter Lucas, Chair of the Paroo Wild Dog Management Advisory, has described how the arrival of wild dogs in the area resulted in landholders banding together, regardless of their enterprises, with the common goal of managing wild dogs in the area. A booklet produced by the Paroo Shire Council describes the model and indicates that successful

reduction in wild dog numbers led to people remaining in their industries and even returning (Paroo Shire Council 2011).

The Paroo Model is an example of the 'nil tenure' approach to wild dog management. This means that the problems and solutions are recognised to cross land tenures and require high levels of collaboration among stakeholders—affected and unaffected. The report characterises the Paroo Model nil tenure approach in the following way:

The approach involves the removal of all land tenure issues when planning and implementing an agreed solution. It involves the collective identification of the problem and subsequent solutions, irrespective of land ownership, tenure boundaries and legal obligations (Paroo Shire Council 2011).

The model has been implemented by the Paroo Wild Dog Committee, which involves graziers, the South West Natural Resources Management Group and the Paroo Shire Council, with the latter also contributing funding. The Shire was divided into four regions that managed their own wild dog management programs based on local knowledge, though in coordination. The Committee also employed a trapper to monitor wild dog numbers and to remove any animals missed during the management programs. All baiting was recorded using global positioning systems. An economic analysis of the program has indicated substantial economic benefits (Paroo Shire Council 2011). The booklet developed by the group features a checklist for establishing a wild dog management group and management programs.

Scientific knowledge versus local knowledge

A key factor that can be linked to the tension between localised and centrally managed wild dog control is the division between scientific and local knowledge, often discussed in literature about people's natural resource and environmental management practices (Agrawal 1995; Berkes & Folke 2000; Berkes et al. 2003; Aslin & Brown 2004; Davidson-Hunt & O'Flaherty 2007). It refers to the differences between the knowledge systems of local, regional or indigenous communities, and those of western-trained scientific and professional agency staff (who may be located at a distance from people and places affected by their decisions, and who tend to rely on knowledge gained through academic training rather than personal experience in particular places). This tension is identified explicitly by Franklin (2012), who suggests that government decision-making is highly reliant on scientific knowledge, and identifies several impacts arising from this reliance:

- decision-makers often rely on information provided by researchers or practitioners trained or experienced in the natural sciences (rather than the humanities or social sciences)
- technical, natural science-trained practitioners, government representatives and landholders are not necessarily trained in managing community groups, or skilled in communication, facilitation or negotiation. They are also not necessarily expected to deal sympathetically with 'neighbour' stakeholder groups. (However, there are some exceptions. For example, the New South Wales National Parks and Wildlife Service's 'Good Neighbour Policy' puts real expectations on staff to work effectively with community and stakeholder groups).

Franklin (2012) also notes, based on her personal experience and involvement in wild dog management groups, a series of beliefs she thinks government representatives tend to hold, including that:

- they are accountable to the majority Australian public rather any minority group
- they are only required to make decisions on behalf of their organisation and uphold government policy on the lands under their control

- formal, credentialed knowledge is superior to other kinds of knowledge, and they have a responsibility to uphold that knowledge in practice
- wool grower stakeholders should accept the superiority of formal, credentialed knowledge.

Franklin's perspective identifies power dynamics perceptions and imbalances that may affect the ability of multiple stakeholders with different knowledge, skills and capacities to collaborate in an equitable way. Developing community-based models, like the Paroo and Brindabella/Wee Jasper models described above, represents attempts to overcome the perceived over-reliance on 'non-local' knowledge and an attempt to better incorporate both local and scientific knowledge.

The difference between scientific and local knowledge is also evident in areas such as public perceptions and stakeholders' understanding of public perceptions. For example, there is a long history of literature that documents divergence of risk perceptions between scientists and non-scientists. Slovic's work considering perceptions about the dangers of nuclear power, highlights these differences clearly, with scientists and technical experts believing the risk of a nuclear incident to be negligible but the public believing the risk to be more serious (Slovic 1987). Slovic notes that perceptions of risk play a prominent role in the decisions people make, in the sense that differences in risk perception lie at the heart of disagreements between technical experts and members of the general public about the best course of action.

Perceptions of risk, coupled with the differing viewpoints described earlier, in addition to the different roles and responsibilities that various stakeholders have, can clearly contribute to tensions and power imbalances between stakeholders. These aspects of the wild dog issue suggest strongly that solutions lie not only in the technical or biophysical science domain, but also in the social science domain and, in particular, will come from viewing the problem as a human one needing collaborative action. Essential to this is having a better understanding of the social and human impacts of wild dog attacks, reviewed in the next chapter.

3 Social impacts of wild dogs

The predatory nature of wild dogs can bring them into conflict with humans and human interests, and can result in social, economic and environmental consequences. The wide distribution of wild dogs and growing urbanisation of the landscape means that increasing numbers of people and communities are being affected. These encounters can be distressing. Importantly, the impacts of wild dogs stem from the behaviour of the animals as well as methods used to control them. This section considers the range of possible social impacts of wild dogs and how these impacts can be assessed.

Assessing the social impacts of wild dogs and their attacks relates directly to the applied concepts and methods of Social Impact Assessment (SIA), so this is briefly discussed below. This is followed by a review of literature on social impacts of wild dog attacks on livestock enterprises as a whole, and then a section on the psychological impacts reported by individuals involved in these enterprises.

Social Impact Assessment

The applied field of SIA (sometimes abbreviated to Social Assessment or SA) can help identify the wide range of possible impacts that wild dogs and their attacks can have on people. SIA provides a framework and set of methods generally used to identify, analyse, monitor and manage the intended and unintended social consequences, both positive and negative, of planned interventions, including policies, programs, plans and projects (Becker & Vanclay 2003; Coakes 1999; Fenton 2005; Schirmer & Casey 2005; Vanclay 2003). However, SIA can be applied to almost any event, activity or intervention affecting people, whether or not these are planned beforehand. While SIA's main purpose is to try to anticipate impacts before they happen and suggest ways of minimising them, it can also be applied retrospectively to identify and analyse impacts 'after the event'. SIA can use a wide range of methods, and often includes analysing existing information ('secondary data') as well as collecting new information ('primary data') via social surveys and other social research methods. Various kinds of community consultation processes and community-based research are often used to supplement 'desktop' research. In the sense used in SIA, 'social impacts' can vary along a number of dimensions (see Table 3).

Table 3 Dimensions of a social impact analysis and corresponding questions

Dimension	Associated question/s
<i>The kind or nature of impacts</i>	Are the impacts on people's mental and psychological health; quality of life; personal relationships; community or industry viability; work or leisure activities; capacity or resilience - people's ability to cope with change, including potentially adverse change, and to 'bounce back'; attitudes, beliefs, motivations; cultural traditions or practices, including loss of knowledge held by particular generations; policies and programs; future planning and enterprise succession, including for particular agricultural enterprises; community services and service provision, for example the need for mental health services?
<i>Who is affected</i>	Do the impacts fall disproportionately or differently on particular people or groups, for example, do they affect particular generations; women or men; newcomers; government staff; community members; service providers; the agricultural labour force?
<i>The social scale</i>	Are the impacts at the level of particular individuals; families, households or other kinds of groups; whole communities or populations; social structures like institutions, organisations and agencies (government, non-government, private sector); industries, businesses and enterprises?
<i>The geographical scale</i>	Are the impacts at the local scale; regional scale; state-wide scale; national scale; international scale?
<i>The time scale</i>	Are the impacts immediate or delayed, short or long-term; 'one-off' or ongoing?

In practice, in terms of geographical scale, SIAs are usually restricted to local and regional scales (Fenton 2005). Also, for practical reasons, they usually cover a limited time period, often a relatively short period before or after a particular event of interest. SIAs can be undertaken in conjunction with assessing other kinds of impacts, for example environmental and economic impacts. An overall integrated assessment of these different kinds of impacts is usually then required.

In the natural resource management arena, it has been suggested that SIA and SA have an important role to play in helping to foster management approaches that see resources and resource use as part of wider socio-ecological systems (Lane et al. 2000). These kinds of assessments can then play a part in collecting and organising social information to help inform decision-making and make future management more adaptive (Berkes & Folke 2000; Lane et al. 2000).

Relatively little literature is available specifically about the social impacts of wild dogs and their attacks, and the existing literature focuses mainly on the level of livestock enterprises and the individuals involved in these enterprises. There is also some limited literature relevant to assessing possible public health impacts.

Assessing the social impacts of wild dogs—review of recent studies

A workshop convened by the IACRC in 2005 considered the broader question of the social impacts of pest animals and recognised the need for research to identify and quantify social impacts (Fitzgerald 2009). As a result of this workshop several research projects were developed and then funded by the IACRC. Some of these examined the social impacts of pest animals in general and wild dogs specifically.

Accordingly there has been a recent surge of interest in the social impacts of wild dogs on agricultural enterprises in Australia (Russell 2006; Fitzgerald & Wilkinson 2009; Lightfoot 2010; ABARES in preparation 2013). These studies have responded to a need to develop an improved method to assess and account for these impacts. Major social consequences identified in these studies are summarised in Table 4.

Table 4 Social impacts of wild dog attacks recorded in recent studies

Russell 2006	Fitzgerald & Wilkinson 2009	Lightfoot 2010	ABARES (in preparation 2013)
Sense of disempowerment by pastoralists	Reduced farm income	Direct economic impacts ('opportunity costs')	Reduced income
Loss of genetic stock	Financial stress	Health and safety issues (psychological health, public health, risk of attacks on humans)	Psychological distress
Move from sheep to cattle	Additional farm work and expenditure	Impacts on local communities	Changes to industry/stock composition
Impacts of loss of farming families on the community	Psychological distress Loss of community cohesion Land use change	Animal welfare concerns	

Russell (2006) has reported on a small-scale phenomenological study assessing wild dog impacts on a sheep and goat property on the tablelands of central New South Wales. In this study, three perspectives were studied: those of the landholder, the government agency representative, and the industry representative. Findings of the main impacts from the perspective of the graziers are summarised as follows:

- 'not being heard [by others] was more painful than the dingo attack itself'
- a feeling of 'uselessness' in the face of the bureaucracy's unwillingness to engage seriously with the problem, possibly contributing to feelings of being helpless
- the huge loss of genetically improved sheep flocks that had been built up over years of breeding
- in the end, they shifted from farming sheep to farming cattle
- the loss to the community of a family that had been a leading light in the community because of the emotional impact on the family.

In this study, government and landholder perspectives were often found to conflict, with the government representative asserting that the grazier had wildly exaggerated the attacks, were over-emotional, and were not being factual about the extent of harm. It was reported that during the study a 'turning point' came when all participants arrived at the understanding that they were all land managers and needed to work together (Russell 2006). This is an example of a study being a catalyst for a positive change in the relational dynamics of the groups being studied.

In an attempt to address a significant gap in knowledge, Fitzgerald & Wilkinson (2009) undertook an assessment of the social impacts of invasive animals in Australia, focusing on the Upper Hunter Valley in New South Wales. Wild dogs were considered to be the 'Number One' pest in the Hunter Valley. Table 4 summarises the key issues and social consequences (actual or potential) observed in relation to wild dogs in that region. Other findings from their study included:

- farmers claimed that, historically, dogs came down into grazing areas from the national parks, and that 'the worse affected farms were adjacent to national parks'
- there was a perception that the wild dog problem was increasing in the area
- there was a perception that wild dog problems had contributed to a reduction in sheep farming in favour of beef cattle grazing in some areas
- there was a view that cattle farmers were less concerned than sheep farmers and therefore less involved in wild dog management
- there was a perception that there was increased interbreeding of escaped domestic dogs with the wild dog population, reportedly leading to more 'packs' and multiple animal kills.

A key finding of Fitzgerald & Wilkinson (2009) was that most of the social impacts of pest animals in this region seemed to flow from the economic and environmental impacts. However, some direct social impacts did occur. The authors specifically mentioned the psychological distress to farmers caused by fear of wild dog attacks on their stock.

In a social benefit-cost analysis in Victoria, Lightfoot (2010) found that the social impacts of wild dogs were complex and difficult to quantify. He focused on the psychological impacts on

Victorian farmers with narrative descriptions based on a series of in-depth interviews with farmers and others. His assessment of the main categories of impacts included:

- personal health and safety issues
- flow-on effects to community wide economic impacts
- animal welfare issues.

Lightfoot argued that continuous wild dog attacks have been a contributing factor to many farmers leaving the sheep industry in Victoria, but cautioned that this must be viewed in the context of drought, reduced wool prices and effects of ageing on ability to continue farming. Lightfoot also explored the notion that the shift from sheep farming to cattle farming in parts of Victoria has been caused by wild dog activity that has accelerated the decline in local employment and hence jeopardised the viability of local communities. He concluded that the impact of wild dogs is likely to be far less than the combined impact of increasing agricultural productivity and competition from large regional cities. However, he did support the notion that it is likely that the loss of employment resulting from wild dog activity had weakened some communities due to the consequent flow-on effects and the negative multiplier impacts. No evidence emerged in this study to clearly link the activity of wild dogs to the loss of any particular community in Victoria.

Social impacts on livestock enterprises

ABARES (in preparation 2013) has undertaken an integrated study that involved multiple methods, including analysis of data from a national survey of landholders located in wild dog-affected areas (see Figure 2), as well as detailed social and economic assessments of three case study regions in Queensland, South Australia and Victoria. This included a cost-benefit analysis, focus groups and interviews to gather qualitative information, a quantitative assessment of psychological stress, and a choice modelling exercise involving both rural and urban respondents.

The most obvious and widely recognised effect of wild dogs is on the social and economic viability of livestock enterprises. The ABARES' national survey of farmers in areas affected by wild dogs found that over 50 per cent of those surveyed had their calving or lambing birth rate reduced (Figure 3). The findings also clearly indicated that a proportion of landholders were personally affected by the presence of wild dogs and that some (over 30 per cent) experienced distress, anxiety or anger in relation to this issue.

The reduced livestock productivity that can result from wild dog attacks may have a substantial impact on a state or territory's overall economy as well as on individual enterprises (Department of Primary Industries, Victorian Government 2011).

At the enterprise level, wild dog attacks on livestock can quickly reduce productivity and profitability (McLeod 2004; Norris et al. 2006; Wicks & Allen 2012). This may result from several aspects of the attacks:

- the immediate or later death of attacked animals reduces the number of stock for breeding and production. The rate of genetic gain can also be slowed because reduced capacity to apply selection pressure when wild dogs reduce reproductive output
- genetic improvements achieved over many years through selective breeding can be lost when individual rams and their progeny are killed

- carcasses of livestock injured by wild dogs may be downgraded when the injured animals are subsequently slaughtered for their meat, and thus may be worth less in the market
- livestock stressed by wild dog attacks may lose weight or fail to reach target weights and hence lose market value; stressed sheep produce less wool, recovering calves grow more slowly
- lambs that are separated from ewes during an attack may later die, and high-value lamb carcasses and/or fleece may be lost to the enterprise
- wild dogs may spread livestock diseases, leading to condemnation of offal products, which in turn may affect the profitability of the enterprise.

Figure 2 Impact of wild dogs on farmers—percentage of survey responses falling into different impact categories (sample size = 423) (from ABARES in preparation 2013)



Wild dog control techniques are often costly for producers, particularly if neighbours do not share the financial burden. In addition, managing wild dogs (including attending relevant meetings and lobbying government) can be time-consuming and can take effort away from core business activities (ABARES in preparation 2013).

Producers' capacity to withstand profit loss due to wild dog attacks, and their management efforts, are likely to be influenced by their individual financial situations. Farming families may reduce their spending in response to lower income, and this can have ramifications for local businesses and economies. While business impacts are often expressed purely in financial terms, the financial stress often creates psychological distress for producers and their families (see the following section on 'Psychological impacts on individuals involved in livestock enterprises'). A generally unrecognised business impact is that some landholders may refrain from using working dogs for fear they will consume 1080 baits. Furthermore, some sheep producers have found that their flocks become scared of all dogs after a wild dog attack, making farm dogs ineffective in managing their flocks.

Wild dog activity may lead to long-term land use change by encouraging some sheep producers to switch to cattle farming (ABARES in preparation 2013; Fitzgerald & Wilkinson 2009). However, this must be viewed in the local context of drought, wool prices, and other external factors affecting enterprises. The local demand for farm services, like shearing, has sustained some local employment (the majority is conducted by contractors who move from property to property), and there are concerns that the reduced demand for these services may mean these valuable skills are lost (Lightfoot 2010; ABARES in preparation 2013).

Psychological impacts on individuals involved in livestock enterprises

Wild dog activities can cause significant psychological stress to individuals involved in livestock enterprises, which can lead to a range of symptoms. Psychological stress is complex and difficult to quantify, and will vary considerably between individuals. Most research in this field has focused on the psychological stress on producers. However, anyone involved in managing wild dogs, including industry and government agency representatives, can experience psychological stress as a result of wild dog attacks.

Fitzgerald & Wilkinson (2009), Lightfoot (2010), Russell (2006) and ABARES (in preparation 2013) all considered psychological impacts in their research. Fitzgerald & Wilkinson (2009), in their study of wild dogs in the Upper Hunter Valley of New South Wales, used a mainly qualitative research approach that included discussions with stakeholders, semi-structured face-to-face and telephone interviews with key local informants, attendance at a landholders' pest management forum, and gathering secondary data. They found:

- significant emotional upset and frustration associated with wild dog or dingo attacks on farm stock
- the sense of conflict with the dogs, along with the strong sense of responsibility for the welfare of the stock, seemed to be sufficiently intense among sheep farmers that many were prepared to invest more time and money in wild dog management than the pure financial losses might seem to warrant
- a sense of psychological insecurity and uncertainty that farmers lived with on a daily basis when wild dogs were present
- the experience of anxiety and uncertainty over farmers' rights in relation to wild dog management. This was closely related to changing interests in and uses of rural land.

Lightfoot (2010) reported common themes of frustration, loss, grief, a sense of powerlessness, lack of control and helplessness, as well as increasing pressure to do more on the property to counter the effects of wild dog attacks. He reported that, despite the fact that psychological impacts varied considerably between individuals, it was clear that for many, these impacts were significant. A key cause of distress was coping with livestock that had been killed or savaged. The Victorian farmers' stories had common themes of frustration, loss, grief, a sense of powerlessness, lack of control and helplessness which were indicators of the psychological pressure these farmers attribute to wild dog attacks. There was also increasing pressure to fence vast areas, spend more time staying out at night to protect stock, more time talking about the issue, and more time recording statistics and telephoning wild dog controllers to report attacks. The majority of those interviewed indicated that it was not so much the financial loss that affected them, but the anxiety and stress of finding sheep ripped and bleeding. Others spoke of being hyper-vigilant and the effects of losing sleep which can result in poor attention, concentration and memory, irritability and other mood disturbances, and impaired judgement and reaction time. For some, the anxiety felt had escalated to fear for personal safety. This echoed Fitzgerald & Wilkinson's (2009) findings.

A key finding from Russell's (2006) study in New South Wales was that the farmers described the dog attacks in such 'horrific terms and as highly sensual and perceptual events', that very few people would listen to them—neither government agencies, industry bureaucrats nor other landholders. Related to this issue was that the emotional costs could not be quantified whereas financial ones could be.

Hyper-vigilance is a common stress response and has been reported by some producers involved in managing wild dogs (ABARES in preparation 2013). Sufferers have described being in a constant state of watchfulness, always looking for known signs of wild dogs. The 2012 ABARES' national survey of farmers in wild dog-affected areas (ABARES in preparation 2013) found that over 30 per cent of farmers experienced distress, anger or anxiety in relation to wild dog issues. Almost 20 per cent of those surveyed had either left the industry or changed their livestock composition.

ABARES undertook a quantitative survey to assess the level of psychological and emotional stress that landholders, and some wild dog management practitioners experienced as a result of wild dog attacks (ABARES in preparation 2013). This survey was called 'The Impact of Event Scale (Revised) Survey' and was included in a series of primarily face-to-face interviews with 39 landholders and wild dog management practitioners in south-western Queensland, north-eastern Victoria and northern South Australia.

The Impact of Event Scale (IES) (Horowitz et al. 1979) is probably the most widely used self-report measure in the field of traumatic stress. It has been translated into multiple languages (e.g. Chinese, German, Japanese and Spanish), and is used as a measure of traumatic stress in Australia (Creamer et al. 2003). The revised version of this survey includes items to measure intrusiveness (inability to stop thinking about the issue), avoidance (tendency to avoid the issue), and persistent hyper-arousal associated with the issue.

Multiple events and circumstances have been examined for their traumatic effects on individuals. These events include motor vehicle accidents and other life-threatening events like a sudden cardiac arrest or an acute myocardial infarction. While there are no published studies using this survey in relation to farm management stresses, it was considered an appropriate psychometric tool to use in this context because of its simplicity and because there are some data available to make general comparisons with other kinds of stresses.

In comparison with other quantitative studies, the mean score for the total sample of respondents in this study was equivalent to that of people who had experienced having a partner with terminal breast cancer (Butler et al. 2005); or of Taiwanese nurses who were under threat of Sudden Acute Respiratory Disorder (SARS—Cheng-Sheng et al. 2005); and higher than that of respondents who had had a motor vehicle accident (Beck et al. 2008).

In terms of the intrusiveness scale, the mean score for the wild dogs' study was above that of four of the other studies, and lower than that of two other studies. This suggests that wild dog attacks on livestock have a substantial intrusive impact on individuals involved with these issues.

It needs to be emphasised that this survey involved a small number of participants and that the studies used for comparison represent a wide range of contexts. The results cannot be equated to a clinical assessment of post-traumatic stress and are indicative only of the level of stress experienced by the research participants.

Public health impacts

Wild dogs carry the hydatid tapeworm *Echinococcus granulosus* (Allen 2008; Lightfoot 2010). Hydatid disease ('echinococcosis') is classified as a notifiable disease in most Australian jurisdictions and is potentially fatal in humans. The disease can lie dormant for many years, is difficult to treat, and may cause death without specific diagnosis. The main risk is for people who frequent environments contaminated by wild dogs and come in contact with wild dogs or their faeces. However, some research (Appleton et al. 2011), also reveals that wild dogs have been seen in urban parks, lying on tables and licking barbeque hotplates. Possible health issues may become more important in the future as urbanisation brings more people into contact with wild dogs.

Wild dogs have been known to attack and even kill humans, as exemplified by the notorious Azaria Chamberlain case, in which a dingo took a baby from a campground in Uluru-Kata-Tjuta National Park in the Northern Territory (Bryson 2000). The baby's body was never found. In April 2001, two dingoes killed a child on Fraser Island in Queensland (Hyttén & Burns 2007). This led to the Queensland Environmental Protection Agency culling 31 dingoes on the island. There have been recent reports of greater numbers of wild dogs around major regional towns, causing residents to fear for their safety (Phillips & Hunt 2011). In one instance, a 13 year-old girl was attacked at night while camping at a Northern Territory caravan park (O'Toole 2012). It needs to be noted that most of these cases involved situations where the dingoes in question had become habituated to people and had probably been fed regularly by humans (Lightfoot 2010). ABARES (in preparation 2013) observes that perceptions of the danger of wild dogs to humans vary across different geographies with, for example, those interviewed in arid South Australia saying there was no danger as compared to some farmers interviewed in Queensland who were concerned about the risk of attacks.

The following section briefly discusses some of the gaps in existing knowledge about the social and psychological impacts of wild dog attacks, based on the review of existing literature.

4 Gaps in knowledge about social and psychological impacts of wild dog attacks

Apart from the studies examined here, there are very few other studies examining the social or psychological impacts of wild dogs or other pest animals in general. Fitzgerald & Wilkinson (2009) note this specifically. They identify several gaps in the social impact research undertaken by McLeod (2004), which was considered the most comprehensive research into the impacts of invasive or pest animals at the time. Because McLeod concentrated on economic impacts, these gaps relate to:

- the social effects of efforts to manage pest animals
- impacts on individuals (e.g. human physical and mental health and wellbeing, sense of empowerment and identity)
- impacts on families and households (e.g. quality of life, leisure time, social acceptance, financial security, lifestyle)
- impacts on communities (e.g. community cohesion, neighbour conflict, social deprivation, community diversity, distribution of costs and benefits)
- impacts at the regional or landscape level (e.g. tourism, recreational opportunities, conflicts about management of multiple issues, public safety, urban and rural tensions)
- impacts on the nation (e.g. cultural heritage, national identity and pride, trust in institutions, impact on indigenous cultures).

They further note that McLeod did not consider the biophysical or environmental impacts of pest animals as directly affecting 'people, families, communities, institutions or society' (Fitzgerald & Wilkinson 2009), while:

The direct and indirect impacts of pest animals on the economic and material wellbeing of people, families, communities and society were rendered as 'economic' costs, without attendant social effects (p. 4).

The social and psychological impacts of wild dogs and their management are felt outside of the communities that are directly affected by wild dog predation. The 'ownership' many Australians feel of the dingo as an icon and cultural resource means that many management actions undertaken to prevent wild dog attacks on livestock can cause anger, frustration and distress to other community members. This, too, has received little research attention to date.

There is therefore a large scope and opportunity for the social impacts of wild dog attacks to be examined further.

Persistent issues

Several issues persist, to varying degrees, through the studies examined here. They are related to:

- the challenges of documenting and reporting on the ongoing, visceral and horrific stories of the impacts of wild dog attacks on stock, so that those affected feel that they are being heard and represented in the reporting process

- the challenge of finding a way to quantify the psychological distress (emotional cost) experienced by landholders coping with this issue
- the challenge of communicating psychological and emotional impacts of wild dog attacks to others who are in key decision-making positions and may be able to help in some way.

These challenges in understanding the social and psychological impacts of wild dog attacks are combined with the lack of recorded detail about actual physical occurrences on properties. Additionally, the challenge of engaging communities and running effective group processes adds another dimension of complexity to an already technically- and operationally-complex management system. A major question then becomes: 'How do we use the knowledge we have, coupled with new knowledge, to develop processes to strengthen community-based management?' This question assumes, based on the literature reviewed and current trends in managing complex or 'wicked' resource management issues, that a nil tenure, community-based, collective action approach is likely to achieve the best outcomes for the wild dog problem. This conclusion is based not only on the perceived advantages cited in the literature and examples of collective approaches, but also on the failure of un-coordinated or piecemeal approaches to wild dog management that currently exist and have been commented on in the literature.

The following section outlines some of the issues inherent in wild dog management, partly because of the governance system's complexity. It provides an overview of the legislative and governance arrangements for managing wild dogs nationally and in each Australian state and territory. These arrangements can both help and hinder wild dog management.

5 Governance and structure of current wild dog management programs

Historically, responsibilities for managing wild dogs have rested primarily with individual landholders but, more recently, state and territory governments have also taken on management responsibilities. For example, the legislation pertaining to vertebrate pest management in New South Wales was changed in 1998 such that all owners and occupiers of all lands, specifically including public lands, are responsible for eradication of wild dogs on their lands. However, legislative arrangements for managing wild dogs are different in each state and territory, which leads to conflict and frustration where management is required across jurisdictions. This is further complicated by the inconsistencies among states and territories about the pest status of dingoes and other wild dogs (Southwell et al. 2011). The Australian Government provides support to manage pest animals where they threaten native species protected under international treaties or national legislation, or where they occur on Commonwealth land.

Each Australian state and territory has legislation covering how wild dogs can be managed and where. Wild dogs are considered pests in most jurisdictions when they occur on particular kinds of land. As wild dogs are distributed across land with a range of different land tenures and land uses, legislation like this can create tension among stakeholders and lead to difficulties in managing wild dog populations across land tenures. This has led to the nil tenure management approach being advocated. The Northern Territory is an exception as wild dogs are protected there on all private and public land, but livestock producers can gain exemption to manage wild dogs when losses are demonstrated.

The Stockwell case (Supreme Court of Victoria 2001) in Victoria highlighted the point that the law now requires land-owners to take reasonable measures to control pest animals, including wild dogs. However, the judgement in this case, which found against the State of Victoria, related to the State's duty to control wild dogs.

Wild dog management by jurisdiction

Table 5 summarises the legislation directly relevant to wild dog management in each Australian jurisdiction. This is then followed by a brief summary of the situation in each.

Australian Government

The main national legislation relevant here is the *Environment Protection and Biodiversity Conservation Act 1999* ('EPBC Act'), administered by the former SEWPaC (now the Department of the Environment). It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places. These are defined in the EPBC Act as matters of 'national environmental significance' (Department of Sustainability, Environment, Water, Population and Communities, Australian Government 2013). Under the Act, for example, funding can be provided to control pest animals that threaten listed ecological communities.

The EPBC Act is now supported by the Australian Pest Animal Strategy. The strategy forms part of the Australian Government's Australian Biosecurity System for Primary Production and the Environment (AusBIOSEC) and is overseen by the Vertebrate Pests Committee. Under current national biosecurity policy and institutional arrangements, the Vertebrate Pests Committee reports to the National Biosecurity Committee, which then reports to the Primary Industries Standing Committee and the Standing Council on Primary Industries. The Vertebrate Pests Committee convenes a number of Working Groups to advise on technical matters. It maintains links with other national sectoral committees like the Animal Health Committee, Animal Welfare

Table 5 Legislation directly relevant to wild dog management in different jurisdictions*

Jurisdiction	Key legislation	Objectives
Australian Government	<i>Environment Protection and Biodiversity Conservation Act 1999</i>	Provides legal framework to protect nationally and internationally important flora, fauna, ecological communities and heritage places—‘matters of national environmental significance’. ‘Native species’ are those extant in 1400
Australian Capital Territory	<i>Nature Conservation Act 1980</i>	Protects dingoes; their destruction must be authorised by Environment ACT
New South Wales	<i>Rural Lands Protection Act 1998</i>	Dogs and dingoes are declared pests throughout the state; all landholders required to eradicate wild dogs on their land unless designated as Schedule 2 lands and covered by an agreed management plan.
	<i>Wild Dog Destruction Act 1921</i>	Pertains to the border dog-proof fence and wild dog management in the Western Division
	<i>National Parks and Wildlife Act 1974</i>	Dingoes considered ‘native’, but unprotected on park estate. Domestic dogs prohibited
Northern Territory	<i>Territory Parks and Wildlife Conservation Act 2006</i>	Protects dingoes as ‘native wildlife’ on all land
Queensland	<i>Land Protection (Pest and Stock Route Management) Act 2002</i>	Wild dogs declared Class 2 pests; landholders and government agencies responsible for state land must control pests; local governments must have a pest management plan
Queensland	<i>Nature Conservation Act 1992</i> <i>Forestry Act 1959</i>	Dingoes protected as ‘native wildlife’ in all protected areas, including national parks and state forests
South Australia	<i>Animal and Plant Control Board (Agricultural Protection and Other Purposes) Act 1986</i> <i>Dog Fence Act 1946</i>	Wild dogs proclaimed pests in the sheep zone south of the Dog Fence and must be controlled Landholders required to destroy dingoes and wild dogs near the SA dog fence
Tasmania	<i>Dog Control Act 1987</i> <i>National Parks and Wildlife Act 1970</i>	Feral dogs which prey on livestock must be controlled Prohibits dingoes being imported into Tasmania
Western Australia	<i>Agriculture and Related Resources Protection Act 1976</i> <i>Western Australian Wildlife Conservation Act 1950</i> <i>Dog Act 1976</i>	Wild dogs to be managed where they pose a threat to livestock Domestic dogs must be controlled

*This table does not include animal welfare legislation applying in the different jurisdictions

Committee and the Australian Weeds Committee to address areas of overlap and common interest (Department of Agriculture, Fisheries and Forestry, Australian Government 2011).

The Australian Government provided funding for invasive animal management via community grants administered through two different programs. The Caring for Our Country Initiative provided on-ground support for pest management. APARP funded research and extension projects that developed and promoted improved monitoring and control techniques to reduce the agricultural impacts of pest animals, and was completed in June 2013. APARP funding was aligned with the Australian Pest Animal Strategy (Natural Resource Management Ministerial Council 2007). The Australian Pest Animal Strategy sits under the overarching Australian Biosecurity System for Primary Production and the Environment (AusBIOSEC). AusBIOSEC has established a framework for greater national collaboration on biosecurity issues, both within and across jurisdictions, in the primary production and environment sectors (Natural Resource Management Ministerial Council 2007).

Australian Capital Territory

In the Australian Capital Territory, the *Nature Conservation Act 1980* both protects dingoes and provides for their destruction, subject to authorisation by Environment ACT. Dingoes are classified as native animals and domestic dogs are considered to be exotic. Genetic testing of a large number of wild dogs has apparently shown that there are no feral dogs (domestic dogs gone wild) in the Australian Capital Territory (ACT Government 2012). Research for a doctoral thesis by Stephens (2011) has also indicated there are no feral dogs and few pure dingoes in the Australian Capital Territory.

The Australian Capital Territory has a *Pest Animal Management Strategy 2012-2022* (ACT Government 2012), which indicates that the government supports maintaining a higher-order predator, stating:

Wild dogs may perform an important role as higher order predators in natural ecosystems (Glen *et al.* 2007), irrespective of their genetic makeup or coat colour. The ACT Government therefore aims to maintain viable populations of wild dogs in conservation areas.

The Australian Capital Territory Government also recognises that wild dogs do kill livestock and so maintains an active wild dog management strategy, including monitoring wild dog numbers.

New South Wales

Management of wild dogs in New South Wales is controlled by several pieces of legislation, detailed in Appendix 1 of the State's Wild Dog Management Strategy. This Strategy was developed by Biosecurity New South Wales with input from the Wild Dog Working Group (WDWG), a working group of the New South Wales Pest Animal Council. The WDWG includes landholders, representatives of the New South Wales Farmers' Association, the Department of Primary Industries, Livestock Health and Pest Authorities (LHPAs), the Office of Environment and Heritage, and the Forestry Corporation of New South Wales (Department of Primary Industries, New South Wales Government 2013). The management strategy includes public lands listed under Schedule 2 of Pest Control Order Number 17. According to the Wild Dog Management Strategy:

In order to balance the need for wild dog control with the conservation of dingoes, the general destruction obligation for lands listed under Schedule 2 of the Wild Dog Pest Control Order can be satisfied through the preparation of a Wild Dog Management Plan with both control and conservation objectives (p. 9).

Wild dog management is based on the 'across-tenure' planning process, detailed in the Invasive Animals CRC publication, *Managing wild dogs: guidelines for preparing a working plan to manage*

wild dogs (Allen et al. 2011). Wild Dog Management Plans are developed by first determining what the issues are (damage, conservation etc.), who the stakeholders are, mapping affected areas and control activities, and then specifying what control and monitoring work will be done, the timelines, and which stakeholders are responsible for each activity. The planning process also determines allocation of resources and costs (Department of Primary Industries, New South Wales Government 2012). In the Western Division of New South Wales, dogs are managed by the Wild Dog Destruction Board which, under the *Wild Dog Destruction Act 1921* forbids ownership of dingoes in that region, except when authorised. The Wild Dog Destruction Board oversees management, maintenance and upgrading of the Wild Dog Border Fences.

Queensland

As for New South Wales, Queensland has a range of legislation relating to wild dog management. In particular, wild dogs are ‘declared animals’ under the *Land Protection (Pest and Stock Route Management) Act 2002* (Department of Agriculture, Fisheries and Forestry, Queensland Government 2013). As such, all landowners in Queensland are required to reduce numbers of wild dogs on their properties.

The 2011–16 Wild Dog Management Strategy (Department of Employment, Economic Development and Innovation, Queensland Government 2011) sets a framework for coordinating all stakeholders’ actions to maximise effective use of physical and economic resources to manage wild dogs. Local government has primary responsibility for co-ordinating wild dog management under State legislation. The Queensland Government does not fund lethal wild dog control but it does fund management of the Wild Dog Barrier Fence.

South Australia

Biosecurity SA has state-wide responsibility for managing dingoes and other species considered to be pests or invasive species. It is responsible for developing relevant policies, approved by the South Australian Minister for Environment, and for managing each species declared under the *Natural Resources Management Act 2004*. Policies are reviewed periodically in consultation with the eight regional Natural Resource Management (NRM) Boards in South Australia. Landowners and other stakeholders can provide input to this process through their regional board.¹

The NRM Biosecurity Unit in Biosecurity SA provides policy, coordination and technical support to other government agencies to manage pest incursions and existing pest animals. Its main focus is on the Arid Lands Region of South Australia. It does not have any staff dedicated specifically to dog or dingo control.

The NRM Boards are administered overall by the South Australian Department of Environment, Water and Natural Resources. These boards implement state policies on declared vertebrate pests in their region, using risk analysis to set priorities for species to be the subject of coordinated control programs, involving enforcement, assistance, education and awareness activities. South of the Dog Fence, the NRM Boards have a community engagement focus. They bring landholders together and provide the assistance that landholders seek. They are also responsible for ordering baits and run a twice-yearly service to inject baits with 1080 (H Miller pers. comm. 27 Sept 2012). Two staff are employed under grants to focus on dingo management. Most dingo management work in South Australia is undertaken in the Arid Lands Region by the SA Arid Lands Board—which includes six NRM groups. South of the Dog Fence there are approximately 20 working groups dealing with dingo management. The third organisational structure is the Dog Fence Board, which is responsible for maintaining the Dog Fence. This work

1

http://www.pir.sa.gov.au/biosecuritysa/nrm_biosecurity/pest_animal/pest_animal_policies/policy_on_management_of_dingo_populations_in_sa, sighted 3 October 2012

is funded by the State Government, which matches landholder contributions for fence maintenance.

Tasmania

Tasmania does not have any dingoes and therefore no legislation for dingo control other than a prohibition on importing them into Tasmania under Section 32 of the *Nature Conservation Act 2002*. In Tasmania, wild domestic dogs are referred to as ‘feral dogs’ and their management falls under the *Dog Control Act 2000*, administered by local governments (Department of Primary Industries, Parks, Water and Environment, Tasmanian Government, pers. comm. 2013).

Victoria

Wild dog management in Victoria has a long history, going back more than 75 years to the Chestnut Wild Dog Destruction League in the north-east of the state. Currently, the *Catchment and Land Protection Act (1994)* is the main piece of legislation dealing with managing invasive plants and animals in Victoria (Department of Primary Industries, Victorian Government 2010). Under this Act, species of plants and animals can be declared as noxious weeds and pest animals. A primary objective of the Act is to protect primary production, Crown land, the environment and community health from the effects of noxious weeds and pest animals. The Act defines roles and responsibilities and regulates management of noxious weeds and pest animals.

There are two main Victorian strategies dealing with invasive plants and animals:

- the Biosecurity Strategy for Victoria
- the Invasive Plants and Animals Policy Framework (IPAPF).

The Biosecurity Strategy is primarily aimed at preventing new risks while the IPAPF is aimed at existing threats.

At the time of writing, the Victorian Department of Primary Industries was developing new invasive species management legislation. This will replace the noxious weeds and pest animal provisions of the *Catchment and Land Protection Act 1994*, and close gaps currently existing in powers to manage incursions of taxa that are currently not, or only partially, covered by Victorian biosecurity legislation (Department of Primary Industries, Victorian Government 2010).

Under the Victorian Government’s Wild Dog Control Program, staff are employed to manage wild dogs and there is community representation to government through a Wild Dog Management Committee (WDMC). The Victorian Government also has 24 Wild Dog Controllers. People in these positions—who undertake the on-ground work for wild dog control—are commonly referred to as ‘doggers’.

The ABARES’ report on wild dogs (ABARES in preparation 2013) indicates that the ‘wild dog control culture’ in Victoria has been undergoing radical change recently, with an increasing emphasis on encouraging communities and government staff to work together. The State Government is making efforts to assign more control to communities—providing them with opportunities to learn new skills in wild dog control.

Western Australia

Vertebrate pests can be declared in Western Australia under the *Agriculture and Related Resources Protection Act 1976*. Under this Act, dingoes and other dogs are declared in the manner shown in Table 6. Category A7 means that as animals native to Western Australia,

dingoes should have an approved, published and implemented program for their management (Department of Agriculture and Food, Western Australian Government 2006). Category A5 means that hybrids and other wild dog populations must be controlled (ibid).

Table 6 Declaration of the status of dingoes and other dogs under the Western Australian *Agriculture and Related Resources Protection Act 1976*

Dingo	<i>Canis lupus dingo</i>	A7
Dingo–dog hybrids	<i>Canis lupus dingo x Canis lupus familiaris</i>	A5
Dog, domestic	<i>Canis lupus familiaris</i>	Excluded from declaration except as specified for Wild or Feral Dog.
Dog, wild or feral	<i>Canis lupus familiaris</i>	A5 (when running wild in agricultural and pastoral areas)

There is a slightly different system for managing wild dogs in the two main regions of the state—the Rangelands and the Agricultural Area.

Rangelands

This region is a large one with limited effective wild dog management. It has five Regional Biosecurity Groups (RBGs) funded by landholder rates with matching government funding. RBGs are incorporated associations managed exclusively by a members' committee. The RBG framework gives communities the opportunity to come together to address issues with locally-significant pests. Communities can identify their priority pests, then plan and coordinate efforts to tackle them. The RBGs do not hire staff. The Western Australian Department of Agriculture and Food (DAFWA) supports RBGs by providing advice on governance, helping develop annual operational plans, assisting with consultation to determine an appropriate rate for the RBG to set, technical advice and operational support (Department of Agriculture and Food, Western Australian Government 2009).

Agricultural Area

The Western Australian Government recognises the importance of a nil tenure approach to wild dog management (Department of Agriculture and Food, Western Australian Government 2006). For example, escaped pet dogs from peri-urban properties with inadequate fencing can attack livestock on neighbouring farming properties. In Western Australia, local councils are responsible for prosecuting offending dog owners, but in practice this may occur only infrequently (Jennens 2002).

In the south-west agricultural area, wild dogs are managed by Declared Species Groups established by regional landholders. At least two of these groups focus on wild dogs, the Northern Mallee, which has a focus on the Esperance fence extension, and the Eastern Wheatbelt. The Eastern Wheatbelt Declared Species Group has been particularly successful in engaging state and local government, landholders and mining companies in wild dog management, and has significantly reduced stock loss in its region (Department of Agriculture and Food, Western Australian Government 2009). To encourage coordinated management, DAFWA and the Agriculture Protection Board provide dollar-for-dollar funding to Declared Species Groups.

The next section of this review assembles the information provided in this chapter and previous ones to identify the main barriers to effective and coordinated action to address wild dog issues Australia-wide.

6 Barriers to effective and coordinated action to manage wild dogs

On the basis of the preceding review, this section briefly summarises what appear to be the main barriers to achieving effective and coordinated action, and then considers what might be done to overcome them.

Value and attitudinal differences between stakeholders

Previous sections have detailed some major tensions between stakeholders, arising from their differing values and interests, reliance on different kinds of knowledge, and varying attitudes to wild dogs and their control methods. These tensions are clearly a barrier to achieving effective coordinated and collaborative action among stakeholders. Ford-Thompson et al. (2012), in their study on programs managing vertebrate pests, found that conflict amongst stakeholders was a common obstacle amongst these groups. Programs managing wild dogs reported among the highest stakeholder conflict compared to programs managing other species. These conflicts were related to a range of issues including land tenure and invasive species control measures, and including whether or not to control wild dogs at all. The authors also found that the degree of conflict correlated with decreasing stakeholder participation.

Ford-Thompson et al. (2012) also found that programs in which there were a larger number of stakeholders participating reported more positive interactions. Methods are needed to help stakeholders value and work with their differences and achieve at least some degree of consensus about future management plans and actions, and their respective roles in implementing them. One possible way to do this is to work towards a more community-based management model than is often used at present. Some stakeholders see the current model as being too 'top-down' and government-controlled, and paying insufficient attention to views of landholders directly affected by wild dog attacks. Ford-Thompson et al. (2012) found that citizen initiated pest management programs reported greater cooperation than agency-initiated programs.

Legislative and jurisdictional barriers

Legislation and regulations can affect the efficiency and effectiveness of wild dog management techniques and strategies. For example, as mentioned above, the Australian Government's EPBC Act provides a legal framework to protect biodiversity at a national level. This Act can come into conflict with actions or legislation for wild dog management in the states and territories. For example, it has been reported that approval for aerial baiting in Victoria was withheld recently under the EPBC Act because of concerns about potential adverse effects of baits on populations of the endangered spotted-tailed quoll (the spotted-tailed quoll is a middle-sized marsupial predator).

Differences in legislation among the jurisdictions reflect the difficulties of dealing with wild dogs both as native fauna and as pests, and can be a potential barrier to managing wild dog populations across borders (Fleming et al. 2001). Wild dog management plan areas are often tailored to each region to accommodate a range of factors, including differences in geographical setting, legislative context and nature of stakeholders involved. Use of particular control methods is contentious and differs among jurisdictions.

The immediate context for and scope of wild dog management planning also varies. For example, in some regions, wild dog management plans are combined with plans for other invasive pests.

As a case in point, the Brindabella and Wee Jasper Valleys in New South Wales have a joint wild dog and fox management plan.

Regulation of 1080 baiting provides an example of government controls affecting wild dog management at the jurisdictional level. In the Northern Territory, private landholders must complete a certified course in using 1080 before obtaining two different permits from two separate government departments—one permit allows the use of poison (valid for two years), and the other gives permission to bait (valid for three months). Aside from the difficulty created by different expiry dates, landholders claim the regulations prevent baiting in sufficient volumes to achieve results (Adlam 2012; Bran 2012). In comparison, South Australian residents need only obtain an Approval to Possess 1080 bait and file proof they have notified neighbours (Primary Industries and Resources South Australia 2011). Baiting actions are also affected by conservation legislation, particularly on public lands, which may create problems for coordinated action across boundaries of publicly- and privately-owned land within particular jurisdictions.

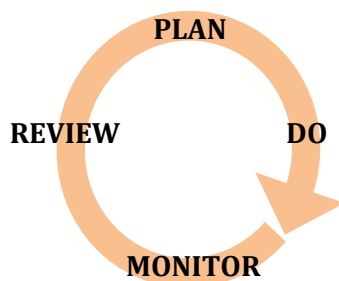
Tenure-related barriers

As described elsewhere in this document, land tenure has been a barrier to achieving coordinated action amongst stakeholders. The nil-tenure approach has been developed to try and overcome tenure-related issues (e.g. the Wee Jasper and Paroo examples). These barriers are closely related to the jurisdictional and legislative barriers, as well as of course to the different land tenures and land uses in the various regions across Australia where wild dogs are a problem.

Overcoming the barriers

Any policy or program can raise tensions between stakeholders with conflicting views and objectives. Different stakeholders have varying perspectives on wild dogs and how to manage them, depending on situations, values and interests. Therefore, it is inevitably going to be very difficult to find any one solution that satisfies everybody. Also, managing any pest species, including wild dogs, is usually a long-term and ongoing process as complete eradication is seldom possible and may not even be desirable. This directs attention to the need to develop ongoing processes to support adaptive management. 'Adaptive management' is an important approach to natural resource issues (Walters 1986; Allan 2007), and its principles are, for example, formally embedded in catchment and water planning in Australia through the bilateral agreements that originally underpinned the Australian Government's National Action Plan for Salinity and Water Quality. Adaptive management can be represented visually as in Figure 3.

Figure 3 Example of an adaptive management cycle (after Walters 1986, Allan 2007)



There are compelling arguments in the literature that participatory and adaptive processes are needed to ensure a range of stakeholders are engaged and can express their views, have their views heard, and have an opportunity to influence decision-making. The overall success of

management, and stakeholders' satisfaction with management efforts, are likely to depend critically on how successful these processes are in allowing different stakeholders' voices to be heard and incorporated. Only through this are the various stakeholders likely to feel 'ownership' of management decisions. A first step is to identify the major stakeholders and better understand their positions via Stakeholder Analysis.

Stakeholder Analysis

Stakeholder Analysis is a method to identify, prioritise, and better understand the nature and interests of stakeholders involved in an issue, program or project. A 'stakeholder' can be defined as any person or group who has something to gain or lose through the outcomes of a planning process or project (Start & Hovland 2004, p. 28). Stakeholder Analysis helps set the social context within which a problem and its solution will occur. It can be helpful to understand the relationship dynamics between different stakeholders, and how these stakeholders and any tensions between them can be managed. Stakeholder Analysis can also help identify and engage the relevant people and groups in a project or program. Schmeer (1999) suggests that Stakeholder Analysis is also useful to understand stakeholders' knowledge of the policy, problem or program, their position for or against it; and identify potential alliances between stakeholders.

Schmeer (1999) lists eight major steps in Stakeholder Analysis:

- planning the process
- selecting and defining a policy
- identifying key stakeholders (which some would argue should come first)
- adapting the tools
- collecting and recording the information
- filling in the stakeholder table
- analysing the stakeholder table
- using the information.

Start & Hovland (2004) have developed a stakeholder process involving identifying and prioritising stakeholders, and then classifying them into four categories based on an assessment of their level of power over the issue or project; influence in the direction of the issue or problem; and interest in the project or program. Figure 4 shows a matrix to assess the importance of different stakeholders, based on their classification. It is used to indicate how to manage stakeholders in the way shown in Table 7. This can help understand why people take certain stances and how they can be encouraged to modify their stance. The final step in Stakeholder Analysis is to develop a strategy for how best to engage different stakeholders; to 'frame' or present the message or information so it is useful to them; and to maintain relationships with different stakeholders given their individual and group characteristics.

Start & Hovland (2004) also suggest that this analysis can be developed further through 'Influence Mapping'. 'Influence Mapping' identifies the individuals and groups with the power to affect a key decision. It further investigates the position and motives of each stakeholder or group, and helps identify the most appropriate and effective way to communicate with them. The approach is also known as 'Stakeholder Influence Mapping', 'Power Mapping' or the 'Arena of Influence' (Start and Hovland 2004). Start & Hovland (2004, p. 28) describe the Influence

Mapping process in the following way:

Be clear over the policy issue or change being analysed and single out those in high positions of power. First, differentiate between the *decision-makers* who have the actual responsibility to make the decisions in a specific policy area, and their *opinion-leaders* who can influence them or lead their opinion, and who are generally more accessible.

Figure 4 Stakeholder analysis matrix (from Start & Hovland 2004)

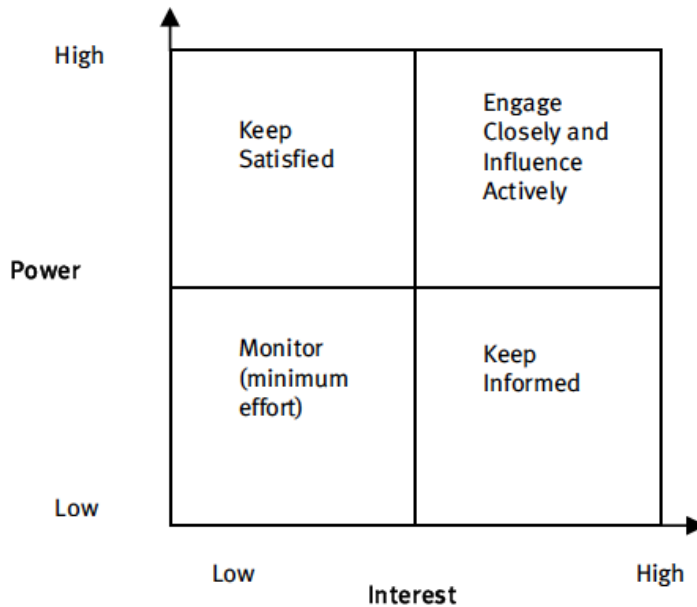


Table 7 Managing stakeholders according to their power and interest classification (from Start & Hovland 2004)

Power and interest rating	Management approach
Power = High, Interest = Low	These stakeholders have low interest in the project but a high level of power to influence its progress or put a stop to it. The best approach to manage them is not to manage them closely but to keep them satisfied.
Power = High, Interest = High	This category of stakeholders is very important and must be managed carefully. Attention to and development of a close relationship with them can help implement the project. They are highly interested and must be kept informed; on the other hand, they have power to influence the project and this can be used to progress the project.
Power = Low, Interest = Low	These stakeholders are those who are involved in the project, but they are not considered important since first, their level of interest is low toward the project and they are not powerful enough to change its direction or put a stop to it. Minimum effort can be taken to manage this category of stakeholders and the best action is for regular monitoring to identify their needs and watch for their actions.
Power = Low, Interest = High	These stakeholders have high interest in the project but low level of power to influence it. Therefore the best strategy to use is to keep them informed and maintain their interest.

Wild dog management stakeholders

Based on this literature review and applying Stakeholder Analysis principles, a non-exhaustive list of major stakeholder in Australian wild dog management includes, in no particular order:

- livestock producers/landholders
- wild dog management groups
- pest animal controllers/trappers
- Indigenous groups
- community groups of relevance (e.g. local wildlife conservation groups, local reserve management groups)
- industry research and advocacy bodies (e.g. AWI, Meat and Livestock Australia, Wool Producers Australia, National Farmers Federation)
- local government bodies
- regional NRM bodies (e.g. Catchment Management Authorities, Natural resource Management Boards, LHPAs)
- state and territory government agencies with responsibility for legislation or management, or responsibilities for managing public lands (national or state parks, state forests, conservation reserves, departments of primary industry, departments of environment, department of transport)
- Australian Government Departments and funding initiatives (e.g. the former DAFF and SEWPaC), the Caring for Our Country Initiative
- the Australian Game Council
- public or privately-owned utilities with extensive land holdings (e.g. water and electricity companies)
- funding bodies and their staff (e.g. APARP, the Rural Industries Research and Development Corporation)
- researchers (e.g. IACRC, CSIRO, ABARES, university-based, state agency-based, consultants)
- animal welfare organisations (e.g. the RSPCA)
- conservation groups
- related suppliers and retailers (e.g. producers and sellers of baits, traps)
- tourism operators
- the media.

The list above highlights, in broad categories, the large number of potential stakeholders that might be involved in wild dog management strategies. Each group, and indeed each individual stakeholder, will possess particular institutional and personal goals, values, perspectives and approaches to managing the issue—or views on whether there is even an issue at all. Being able

to understand the different stakeholders; their interests, relationships, roles and responsibilities; and their ability to influence decision-making processes; is critically important to successful wild dog management strategies. This is particularly so under a strategic, adaptive management approach.

Stakeholder engagement and capacity building

In social sciences, the term 'engagement' is often used in a specialised way to refer to participatory processes where communities or stakeholders in a particular issue have the opportunity to influence decisions by being involved in an engagement process, often coordinated by government. 'Engagement' is distinguished in this sense from more passive forms of community involvement where people are informed or consulted but have no real decision-making power. This distinction comes from the classic work of Sherry Arnstein in which she proposed a 'ladder' of citizen participation (Arnstein 1969). The ladder contains eight 'rungs': 1 Manipulation; 2 Therapy; 3 Informing; 4 Consultation; 5 Placation; 6 Partnership; 7 Delegated power; and 8 Citizen control. There is an implicit moral judgement in this ladder that higher rungs in which citizens have greater decision-making power are preferable to lower ones, but this is not always possible because of the different roles participants may be playing and the varying constraints affecting them.

Since Arnstein's paper, much effort has been directed to developing participatory processes and methods that allow citizens and, more particularly, the stakeholders in the problem at hand, to have an active role in decision-making. The idea of community engagement lends itself to being incorporated in 'community engagement strategies', which refer to planned, sequential approaches to ensure key stakeholders and stakeholder groups have the opportunity to be involved. These strategies may involve a range of social science methods and processes, including public meetings, workshops, focus groups and interviews (Aslin & Brown 2004).

One of the major issues in managing wild dogs is the conflicting views people hold about dingoes and other wild dogs, as detailed earlier in this report. These conflicting views and interests need to be reconciled, at least to some degree, to achieve effective management, particularly across land tenures, land uses and jurisdictions.

Previous work on community engagement has developed principles and criteria for successful engagement processes involving a range of stakeholders (Aslin & Brown 2004). The principles are to:

- act for change—processes need to be based on accepting that there is a need for change and current approaches may not be working
- agree on values—those involved need to try to find some common ground among their values and keep this in mind in what they do
- develop effective communication—processes need to be effective in allowing people to share their views and they need to genuinely involve a wide range of people and interests, not only the 'usual suspects' or a select group of interests
- develop and commit to a shared vision—a shared vision is needed to guide engagement processes and ensure participants are working towards a common goal
- try to achieve representativeness—those involved need to accept that they may be representing a wider interest group, not only their personal views—and it may be necessary to have people formally nominated or elected by the groups they are representing

- accept that mutual learning is needed—no-one is likely to have all the answers and everyone needs to accept they have something to learn
- work towards long-term goals—achieving desired goals may seem to be a long way off and long-term persistence and continuing efforts may be necessary
- base processes on negotiation, cooperation and collaboration—participants need to be prepared to negotiate with others and work towards mutually-agreed goals.

Engagement processes and their outcomes can be evaluated using a range of success criteria (Aslin & Brown 2004). These criteria include whether or not:

- participants felt ownership of the process and its outcomes
- participants feel everyone was treated with equity, respect and trust
- a wide range of interests was included
- there was a focus on strategic outcomes
- interest group representatives were selected appropriately
- there was open-ness and transparency about the process—no ‘hidden agendas’
- the process was conducted at an appropriate scale and with an appropriate scope
- personal contacts and face-to-face processes were used rather than indirect communication methods
- there were sufficient time and resources for the purpose.

If processes used to make wild dog management decisions were assessed as being successful in terms of these criteria, this could be an important contribution towards achieving effective management. Agreeing on what effective management looks like ‘on the ground’ then becomes an outcome of a participatory engagement process, not something dictated beforehand by any one group or set of interests. While actual on-ground outcomes must also be achieved, this emphasises that effective management of wild dogs is only likely to come from successful participatory processes involving a range of stakeholders and their collaborative efforts.

The importance of community engagement in pest management has been recognised in the recent (2012) five-year extension to the funding of the IACRC. This extension has a program focusing specifically on addressing the governance, institutional and community engagement aspects of wild dog management (Program 4: Community Engagement: institutional, policy and adoption processes), and a project that aims to help stakeholders develop strategic adaptive management plans (Project 3.L.14: Facilitating Strategic Management of Wild Dogs throughout Australia).

Participatory Action Research

One approach particularly relevant to this study is ‘action research’ or ‘Participatory Action Research’ (PAR). PAR is an interactive enquiry process designed to address an immediate problem. In PAR, researchers work directly with those affected to collectively develop solutions. Action research uses a reflective process of progressive problem solving (Argyris & Schön 1978; Reason & Bradbury 2001). By involving stakeholders in the research process from the start, those designing the process hope to dissolve the distinctions between ‘researcher’ and

'researched'. They also hope to ensure that everyone affected by the problem, and everyone who needs to take action to solve it, feels ownership of the problem and the solutions developed during the research process. This enhances the likelihood that the solutions developed collectively and collaboratively will be implemented as intended.

A collaborative research process can provide opportunities for stakeholders to share their different kinds of knowledge and develop a better understanding of one another's views. This can help reduce the impression that any one group's knowledge is 'superior' or 'truer' than that of others—a common perception where the issues are framed mainly as biological or ecological problems. In these cases, biologists and ecologists may see themselves as 'the experts' and may be reluctant to give credence to the knowledge and experience of local people who are not formally trained in these areas (Fischer 2000). This can of course lead to local people feeling disempowered and unheard. Equally, affected local people sometimes feel that they hold the 'real' knowledge and experience, and the scientists' knowledge is impractical and of academic interest only. This leads to scientists feeling their knowledge is undervalued or ignored. PAR approaches that engage a range of stakeholders provide opportunities for them to collectively develop solutions, and allow them to share their knowledge, uncertainties and perspectives, can help overcome barriers related to engagement and empowerment.

A useful form of PAR is 'Appreciative Inquiry', which involves collaboratively exploring what is valuable in current processes in order to determine ways to build on these positive aspects (Reed 2007). It takes a less problem- and a more solution-focused approach than some other forms of inquiry. Appreciative Inquiry also respects different worldviews and notions of science, truth and fact.

Public Participation GIS

A more recent approach to both community engagement and Stakeholder Analysis involves using group-based, community Geographic Information Systems (GIS) approaches—commonly referred to as Public Participation GIS (PPGIS). These approaches involve using maps and GIS data to map not just geographical data but also social data—like perceived areas of conflict, interest or influence.

Brown & Weber (2012) outline how PPGIS was used to provide stakeholders in conservation management in New Zealand with an opportunity to identify their significant places of conservation value. The approach employed a place-based framework, focusing on practically implementing ecosystem management principles. This included making use of 'the full suite of human activities occurring in spatially demarcated areas', while also 'accounting for biophysical, socio-economic and jurisdictional considerations' (Young et al. 2007, p.22). In this context, Brown & Weber (2012) explored the meaning of 'place' and indicated the strong connection between the 'geography' of places and the 'human dimensions' of places, wherein humans ascribe meaning to places. The authors list the multiple perceptual attributes mapped using PPGIS:

- landscape values
- special places
- development preferences
- national park experiences
- perceived environmental impacts
- climate change risks

- highway qualities
- urban park and open space values
- knowledge of landscape conditions
- recreation resources
- ecosystem services.

The value of PPGIS lies in providing a community-based process for defining values in a landscape that reflects community experience and knowledge, rather than a 'top-down' approach (Brown & Weber 2012).

ABARES has developed an application to decision-making using the PPGIS approach called the 'Multi-Criteria Analysis Shell for Spatial Decision Support' (MCAS-S). ABARES suggests that:

MCAS-S can assist in participatory processes and workshop situations where a clear understanding of varying approaches to spatial data management and information arrangement is necessary. Stakeholders can see the potential impacts that their decisions may make (Australian Government 2012).

Lesslie et al. (2008) have tested the MCAS-S software shell for decision-making in a natural resources management context in Australia, including for:

- land use planning processes that involved mapping priorities for re-vegetation in the West Hume region of southern New South Wales
- national assessment of factors affecting the sustainability of extensive livestock grazing in the Australian rangelands.

They define multi-criteria analysis (MCA) in the following way:

MCA is a technique that allows for the measurement and aggregation of the performance of alternatives or options, involving a variety of both qualitative and quantitative dimensions. As a means of considering the links among biophysical, economic and social data with human imperatives, it is therefore particularly useful for approaching complex interactions and effects in the context of land use and land management (p. 74).

Lesslie et al. (2008) stress that MCA helps decision-making but does not make decisions. Its importance lies in being able to capture multiple stakeholders' perspectives in a decision-making process, and being able to display the decision-making criteria and potential outcomes in real time, as well as visualising them using GIS. The authors stress the importance of using MCA as part of a wider community engagement process.

Given the nature of the wild dog problem, which spans multiple tenures and involves multiple stakeholders with diverse perspectives, the PPGIS approach offers possibilities for community-based mapping of issues and potential solutions. The IACRC has made steps in this direction through its FeralScan tool (<http://www.feralscan.org.au>), which allows the public to contribute information about sightings of feral animals, which are then mapped and provided publicly. Visitors to the website can contribute to a large public map or create their own map for several invasive animal species, including wild dogs. The opportunity now exists for this mapping to become part of group planning and decision-making processes.

Monitoring and evaluating

Without effective evaluation of previous management efforts, it is very difficult to achieve improvements or convince a range of different stakeholders that improvement is needed or is being achieved through management efforts. Typically there has been a lack of monitoring and evaluation activities of Australian natural resource management programs, and wild dog management is no exception. The lack of evaluations, particularly at the national level, can be a barrier to improving wild dog management efforts because there is then a lack of baseline information about the success of previous efforts that can be built upon.

Essentially evaluation involves determining the worth or merit of whatever is being evaluated. Many different uses can be made of these value judgements, from assessing the financial or social impacts of a program to improving program design or planning new programs. 'Formative' evaluations are conducted to provide program staff with judgements useful in improving the program. 'Summative' evaluations are generally conducted after the program is completed and for the benefit of some external audience or decision-maker. The main difference is that the aim of a summative evaluation is to report **on** the program whereas a formative evaluation reports **to** the program (Scriven 1991). Effective programs do both, allowing the adaptive management process to progress and the program to improve.

Other characteristics defining the type of evaluation include whether it is a 'process' or 'outcome' evaluation and whether it is a 'goal-based' or 'needs-based' evaluation. Goal-based evaluation requires strong outcome measures. A needs-based evaluation does not focus only on the stated objectives of the program, but also evaluates the program's impact with regard to the needs of the stakeholder group and the needs of society in general (Dart et al. 1998).

Evaluation strategies may be of many types. For example they can:

- examine the program logic for developing the program
- understand how the program is being implemented for program improvement
- assess whether outcomes have been reached for accountability purposes
- feed back into an on-going monitoring system.

The importance of evaluation as a key step in a strategic approach to managing wild dogs (Fleming et al. 2001; Braysher & Saunders 2003) is evident. In 1998, the Rural Industries Research and Development Corporation (RIRDC) undertook a review of five main forms of evaluation that could be used to evaluate extension programs (Dart et al. 1998). The review drew from literature on program evaluation, health and education programs, and monitoring and evaluation of overseas agricultural development projects. A key finding was that agricultural extension evaluations in Australia usually involved a mixture of qualitative and quantitative data. The evaluations were usually conducted while the project was in a 'settled' stage and were carried out by external evaluators. This review highlighted the fact that many new and innovative evaluations were underway at the time of writing that were more qualitative in nature than in the past.

The RIRDC review process categorised more than 100 evaluations by purpose, using the conceptual model suggested by Owen (1993). The five categories in this evaluation framework were:

- evaluation for impact assessment—for justification; objectives-based outcome evaluation, needs-based evaluation

- evaluation for program management—for accountability; program monitoring, component evaluation, system evaluation, program improvements over time
- process evaluation—for improvement; implementation studies, action research, process evaluation
- evaluation for design clarification
- evaluation for program development.

Allen et al. (2011), together with Ballard (2005, 2006), have built on earlier writings by Fleming et al. (2001) and Braysher & Saunders (2003) to document a six-step approach to managing wild dogs strategically. Figure 5 illustrates the main elements of the strategic approach as a flow chart. This approach has been developed to help stakeholders develop a management plan specific to their local area, region or state. It takes a strategic approach that includes monitoring and evaluation components to help develop an adaptive management process and increase the chances of successful outcomes. Step 5 is focused on 'Evaluating the Plan'. Evaluating the current plan forms the basis for improving the next plan. Allen et al. (2011) suggest that evaluation should involve all stakeholders to ensure their different perspectives are included. As well, data gathered in the monitoring process should be included to contribute to informed decisions on the plan's success and identify any changes needed. The authors provide examples of ten questions that could be included in an evaluation.

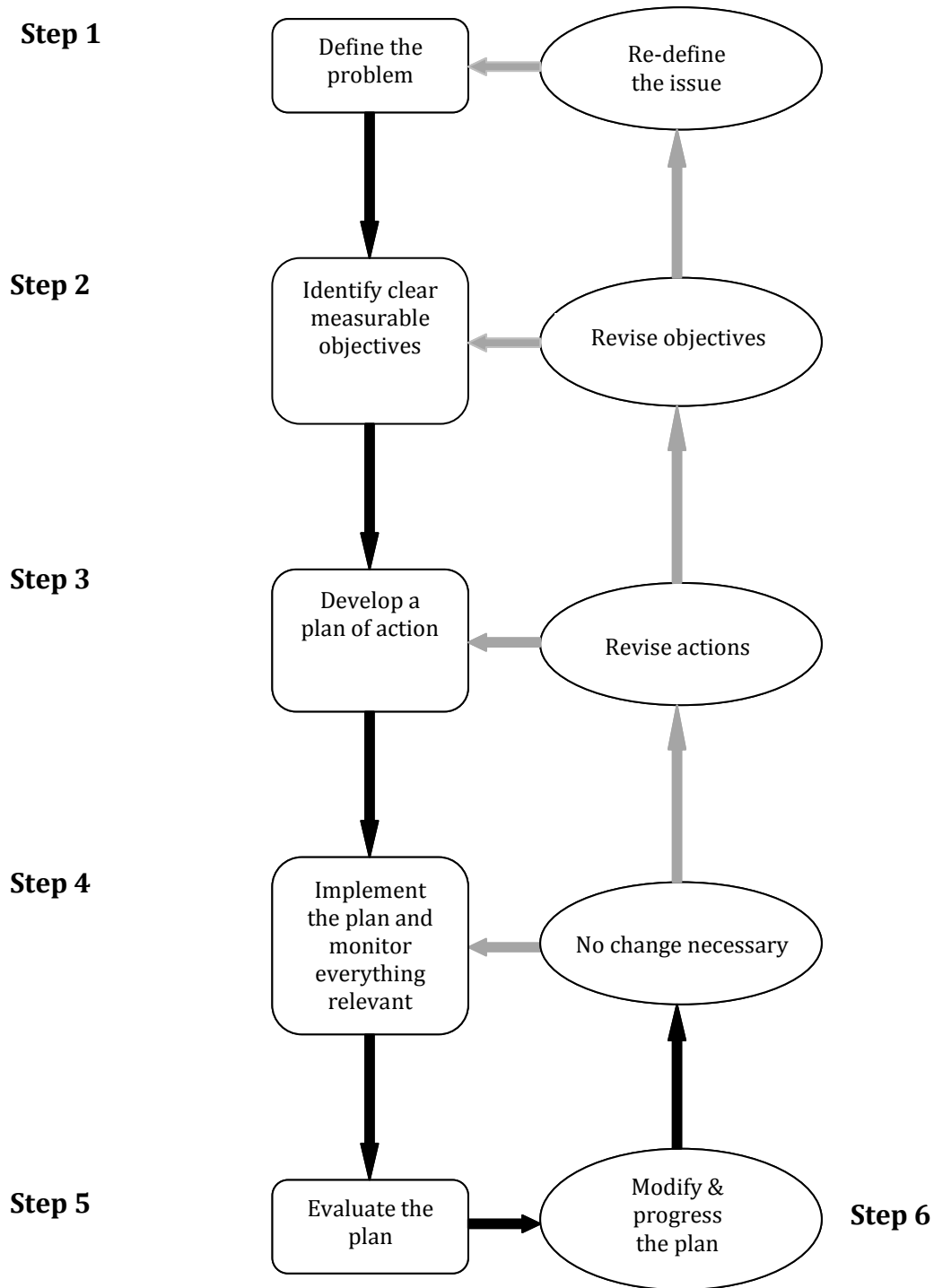
To evaluate wild dog management, it is suggested that the focus would be primarily on undertaking a formative evaluation to report back to the program. It is likely to be an evaluation of process and outcome—the emphasis depending on the stage of the plan being evaluated. It is also likely to incorporate a mix of goal-based and needs-based approaches—depending on the available data acquired through monitoring activities and the stage of the plan.

Wild dog management programs need to be participatory in nature, involving multiple stakeholders. Because of this characteristic, participatory evaluation processes need to be used—ones that contain a significant element of qualitative inquiry to better understand process and stakeholders' needs and obligations.

The community engagement literature (see previous sections) also provides guidance on how to evaluate processes designed to effectively involve a range of different stakeholders. The stage of wild dog management plan development and implementation in various Australian regions will determine which evaluation approach to take. The majority of plans are likely to come under the heading of the first three evaluation approaches in the list—plans that are at least being implemented, if not formalised.

The final section of this review considers what support stakeholders may need to be able to improve wild dog management efforts, with a particular focus on the wild dog management groups established for this purpose.

Figure 5 A flow chart for a strategic, adaptive approach to wild dog management (after Allen et al. 2011). The idea is to start at the top left and progress down the left-hand side. After reviewing the plan in Step 6, then progress up the ovals on the right-hand side. If no changes are necessary, re-implement the plan, but if changes are needed, the grey arrows need to be followed until the point where the changes are needed. Then continue from the revised starting point.



7 Wild dog management groups' key support needs

On the basis of the available literature, the previous chapters have highlighted the complexity of the social aspects of the wild dog management problem. Complexity exists in terms of the large number of stakeholders involved; their differing interests, viewpoints, roles and responsibilities; and the varying weight they place on different kinds of knowledge. A key place for these aspects to meet would seem to be the wild dog management groups where wild dog management plans are developed and implemented. A key question is:

How can stakeholders and, in particular, wild dog management groups, be supported to successfully engage multiple stakeholders in coordinated wild dog management?

AWI has been asking this question for some time and, in 2010, an unpublished issues paper prepared by Franklin for AWI made seven draft recommendations about how to support wild dog management groups:

Recommendation 1: The nil tenure concept may be seen as the initiating step in the development of a co operative approach to dingo/wild dog management. Representatives of all land tenures within any area designated for the protection of both livestock and wildlife resources are stakeholders. It is within this approach that financial resource needs are identified for the area, and budgetary commitments are defined, and financial allocations are delivered by participating local and state government agencies as appropriate.

Recommendation 2: Following the negotiation and acceptance of responsibilities for resource provision under the nil tenure approach, the process of negotiating and implementing a plan must be community based and community focused.

Recommendation 3: An appropriate assessment and evaluation process must be designed and implemented for the regular review and monitoring of management outcomes of community based programs. This review process has two crucial functions as these affect accountability to resource providers (land owners and managers including state and local agencies), and accountability to the stakeholder beneficiaries of the management program (stock owners and public land management agencies).

Recommendation 4: Community based individuals with the motivation and experience to organise and deliver the leadership required for the re introduction and reinvigoration of local cooperative dingo/wild dog management, should be identified and assisted with appropriate skills training and financial remuneration to act for and on behalf of industry stakeholder groups.

Recommendation 5: Environmental management policies must include an evaluation of social justice implications. Wherever these policies might negatively affect adjacent industry participants and undermine the socio economic viability of these participants and their communities, immediate redress in the form of crisis support should be made available until the negative policy impacts are remedied.

Recommendation 6: Environmental management credentials should include social scientific as well as natural science expertise. In particular, environmental management studies might include understandings about the social processes that produce science, the contextualised nature of scientific knowledge and the social imperatives for its present exclusive place in contemporary Australian environmental management.

Recommendation 7: Rural leaders and rural industry organisations should assist in the production of a sympathetic and a positive view of communities and individuals marginalised by environmental policies and programs, especially as these produce unjust and unjustified social outcomes, as well as economic hardship.

These recommendations draw on Franklin's unpublished review of wild dog issues across Australia and her extensive personal and family experience managing wild dogs as a sheep producer. They respond to perceptions of how the power dynamics between 'credentialed' and 'un-credentialed' stakeholders affect how wild dog management groups operate. As such, Franklin calls for skills to be developed in the areas of communication, facilitation and negotiation, to help manage any power imbalances—which she refers to as 'social justice' issues. What constitutes 'social justice' in a particular situation is subjective and difficult to define in any single way given the multiple perspectives that may be involved. However, acknowledging the justice dimension draws attention to the widely accepted procedural principle that people have a right to have a say in decisions that affect them.

These recommendations clearly support the findings of some of the literature reviewed here, particularly the need to focus on community engagement principles and processes, stakeholder analysis, and monitoring and evaluating previous efforts.

Addressing the needs of wild dog management groups

In recognising the complexity of wild dog management issues, in 2011 AWI released a position statement detailing its support for a 'dual social and natural science research approach and support for grazier endorsed control activities' (Littlejohn & Marshall 2011). To support its position statement, AWI is investing some \$600,000 over three years to help regional groups apply the nil tenure approach to developing wild dog management plans; over \$30,000 to support graziers to participate in national forums on wild dog management; and \$400,000 for a 'triple bottom line' analysis of wild dog impacts (AWI Ltd 2012). In May 2013, AWI also announced an additional \$2 million dollars for investment in on-ground wild dog control. This literature review forms part of the AWI investment in wild dog management research. It also forms part of a larger research project that will use case studies to examine how some of the principles, processes and techniques examined here can be applied to wild dog management groups. This research will include a monitoring and evaluation component to help measure any benefits or drawbacks.

This AWI program, and this review as part of it, aims to address some of these groups' identified needs and to improve stakeholders' ability to deal effectively with wild dog management issues in future. Through this, they aim to help reduce the social and psychological impacts of wild dog attacks on livestock, reduce the economic impacts of these attacks, and improve the sustainability of the sheep industry.

Appendix 1 Media content analysis method and issues identified

An applied, qualitative media content analysis (as described in White & Marsh 2006) was conducted to answer the question: *How do the media portray wild dog management issues?* The database 'Mediaportal' (supplied by Media Monitors) was purposively sampled over the period May to August 2012 to identify any newspaper articles and radio segments that contained the words 'dingo' or 'wild dog'. Items containing one or both words were recorded and coded if they mentioned specific management barriers, programs or stakeholders. Items that only referred to generic terms, for example 'coordination', 'management' or 'stakeholder' were not coded. Items were coded only if they contained new information or themes not previously recorded.

Table A1 Wild dog issues identified by the media analysis

State/ territory of publication	Government action	Stakeholder tension	Stakeholder coordination	Human health	Other themes
NT	Cattle farmers claim excessive baiting regulations hinder effective wild dog management			Fear of rabies spread from Indonesia Dingo attack on campers in a national park prompts shooting by government	
NSW	Segmented government funding for management activities Farmers of property adjacent to Crown land are frustrated at lack of government involvement to wild dog issues	Landholders not participating in coordinated management activities Cattle farmers are not baiting their property, to the detriment of sheep farmers. LHPA says it is difficult to enforce the legislation to bait Sheep producers rebelled against LPHA tracker because they redirected AWI funding for trapping into aerial baiting Public backlash over LPHA suggestion to discontinue aerial baiting prevented the idea from going ahead; landholders were concerned that it would have undermined management efforts in other regions	Coordinated effort between Mid Coast LHPA, farmers, AWI and the NSW Minerals Council raised funds for aerial baiting Workshops teach farmers how to bait on their property Minerals Council working with farmers and NRM managers to coordinate baiting	General concerns for human safety as wild dog populations increase in the future A farmer had to destroy 30 lambs in one night because of wild dog attacks Community concerns that wild dogs are moving into peri-urban areas and could threaten pets and humans. Wild dogs entering urban areas from national parks were particularly identified	NSW DPI research suggests that re-introducing dingoes to combat feral pests could endanger the sustainability of native wildlife populations
Tas.	Park rangers eradicate wild dogs from parks using shooting and baiting, calls for park users to report wild dog sightings	Urban domestic dogs attacking livestock at night; legislation allows farmers to shoot dogs		Dog attacks cause farmers emotional distress	Shooters call for a bounty on wild dog scalps
WA	Easier to get approval to bait on private land Farmer lobby groups call for more government funding Government allocating funding to the upgrade of existing dog				A pastoral alliance calls for a dog fence to help sheep farmers rebuild; others say the fence will be ineffective Farmer lobby group calls

	<p>fence and continuing work of 'doggers'</p> <p>Government criticised for removing 'doggers' from Crown land</p> <p>Government reduces regulations for 1080 approval; conducts free workshop to train landholders to handle 1080</p>				<p>for a wild dog bounty to be introduced.</p>
SA		<p>A researcher called for dog fence to be removed; concerns this would increase attacks on livestock and koalas</p>		<p>Wild dog attacks on urban pet dogs</p>	<p>Poorly maintained dog fence is not restraining dingoes</p> <p>Calls for wild dog bounty, but concerns about how it would be policed and making dogs 'bait shy'</p> <p>The Koala Foundation identifies wild dogs as a threatening process to koala populations</p>
Vic.	<p>Resources moved from the Wild Dog Control Program to study big cat sightings (pre-election promise)</p> <p>SEWPaC withholding approval to aerial bait with 1080 for fear of the consequences to endangered quoll populations</p> <p>3 km buffer zone around Crown land; farmers argue it just protects hybrids</p>	<p>Shooters leave sambar deer carcasses in national parks, which feed wild dog populations during the breeding season</p>			
Qld	<p>Contradictory legislation regarding wild dog status</p> <p>Government installs a peri-urban wild dog destruction officer, to operate in close consultation with land owners, local government and wild dog committees</p>	<p>Landholders seek more information about coal seam gas (CSG) companies' management efforts; possible increase in wild dog attacks following CSG operations and LPG pipelines established in the region</p>	<p>Several local councils are banding together to attempt coordinated wild dog management</p> <p>Caring for our Country-funded information sessions that brought together Federal and state</p>	<p>Pets attacked by wild dogs</p> <p>Communities can hear wild dogs howling</p> <p>Wild dogs roaming closer to urban areas</p> <p>Concern for human safety at night</p> <p>Article estimates wild dog</p>	

ACT	<p>Government removes baiting requirement that the meat must be human grade food, making it easier to bait</p> <p>Contradictory legislation regarding wild dogs</p> <p>Government installed five new wild dog officers</p>	<p>Indigenous communities angry about new dog fence, saying it cuts through native title land</p> <p>Graziers call for increased public participation and coordination in QDog initiative</p>	government speakers	<p>damage at \$33 million in lost production</p>	<p>Wild dogs getting 'smarter' and more difficult to trap</p>
-----	--	---	---------------------	--	---



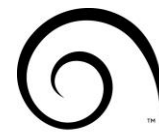
Glossary

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences, an Australian Government research bureau within the former DAFF (now Department of Agriculture)
APARP	Australian Pest Animal Research Program
AusBIOSEC	Australian Biosecurity System for Primary Production and the Environment
AWI	Australian Wool Innovation Ltd
CITES	Convention on International Trade in Endangered Species
DAFF	former Australian Government Department of Agriculture, Fisheries and Forestry (now Department of Agriculture)
Dingo	<i>Canis lupus dingo</i> . Originally a native dog of Asia, present in Australia before European arrival. 'Pure' dingoes are those that show no evidence of hybridisation with European domestic dogs
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> , Australian Government legislation that aims to protect flora, fauna, ecological communities and heritage places of national significance. Administered by the Australian Government Department of the Environment (formerly SEWPaC)
Feral dog	<i>Canis lupus familiaris</i> . Wild-living European domestic dogs
GIS	Geographic Information Systems
Hybrid dog	Dogs resulting from cross breeding of a dingo and a domestic or feral dog, and the descendants of crossbred progeny
IACRC	Invasive Animals Cooperative Research Centre
IPAPF	Invasive Plants and Animals Policy Framework (Victoria)
IUCN	International Union for the Conservation of Nature
LHPA	Livestock Health and Pest Authority
MCA	Multi-Criteria Analysis
MCAS-S	Multi-Criteria Analysis Shell for Spatial Decision Support
Meso-predator	Medium-sized predator, including foxes, cats and spotted-tailed quolls



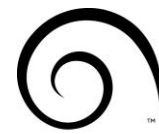
Meso-predator release	The hypothesis that removal of 'top-down' population control of medium-sized predators, like foxes and feral cats, due to the removal of competition with larger predators, like wild dogs, allows their populations to increase with consequent impacts at lower trophic levels (e.g. small native vertebrates)
Meso-predator suppression	The hypothesis that larger predators (e.g. wolves, lions, wild dogs) suppress the population sizes of co-occurring meso-predators and subsequently prevent unsustainable predation on animals at lower trophic levels
Nil-tenure strategy	A management strategy planned and applied across all land tenures by all stakeholders. For planning purposes, all land tenure boundaries are ignored. The strategy focuses on management at a landscape level rather than at a 'property' scale, and relies on cooperation and coordination among stakeholders
NRM	Natural Resource Management
NSW NPWS	New South Wales National Parks and Wildlife Service, responsible for wild dog management on the park estate under the New South Wales <i>Rural Lands Protection Act 1998</i> and dingo conservation under the New South Wales <i>National Parks and Wildlife Act 1974</i>
NWDF	National Wild Dog Facilitator
PAPP	Para-aminopropiophenone, a poison used to kill wild dogs
PAR	Participatory Action Research
Peri-urban	The perimeter region of urban areas which often combine urban and rural land use activities, including suburban and small to medium-sized agricultural holdings, and 'hobby farms' and 'life style' blocks
PPB	Pasture Protection Board
PPGIS	Public Participation Geographic Information Systems
Ramsar Convention	Convention on Wetlands of International Importance, signed in the city of Ramsar, Iran
RGBs	Regional Biosecurity Groups
RIRDC	Rural Industries Research and Development Corporation
SEWPaC	Former Australian Government Department of Sustainability, Environment, Water, Population and Communities, now the Department of the Environment

PROJECT FINAL REPORT



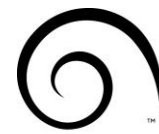
awil Australian Wool
Innovation Limited

SIA	Social Impact Assessment
1080	Sodium mono-fluoroacetate, the active ingredient currently used in wild dog baits
Wild dog	Any dog living in the wild, including dingoes, feral domestic dogs and their hybrids
WDMC	Wild Dog Management Committee
WDWG	Wild Dog Working Group

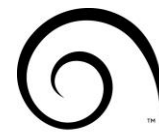


References

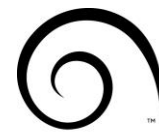
- ABARES in preparation 2013, *An integrated assessment of the return on investment in pest animal management—wild dogs*, manuscript in preparation, ABARES, Canberra.
- ACT Government 2012, *ACT Pest animal management strategy 2012–2022*, Environment and Sustainable Development, ACT Government, Canberra.
- Adger, WN 2003, 'Social capital, collective action, and adaptation to climate change', *Economic Geography*, vol. 79, no. 4, pp. 387–404.
- Adlam, N 2012, 'Plans to cut baiting red tape', *Northern Territory News*, 24 July 2012.
- Agforce 2010, *Post-project analysis—Blueprint for the Bush. Raising the awareness of coordinated wild dog control*, Agforce, Brisbane.
- Agrawal, A 1995, 'Dismantling the divide between indigenous and scientific knowledge', *Development and Change*, vol. 26, issue 3, pp. 413–9.
- Allan, C 2007 'Adaptive management of natural resources', in AL Wilson, RL Dehaan, RJ Watts, KJ Page, KH Bowmer & A Curtis (eds), *Proceedings of the Fifth Australian Stream Management Conference, Australian rivers: making a difference*, Charles Sturt University, Thurgoona, New South Wales.
- Allen, BL & Fleming PJS 2012, 'Reintroducing the dingo: the risk of dingo predation to threatened vertebrates of Western New South Wales', *Wildlife Research*, Vol. 39, no. 1, pp. 35–50.
- Allen, B & West, P 2013, 'Influence of dingoes on sheep distribution in Australia', *Australian Veterinary Journal*, vol 91, no. 7, pp. 261–6.
- Allen, B, Ballard, G & Fleming, PJS (eds) 2011, *Guidelines for preparing a working plan to manage wild dogs (brown book)*, 2nd edition, Invasive Animals Cooperative Research Centre, Canberra.
- Allen, BL, Engeman, R & Allen, LR 2011, 'Wild dogma: an examination of recent "evidence" for dingo regulation of invasive mesopredator release in Australia', *Current Zoology*, vol. 57, no. 5, pp. 568–83.
- Allen, B, Fleming, PJS, Hayward, M, Allen, LR, Engeman, RM, Ballard, G & Leung, K-P 2013, 'Top-predators as biodiversity regulators: contemporary issues affecting knowledge and management of dingoes in Australia', Chapter 4 in *Biodiversity enrichment in a diverse world*, ed. G. A. Lameed, Intech, pp. 85–132.
- Allen, L 2008, *Wild dog management in Queensland—an issues paper*, Biosecurity Queensland, Brisbane.
- Appleton, H, Best, R, Davis, D, McLaren, A, Passarelli, M & Whale, Z 2011, *A dog of a problem: managing wild dogs in peri-urban Australia*, Australian Government Department of Agriculture, Fisheries and Forestry, Canberra.
- Argyris, C & Schön, D 1978, *Organizational learning: a theory of action perspective*, Addison-Wesley, Reading, MA.
- Arnstein, SR 1969, 'A ladder of citizen participation', *Journal of the American Institute of Planners*, vol. 35, pp. 216–24.
- Aslin, HJ & Brown, VA 2004, *Towards whole of community engagement: a practical tool kit*, Murray-Darling Basin Commission, Canberra.



- Australian Pesticides & Veterinary Medicines Authority 2008, *Sodium fluoroacetate final review report and regulatory decision: the reconsideration of registrations of products containing sodium fluoroacetate and approvals of their associated labels*, Australian Pesticides & Veterinary Medicines Authority, Canberra.
- AWI Ltd 2012, *AWI R&D Update: wild dog control*, AWI Ltd, Sydney.
- Ballard, G 2005, *Australian wildlife management and the human dimension*, PhD thesis, School of Environmental Sciences and Natural Resources Management, University of New England, Armidale.
- 2006, 'Social drivers of invasive animal control', paper presented to *Proceedings of the Invasive Animals CRC workshop on social drivers of invasive animal control*, 26–27 July, Adelaide.
- Bancroft, D 2013, 'A call for action on wild dogs', *Ruralweekly*, 25 April 2013, <http://www.ruralweekly.com.au/news/a-call-for-action/1841808/>, accessed 7 June 2013
- Beck, JG, Grant, DM, Read, JP, Clapp, JD, Coffey, SF, Miller, LM & Palyo, SA 2008, 'The Impact of Event Scale—revised: psychometric properties in a sample of motor vehicle accident survivors', *Journal of Anxiety Disorders*, vol. 22, no. 2, pp. 187–98.
- Becker, H & Vanclay, F (eds) 2003, *The international handbook of Social Impact Assessment*, Edward Elgar, Cheltenham, UK.
- Berkes, F & Folke, C 2000, 'Linking social and ecological systems for resilience and sustainability', in F Berkes & C Folke (eds), *Linking social and ecological systems: management practices and social mechanisms for building resilience*, Cambridge University Press, Cambridge, pp. 1–27.
- Berkes, F, Colding, J & Folke, C 2003, *Navigating social–ecological systems: building resilience for complexity and change*, Cambridge University Press, Cambridge, UK.
- Biosecurity Queensland 2013, *Sodium fluoroacetate fact sheet*. Available from www.biosecurity.qld.gov.au
- Bran, M 2012, *NT Country Hour*, ABC Central Australia, Alice Springs, 9 August, radio interview notes.
- Braysher, M & Saunders, G 2003, *PESTPLAN: a guide to setting priorities and developing a management plan for pest animals*, Bureau of Rural Sciences, Canberra.
- Brown, G & Weber, D 2012, 'A place-based approach to conservation management using public participation GIS (PPGIS)', *Journal of Environmental Planning and Management*, vol. 56, issue 4, pp. 455–73.
- Brown, VA 2008, *Leonardo's vision: a guide to collective thinking and action*, SENSE, Rotterdam.
- Brugha, R & Varvasovszky, Z 2000, 'Stakeholder analysis: a review', *Health Policy and Planning*, vol. 15, no. 3, pp. 239–46.
- Bryson, J 2000, *Evil angels: the disappearance of Azaria Chamberlain*, Hodder, Sydney.
- Buller, C, Cathles, H, Dall, D & Hunt, R 2005, '"Nil tenure" approach to invasive animals management in Australia—extending the paradigm', *13th Australasian Vertebrate Pest Conference*, Te Papa Wellington, New Zealand, 2–6 May.
- Butler, LD, Field, NP, Busch, AL, Seplaki, JE, Hastings, TA & Spiegel, D 2005, 'Anticipating loss and other temporal stressors predict traumatic stress symptoms among partners of metastatic/recurrent breast cancer patients', *Psycho-Oncology*, vol. 14, no. 6, pp. 492–502.



- Cheng-Sheng, C, Pinchen, Y, Cheng-Fang, Y & Hsiu-Yueh, W 2005, 'Validation of Impact of Events Scale in nurses under threat of contagion by severe acute respiratory syndrome', *Psychiatry and Clinical Neurosciences*, vol. 59, no. 2, pp. 135–9.
- Chudleigh, P, Simpson, S & Lai, J 2011, *Economic analysis of the National Wild Dog Facilitator project*, Invasive Animals Cooperative Research Centre, Canberra.
- Claridge AW & Mills DJ 2007, 'Aerial baiting for wild dogs has no observable impact on spotted-tailed quolls (*Dasyurus maculatus*) in a rainshadow woodland', *Wildlife Research*, vol. 34, pp. 116–24.
- Claridge, AW, Mills, DJ, Hunt, R, Jenkins, DJ & Bean, J 2009, 'Satellite tracking of wild dogs in south-eastern mainland Australian forests: implications for management of a problematic top-order carnivore', *Forest Ecology and Management*, vol. 258, no. 5, pp. 814–22.
- Coakes, S 1999, *Social Impact Assessment: a policy maker's guide to developing Social Impact Assessment programs*, Bureau of Rural Sciences, Canberra.
- Corbett, L 2001, 'The conservation status of the dingo *Canis lupus dingo* in Australia, with particular reference to New South Wales: threats to pure dingoes and potential solutions', Proceedings of a Symposium on the Dingo, Mosman, Sydney.
- Corbett, LK 2008, *Canis lupus ssp. dingo*, viewed 5 September 2012, <http://www.iucnredlist.org/details/full/41585/0>.
- Creamer, M, Bell, R & Failla, S 2003, 'Psychometric properties of the Impact of Event Scale—revised', *Behaviour Research and Therapy*, vol. 41, pp. 1489–96.
- Dart, J, Petheram, R & Straw, W 1998, *Review of evaluation in agricultural extension*, RIRDC Publication No. 98/136, RIRDC, Canberra.
- Davidson-Hunt, IJ & O'Flaherty, RM 2007, 'Researchers, indigenous peoples and place-based learning communities', *Society and Natural Resources*, vol. 20, pp. 291–305.
- Dawes, RM, Orbell, JM, Simmons, RT and Van De Kragt, AJC 1986, 'Organizing groups for Collective Action', *The American Political Science Review*, vol. 80, no. 4, pp. 1171–85.
- Department of Agriculture and Food, Western Australian Government 2006, *Wild dog management best practice manual*, Department of Agriculture and Food, Western Australia, Perth.
- Department of Agriculture and Food, Western Australian Government 2009, Joint effort blow for wild dogs, viewed 6 September 2012, http://www.agric.wa.gov.au/PC_93664.html
- Department of Agriculture, Fisheries and Forestry, Australian Government 2008, *The Australian Animal Welfare Strategy. Revised edition June 2008*, Department of Agriculture, Fisheries and Forestry, Australian Government, Canberra.
- 2011, Vertebrate pests, viewed 14 March 2013, <http://www.daff.gov.au/natural-resources/invasive/vertebrates>
- Department of Agriculture, Fisheries and Forestry, Queensland Government 2013, Wild dog, viewed 14 March 2013, http://www.daff.qld.gov.au/4790_8290.htm
- Department of Employment, Economic Development and Innovation, Queensland Government 2011, *Wild dog management strategy 2011–16*, Biosecurity Queensland, Brisbane.
- Department of Primary Industries, New South Wales Government 2012, *New South Wales Wild Dog Management Strategy 2012–2015*, Department of Primary Industries, New South Wales Government, Sydney.



Department of Primary Industries, New South Wales Government 2013, *Wild Dog Management Strategy*, viewed 14 March 2013, <http://www.dpi.nsw.gov.au/agriculture/pests-weeds/vertebrate-pests/legislation/state-strategies/management-strategy>

Department of Primary Industries, Victorian Government 2010, Agriculture, viewed 15/02/2013, <http://www.dpi.vic.gov.au/agriculture/pests-diseases-and-weeds/protecting-victoria-pest-animals-weeds/legislation-policy-and-permits/legislation>

Department of Primary Industries, Victorian Government 2011, *Wild dog management in Victoria: social benefit cost analysis*, Department of Primary Industries, Victorian Government, Melbourne.

Department of Primary Industry, Parks, Water and the Environment, Tasmanian Government, 1080 Poison, accessed on 2 May 2013 at: Department of Sustainability, Environment, Water, Population and Communities, Australian Government, 2013, *Environment Protection and Biodiversity Conservation Act 1999*, viewed 14 March 2013, <http://www.environment.gov.au/epbc/>

Environment and Communications Reference Committee 2011, *The koala—saving our national icon*, Senate Printing Unit, Commonwealth Government, Canberra.

Fenton, M 2005, *Guidebook on Social Impact Assessment, prepared for the Comprehensive Coastal Assessment*, Environment and Behaviour Consulting, Townsville.

— 2009, *Wild dog control in pastoral Queensland: an analysis of interviews with sheep and cattle producers*, Agforce, Brisbane.

Feral.org 2012, The distribution of pure dingoes and dingo–dog hybrids in Australia, <http://www.feral.org.au/wp-content/uploads/2012/05/WDFS6.pdf>

Fischer, F. 2000, *Citizens, experts, and the environment: the politics of local knowledge*, Duke University Press, Durham, NC.

Fitzgerald, G 2009, *Public attitudes to current and proposed forms of pest animal control*, Invasive Animals Cooperative Research Centre, Canberra.

Fitzgerald, G & Wilkinson, R 2009, *Assessing the social impact of invasive animals in Australia*, Invasive Animals Cooperative Research Centre, Canberra.

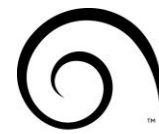
Fleming, PJS & Korn, TJ 1989, 'Predation of livestock by wild dogs in eastern New South Wales', *The Rangeland Journal*, vol. 11, no. 2, pp. 61–6.

Fleming, PJS, Allen, B, Ballard, G & Allen, L 2013 *Wild dog ecology, impacts and management in northern Australian cattle enterprises: a review with recommendations for RD & E investments*, Meat and Livestock Australia, Sydney.

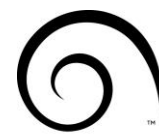
Fleming, PJS, Corbett, L, Harden, R & Thompson, P 2001, *Managing the impacts of dingoes and other wild dogs*, Bureau of Rural Sciences, Canberra.

Fleming, PJS, Ballard, G, Meek, P, Allen, B, Gentle, M & Mifsud, G 2012, 'When wild dogs come to town: management in peri-urban areas where dogs, policy and people meet', paper presented to *AIAM Annual Conference on Animal Management*, Penrith, New South Wales.

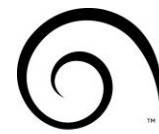
Fleming, PJS, Allen, BL, Allen, LR, Ballard, GA, Bengsen, A, Gentle, MN, McLeod, LJ, Meek, PD & Saunders, GR in press 2013, 'Management of wild canids in Australia: free-ranging dogs and red foxes', Chapter 6 in AS Glen & CR Dickman (eds), *Carnivores of Australia: past, present and future*, CSIRO Publishing, Melbourne.



- Fleming, PJS, Allen, LR, Berghout, MJ, Meek, PD, Pavlov, PM, Stevens, P, Strong, K, Thompson, JA & Thomson, PC 1998, 'The performance of wild-canid traps in Australia: efficiency, selectivity and trap-related injuries', *Wildlife Research*, vol. 25, no. 3, 327–38.
- Ford-Thompson, A, Snell, C, Saunders, G & White, P 2012, 'Stakeholder participation in management of invasive vertebrates', *Conservation Biology*, vol 26, no. 2, pp. 345–56.
- Franklin, J 2012, 'Environmentalism and the marginalising of rural society and rural industrial practices', paper presented to *Emerging and enduring inequalities, The Australian Sociological Association 2012 Annual Conference*, Brisbane, 26–29 November.
- Glen, A & Dickman, C 2008, 'Niche overlap between marsupial and eutherian carnivores: does competition threaten the endangered spotted-tailed quoll?', *Journal of Applied Ecology: ecology with management relevance*, vol. 45, no. 2, pp. 700–7.
- Glen, AS, Dickman, CR, Soulé, ME & Mackey, BG 2007, 'Evaluating the role of the dingo as a trophic regulator in Australian ecosystems', *Austral Ecology*, vol. 32, no. 5, pp. 492–501.
- Harden, R 1985, 'The ecology of the dingo in north-eastern New South Wales. I. Movements and home range', *Australian Wildlife Research*, vol. 12, pp. 25–38.
- Hargrave, TJ & Van De Ven, AH 2006, 'A collective action model of institutional innovation', *The Academy of Management Review*, vol. 31, no. 4, pp. 864–88.
- Horowitz, MJ, Wilner, M & Alvarez, W 1979, 'Impact of Events Scale: a measure of subjective stress', *Psychomatic Medicine*, vol. 41, no. 3, pp. 209–18.
- Hytten, KF & Burns, GL 2007, 'Deconstructing dingo management on Fraser Island, Queensland: the significance of social constructionism for effective wildlife management', *Australasian Journal of Environmental Management*, vol. 14, no. 1, pp. 48–62.
- Jennens, G 2002, *Domestic dog attacks on sheep in the urban fringe areas of Perth, Western Australia*, PhD thesis, Murdoch University, Perth.
- Johnson, C & Van Der Wal, J 2009, 'Evidence that dingoes limit abundance of a mesopredator in eastern Australian forests', *Journal of Applied Ecology*, vol. 46, pp. 641–6.
- Johnson, C, Isaac, J & Fisher, D 2007, 'Rarity of a top predator triggers continent-wide collapse of mammal prey: dingoes and marsupials in Australia', *Proceedings of the Royal Society B*, vol. 274, pp. 341–46.
- Johnston, MJ & Marks, CA 1997, *Attitudinal survey on vertebrate pest management in Victoria*, Department of Natural Resources and Environment, Agriculture Victoria, Melbourne.
- Keen, K 2011, *Human dimensions of dingo and wild dog management in Victoria*, Honours thesis, Deakin University, Melbourne.
- Kennedy, M, Phillips, B, Legge, S, Murphy, S & Faulkner, R 2012, 'Do dingoes suppress the activity of feral cats in northern Australia?', *Austral Ecology*, vol. 37, pp. 134–9.
- Lane, M, Dale, A & Taylor, N 2000, 'Social assessment in natural resource management: promise, potentiality and practice', in A Dale, N Taylor & M Lane (eds), *Institutionalising social assessment in resource management*, CSIRO Publishing, Melbourne.
- Lesslie, RG, Hill, MJ, Hill, P, Cresswell, HP & Dawson, S 2008, 'The application of a simple spatial Multi-Criteria Analysis Shell to natural resource management decision making', in C Pettit, W Cartwright, I Bishop, K Lowell, D Pullar & D Duncan (eds), *Landscape analysis and visualisation: spatial models for natural resource management and planning*, Springer, Berlin, pp. 73–96.

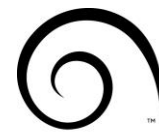


- Lightfoot, C 2010, *Social benefit cost analysis: wild dog management in Victoria*, Department of Primary Industries, Victorian Government, Melbourne.
- Litchfield, C & Smith, B 2009, 'A review of the relationship between indigenous Australians, dingoes (*Canis dingo*) and domestic dogs (*Canis familiaris*)', *Anthrozöos*, vol. 22, pp. 111–28.
- Littlejohn, EJK & Marshall, P 2011, *AWI Position statement: wild dogs in Australia in 2011*, AWI, Sydney.
- Lubell, M, Schneider, M, Scholz, JT & Mete M 2002, 'Watershed partnerships and the emergence of collective action institutions', *American Journal of Political Science*, vol. 46, no. 1, pp. 148–63.
- Marshall, G 2005, *Economics for collaborative environmental management: renegotiating the commons*, Earthscan, London.
- Marshall, G 2008, 'Nesting, subsidiarity, and community-based environmental governance beyond the local level', *International Journal of the Commons*, vol. 2, no. 1, pp. 75–97.
- Marshall, G 2013, 'Transaction costs, collective action and adaptation in managing complex social–ecological systems', *Ecological Economics*, vol. 88, pp. 185–94.
- McLeod, R 2004, *Counting the cost: impact of invasive animals in Australia 2004*, Pest Animal Control Cooperative Research Centre, Canberra.
- Mitchell, B & Balogh, S 2007, *Monitoring wild dog abundance*, Department of Industry and Investment, New South Wales, Orange.
- Murphy, EC, Eason, CT, Hix, S & Macmorran, DB 2007, 'Developing a new toxin for potential control of feral cats, stoats, and wild dogs in New Zealand', paper presented to *Managing vertebrate invasive species: proceedings of an international symposium*, Fort Collins, CO.
http://www.aphis.usda.gov/wildlife_damage/nwrc/symposia/invasive_symposium/content/Murphy469_473_MVIS.pdf
- Natural Resource Management Ministerial Council 2007, *Australian Pest Animal Strategy—a national strategy for the management of vertebrate pest animals in Australia*, Commonwealth Government, Canberra.
- Newsome, AE 2001, 'The biology and ecology of the dingo', in CR Dickman & D Lunney (eds), *Proceedings of a symposium on the dingo*, Royal Zoological Society of New South Wales, Sydney, pp. 20–3.
- Newsome, TM, Ballard, G-A, Dickman, CR, Fleming, PJS & Van de Ven, R 2013, 'Home range, activity and sociality of a top predator, the dingo: a test of the Resource Dispersion Hypothesis', *Ecography*, vol. 36, issue 8, pp. 914–25.
- Norris, A, Henderson, W, McMahon, S & Murphy, E 2006, 'Costing the impacts of invasive animals', Proceedings of the Invasive Animals Cooperative Research Centre workshop on social, economic and environmental impacts, Invasive Animals Cooperative Research Centre, Canberra.
- Oliver, P 1984, '"If you don't do it, nobody else will": active and token contributors to local collective action', *American Sociological Review*, vol. 49, no. 5, pp. 601–10.
- Oskarsson, M, Klütsch, C, Boonyaparakob, U, Wilton, A, Tanabe, Y & Savolainen, P 2011, 'Mitochondrial DNA data indicate an introduction through mainland Southeast Asia for Australian dingoes and Polynesian domestic dogs', *Proceedings of the Royal Society Biological Sciences*, vol. 279 (1730), pp. 967–74.
- O'Toole, K 2012, Morning Show, ABC Darwin, Darwin, 19 July, Radio segment notes,
<http://www.mediaportal.com.au/app/NewsFeedContent.aspx?Page=Search>



- Owen, J 1993, *Program evaluation, forms and approaches*, Allen and Unwin, Sydney.
- Paroo Shire Council 2011, *Paroo model of wild dog control*, South West Regional Economic Development Association Inc., Queensland.
- Phillips, A & Hunt, K 2011, 'Wild dogs on the increase in Queensland' ABC Rural, 13/9/2011, <http://www.abc.net.au/rural/news/content/201109/s3316431.htm>
- Poteete A & Ostrom E 2004, 'Heterogeneity, group size and collective action: the role of institutions in forest management', *Development and Change*, vol. 35, issue 3, pp. 435–61.
- Primary Industries and Resources South Australia 2011, *Policy on management of dingo populations in South Australia*, Primary Industries and Resources South Australia, available at http://www.pir.sa.gov.au/_data/assets/pdf_file/0003/137478/SA_NRM_Act_Dingo_Policy_2011.pdf [Accessed 6 July 2012]
- Reason, P & Bradbury, H (eds) 2001, *The SAGE handbook of action research. Participative inquiry and practice*, 1st Edition, Sage, London.
- Reed, J 2007, *Appreciative inquiry: research for change*, Sage, Thousand Oaks, London and New Delhi.
- Robertshaw, J & Harden, R 1989, 'Predation on Macropodoidea: a review', in G Grigg, P Jarman & I Hume (eds), *Kangaroos, wallabies and rat-kangaroos, vol. 2*, Surrey Beatty & Sons, Sydney, pp. 735–53.
- Robinson, C, Smyth, D & Whitehead, P 2005, 'Bush tucker, bush pets, and bush threats: cooperative management of feral animals in Australia's Kakadu National Park', *Conservation Biology*, vol. 19, no. 5, pp. 1385–91.
- Robley, A, Woodford, L, Lee, P, Kingston, V, Peters, W, Klippell, D & Gormley, A 2009, *Assessing the effectiveness of ground-based baiting for the control of wild dogs*, Arthur Rylah Institute for Environmental Research, Melbourne.
- Rose, B 2007, *Rose Report Two: Aboriginal perceptions of land management issues*, Central Land Council, Alice Springs.
- RSPCA 2010, 'What does the RSPCA think about the trapping of wild dogs?', viewed 2 August 2012, http://kb.rspca.org.au/What-does-the-RSPCA-think-about-the-trapping-of-wild-dogs_145.html
- 2011, 'What is the RSPCA's view on using 1080 for pest animal control?', RSPCA, viewed 2 August 2012, http://kb.rspca.org.au/What-is-the-RSPCA's-view-on-using-1080-for-pest-animal-control_141.html
- Rural Management Partners 2004, *Economic assessment of the impact of dingoes/wild dogs in Queensland*, LP02/03NRM, Department of Natural Resources and Mines, Queensland Government, Brisbane.
- Russell, D 2006, 'Australia's archetypal wild dog and the sheep that cannot be protected: a phenomenological study of impossible management', paper presented to *Third Art of Management and Organisation Conference*, Akademia Pedagogiczna, Krakow.
- Rydin Y & Pennington, M 2000, 'Public participation and local environmental planning: the collective action problem and the potential of social capital', *Local Environment*, vol. 5, no. 2, pp. 153–69.
- Schirmer, J & Casey, AM 2005, *Social assessment handbook. A guide to methods and approaches for assessing the social sustainability of fisheries in Australia*, Bureau of Rural Sciences, Canberra.

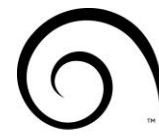
PROJECT FINAL REPORT



awil Australian Wool
Innovation Limited

- Schmeer, K 1999, *Section 2: Stakeholder analysis guidelines*, World Health Organization, Washington DC.
- Scriven, M 1991, *Evaluation thesaurus*, 4th edn, Sage, Newbury Park, CA.
- Sharp, T & Saunders, G 2004, *DOG001 Trapping of wild dogs using padded-jaw traps*, Department of Environment and Heritage, Australian Government, Canberra.
- Slovic, P 1987, 'Perception of risk', *Science*, vol. 236, no. 4799, pp. 280–5, doi: 10.1126/science.3563507.
- Soulé, M, Bolger, D, Alberts, A, Wright, J, Sorice, M & Hill, S 1988, 'Reconstructed dynamics of rapid extinctions of chaparral-requiring birds in urban habitat islands', *Conservation Biology*, vol. 2, pp. 75–92.
- Southwell, D, McCowen, S, Mewett, O & Hennecke, B 2011, *Understanding the drivers and barriers towards adoption of innovative canid control technologies: a review*, ABARES, Canberra.
- Southwell, D, Boero, V, Mewett, O, McCowen, S & Hennecke, B 2013, 'Understanding the drivers and barriers to participation in wild canid management in Australia: implications for the adoption of a new toxin, para-aminopropiophenone', *International Journal of Pest Management*, vol. 59, no. 1, pp. 35–46.
- Start, D & Hovland, I 2004, *Tools for policy impact: a handbook for researchers*, Overseas Development Institute, London.
- Stephens, D 2011, *The molecular ecology of Australian wild dogs: hybridisation, gene flow and genetic structure at multiple geographic scales*, University of Western Australia, Perth.
- Supreme Court of Victoria 2001, *Stockwell v State of Victoria*, Supreme Court of Victoria, Melbourne.
- Thomson, PC 1992, 'The behavioural ecology of dingoes in north-western Australia. IV. Social and spatial organisation, and movements', *Wildlife Research*, vol. 19, no. 5, pp. 543–63.
- TNS Social Research 2006, *Attitudes towards animal welfare: a research report. Prepared for the Department of Agriculture, Fisheries and Forestry*, Department of Agriculture, Fisheries and Forestry, Australian Government, Canberra.
- Trigger, D 2008, 'Indigeneity, ferality, and what "belongs" in the Australian bush: Aboriginal responses to "introduced" animals and plants in a settler-descendant society', *Journal of the Royal Anthropological Institute*, vol. 14, pp. 628–43.
- Trigger, D, Mulcock, J, Gaynor, A & Toussaint, Y 2008, 'Ecological restoration, cultural preferences and the negotiation of "nativeness" in Australia', *Geoforum*, vol. 39, pp. 127–383.
- Vanclay, F 2003, 'International principles for Social Impact Assessment', *Impact Assessment and Project Appraisal*, vol. 21, no. 1, pp. 5–11.
- Walters, C 1986, *Adaptive management of renewable resources*, Macmillan, New York.
- White, M & Marsh, E 2006, 'Content analysis: a flexible methodology', *Library Trends*, vol. 55, no. 1, pp. 22–45.
- Wicks, S & Allen, B 2012, 'Returns on investment in wild dog management—beef production in the South Australian Arid Lands' (Conference paper 12.3), *56th Australian Agricultural and Resource Economics Society (AARES) Conference*, 7–10 February 2012, Fremantle.

PROJECT FINAL REPORT



awil Australian Wool
Innovation Limited

Young, OR, Osherenko, G, Ekstrom, J, Crowder, LB, Ogden, J, Wilson, JA, Day, JC, Douvère, F, Ehler, CN, McLeod, KL, Halpern, BS & Peach, R 2007, 'Solving the crisis in ocean governance: place-based management of marine ecosystems', *Environment: Science and Policy for Sustainable Development*, vol. 49, no. 4, pp. 20–32.