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Wild dog management 2010 to 2014 National landholder survey results

Bill Binks, Robert Kancans & Nyree Stenekes

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Department of Agriculture

Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES)

Postal address GPO Box 858 Canberra ACT 2601 Switchboard +61 2 6272 3933 Email <u>info.abares@agriculture.gov.au</u> Web <u>agriculture.gov.au/abares</u>

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Summary

Wild dogs (including dingoes, feral domestic dogs and hybrids) and foxes are considered major pests in a significant portion of mainland Australia, because of their attacks on livestock. This has a detrimental effect on the agricultural sector, landholders and their families and the environment and is a complex problem being faced by landholders and others in their communities. Regional management groups play an important role in cost effective action to manage wild dogs across the landscape, particularly in terms of landholder participation and collaboration.

This report follows an ABARES study for Australian Wool Innovation (AWI) that examined the nature of groups undertaking wild dog management and the support they may need in future to achieve effective management (Ecker et al. 2015). This study adds further knowledge on collective action in invasive species and natural resource management by examining temporal and spatial change in the impacts and management of wild dogs. It combines results from two national surveys of sheep and cattle landholders, conducted in 2014 and in 2010. It is the final phase in a research package funded by AWI, 'Wild dog management in Australia—a landscape approach to management, including pests, people and place'.

The objectives of the project are to:

- 1) examine landholders' perspectives on changes in wild dog problems and severity, personal and financial impacts, control methods and attitudes to management, between 2010 and 2014.
- 2) provide further understanding of factors influencing wild dog management group functioning and effectiveness, from the perspective of landholders involved in wild dog management groups.

The survey implemented in 2014 was based on a similar survey undertaken by ABARES in 2010, to enable longitudinal change to be assessed; and was expanded in order to explore group functioning and effectiveness. The survey was developed in consultation with AWI, to inform development of programmes and strategies supporting communities affected by wild dog problems. The target population for the survey—sheep and cattle industries in wild dog affected areas—represents 17 per cent of total Australian farms in these industries. The survey response rate was 46 per cent (n=1 010), which provides coverage at the national level that is statistically representative of the target population.

Key findings

Wild dog problems and impacts

In 2014, 71 per cent of surveyed landholders in wild dog affected areas knew of wild dog attacks occurring in their area and 67 per cent reported having a wild dog problem on their own property. Twenty-six per cent of landholders in the areas surveyed rated the wild dog problem on their property as severe or extremely severe.

Variation in severity

Awareness and severity of the wild dog problem varied across and within states and territories. Awareness of wild dog attacks in their area was highest for landholders in the Northern Territory (NT) and Queensland and lowest in South Australia (SA). Seventy five per cent of landholders in the NT rated the wild dog problem on their property as severe or extremely severe; this figure was 34 per cent in Queensland and 24 per cent in Western Australia (WA). Landholders with properties along the Great Dividing Range in New South Wales (NSW) and Victoria also rated their wild dog problem as severe. Severity of problems was comparatively lowest in SA, where 13 per cent of landholders surveyed rated them as severe or extremely severe. There was considerable variability in landholders' rating of wild dog problems within a single region, local area, and even within the same property.

Landholders with properties in close proximity to national parks and state forests reported a higher severity of wild dog problems than those with properties not located in those areas—and this was especially the case in NSW, Victoria and SA.

Severity ratings were broadly similar in 2010 and 2014 for those landholders surveyed in both years, although a slightly greater proportion rated the severity of wild dog problems on their property as moderate rather than minor, in 2014 compared with 2010. The proportion of landholders who rated their wild dog problem as severe was similar in both years. Further, landholders' views on change in severity in the years preceding each survey suggest wild dog problems have stabilised somewhat. In 2014, a smaller proportion of landholders thought the problem on their property had become more severe, and a greater proportion thought it had stayed the same, compared with the proportions in 2010. The proportion of landholders reporting the problem was less severe has remained the same.

The most common view across the areas surveyed was that wild dog problem severity had stayed the same between 2010 and 2014, however in Queensland and the Northern Territory a higher proportion of landholders reported it had increased. Victoria had the highest proportion of landholders reporting lessening wild dog problems.

Financial and personal impacts

Reported stock losses because of wild dogs in 2014 over a 12 month period were highly variable. In surveyed wild dog affected areas nationally, sheep losses per property as a proportion of current stock averaged eight per cent, with higher rates in Queensland and Victoria, and lower rates in SA and NSW. Cattle losses as a proportion of current stock averaged two per cent per property nationally, with higher rates in SA and the NT. Young sheep and cattle less than 12 months old are highly vulnerable to wild dog predation: nationally 66 per cent of all sheep killed and 91 per cent of all cattle killed were aged less than 12 months.

Beyond the loss of livestock through wild dog predation, landholders reported flow-on production and personal impacts. A reduction in lambing or calving rate was reported by around 42 per cent of surveyed landholders in wild dog affected areas in 2014, while 20 per cent were concerned about the viability of their business, and 12 per cent had changed stock composition. Around 10 per cent of landholders reported they had either left, or were thinking of leaving the wool industry, because of the presence of wild dogs. A number of landholders described how they had moved out of sheep into cattle production because wild dog problems had made running sheep unviable. Landholders were personally affected by wild dogs, leaving them angry (30 per cent) and distressed (16 per cent).

Production and personal impacts remained fairly similar between 2010 and 2014. Notable changes were a smaller proportion of landholders reporting reduced lambing and calving rates and an increase of 8 percentage points in the number of landholders considering leaving the industry because of wild dogs, in 2014.

Wild dog management

Overall, 88 per cent of surveyed landholders in wild dog affected areas reported taking actions to manage wild dogs and/or foxes. For those with no wild dog or fox problems on their property, 45 per cent still indicated they take management actions.

The time involved in managing wild dogs is significant for many landholders. On average, landholders in wild dog affected areas are spending 26 days and \$7 197 a year on wild dog management. For many landholders, management is a constant task, being vigilant every day, especially during lambing season. Management costs, which can be a significant financial impost for landholders, included baiting, trapping, shooting, materials, paid contractors, fencing, compulsory pest control levies and rates.

The primary reason for undertaking wild dog management was to reduce stock losses, followed by supporting other landholders in their area. Landholders' main reasons for not managing wild dogs, other than in situations where problems are not great enough, were time constraints and not having effective control methods. While stock losses remained the predominant reason for undertaking management, there was a particular increase in the reason 'because of the impacts wild dog/foxes have on native wildlife'. There was also a notable decrease in 2014 in the proportion of landholders who see management as 'not their responsibility', from 15 per cent in 2010, to 3 per cent.

Control methods

In wild dog affected areas in 2014, shooting, ground baiting, and trapping were the most common wild dog/fox control methods used by landholders, wild dog management groups and government, although government was reported as undertaking more aerial baiting and less shooting. There were some notable differences in methods between states, with a much lower usage of ground baiting on properties in Victoria. Landholders in Queensland, WA and NSW reported higher usage of trapping and aerial baiting on their properties than in other states. Use of exclusion fencing and guard animals by landholders was more common in Victoria than elsewhere.

Between 2010 and 2014 in wild dog affected areas surveyed, there was: a decrease reported in the usage of ground baiting (from 81 to 69 per cent); an increase reported in government action across all control methods; and an increase in all control methods being employed by groups, particularly trapping and exclusion fencing.

A key message from landholders was that a combination of control techniques is the most effective way of managing wild dogs, most commonly combining ground or aerial baiting, with trapping and/or shooting, which are often used for follow up management in targeted areas such as water points. While baiting was the most mentioned specific method overall, a range of problems with baiting were raised:

- it is losing effectiveness because dogs learn not to take baits
- the amount of poison in baits is not strong enough
- there are off-target deaths of domestic and working dogs that are valuable to landholders
- deaths of native animals that take baits
- the complexity (red tape) of obtaining baiting permits, and problems with accessibility to baits, with different levels of support available across jurisdictions.

Effectiveness of management actions

Nationally, in wild dog affected areas around 55 per cent of landholders rated the overall wild dog management actions undertaken by all stakeholders in their area as 'moderately effective' to 'very effective'. Around 31 per cent thought overall management was not or only 'a little' effective. In Queensland, South Australia and Northern Territory landholders were more likely to report wild dog management actions as moderately or very effective. Those in Victoria indicated the highest level of uncertainty while landholders in Western Australia gave the lowest ratings of effectiveness. Between 2010 and 2014 there was an increase in landholders rating overall actions in their area as relatively effective, from 48 up to 60 per cent. While in many areas problems may be serious or at the same level, improved effectiveness of regional management may be contributing to helping stabilise wild dog problems.

Nationally, landholders in wild dog management groups rated the overall effectiveness of management actions in their area more highly than those not in wild dog management groups. Those not in groups were more likely to be unsure about the effectiveness of actions in their area.

Improvements in management

Landholders nationally reported that the most important action that would improve overall management was more management actions on public land, rated by more than 90 per cent as important or very important. Achieving coordination, cooperation and strategic alignment in baiting across landholder types was a key issue, and this is especially relevant to national and state parks. More action on public land was followed in importance by government support to apply different technologies. More effective baiting programmes, improved cooperation between public and private land managers and more accessibility to baits and bait injecting services (particularly in NT) were also seen as highly important. In Victoria the need to relax legislation on trapping was highlighted. Greater use of bounties and putting resourcing into fencing were raised as further actions that would improve management.

Wild dog management groups—activities and outcomes

The survey identified approximately 120 wild dog management groups operating across Australia in wild dog affected areas. Some are highly formalised being incorporated, while others are a loosely connected group of neighbours. Most groups have two or three stakeholder groups represented, most frequently sheep and/or cattle producers, government agencies, and other landholders. Other than organising dog control actions, sourcing funding and developing management plans are the most important group activities. The majority of landholders reported these features of how their group functions:

- good levels of participation and motivation
- decision-making and cooperation among group stakeholders were functioning well
- long-term funding is an issue
- access to specialist skills is adequate
- linkages and relationship with government and industry were established and functional.

Analysis was undertaken to identify core components of group effectiveness and determine how strongly they contribute to outcomes of a group, in terms of: reducing the wild dog problem in the area of the group's operation; and providing better support for landholders who are affected by wild dogs. Two key components were identified representing effectiveness: internal group function; and resources and support. A regression analysis identified that wild dog management

groups with positive internal group functioning and access to adequate resources and support contribute to achieving a reduction in the wild dog problem. In addition, if groups have access to adequate resources and support, it improves the group's ability to provide better support for landholders affected by wild dogs.

These results provide guidance on where effort and investment could be directed, that is towards supporting wild dog management groups through:

- securing long-term funding
- strategic planning, and access to specialist skills (for example mapping, surveying, data collection and monitoring), knowledge and scientific research
- building relationships with industry and government agencies
- encouraging positive internal group function in terms of participation, decision-making and cooperation.

Project outcomes

Key outcomes of this study are:

- a collection in 2014 of national scale data on wild dog impacts and management that is representative of sheep and cattle landholders in areas affected by wild dogs. The report contains findings and analysis of longitudinal change that can inform AWI initiatives and programmes supporting communities in wild dog management
- a detailed dataset combining two surveys that is available to be explored in further depth in specific regions or case study areas, if required. The dataset includes impacts and management of foxes
- an up-to-date understanding of wild dog impacts and issues, and findings of broader interest for the Australian Government on pest animal management and implications for livestock industry productivity
- development of a refined survey tool that measures components of group functional effectiveness and outcomes for wild dog management. This can be used to build longitudinal data collections in future.

1 Introduction

Wild dogs (including dingoes, feral domestic dogs and hybrids) and foxes are considered major pests in a significant portion of mainland Australia, because of their attacks on livestock (Southwell et al. 2013 and West 2008). This has a detrimental effect on the agricultural sector, individual landholders and the environment, and is a complex problem being faced by landholders and their communities. Regional management groups play an important role in cost effective action to manage wild dogs and foxes across the landscape, particularly in terms of landholder participation and collaboration. The extent to which coordinated and effective pest management can occur depends significantly on the capacity of these regional groups and their access to resources.

In 2013, Australian Wool Innovation (AWI) commissioned ABARES to undertake a research project examining the nature of groups undertaking wild dog management—and the support they may need in future to achieve effective management (Ecker et al. 2015). That study contributed to the knowledge base regarding factors that help or hinder collective action in invasive species and natural resource management. The current study aims to build on this knowledge by providing information on temporal and spatial changes in the impacts and management of wild dogs.

These two projects are part of a research package funded by AWI— 'Wild dog management in Australia—a landscape approach to management, including pests, people and place'—which consisted of three phases as outlined in Figure 1. The research aims to assist AWI and other stakeholders design and plan future investment in wild dog management programmes in order to support the wool industry and wool producer viability.



Figure 1 Project phases

Note: a Survey covered states and territories except Tasmania and Australian Capital Territory. b The 2010 survey was undertaken by ABARES for the Invasive Animals Cooperative Research Centre.

Objectives

In 2010, AWI commenced a programme supporting landholders to manage wild dogs, including supporting and establishing community groups, and therefore has an interest in monitoring changes and the effectiveness of wild dog/fox interventions. National surveys are a suitable approach to tracking change.

The objectives of this third and final phase of the project are to:

- examine landholders' perspectives on changes in wild dog problems and severity, personal and economic impacts, control methods and attitudes to management, between 2010 and 2014
- 2) provide further understanding of factors influencing wild dog management group functioning and effectiveness, from the perspective of landholders involved in wild dog management groups.

Research method and key questions

This report combines results from two national surveys of livestock landholders, undertaken by ABARES in 2010 and 2014. The 2010 wild dog and fox management survey was undertaken for the Invasive Animals Cooperative Research Centre (CRC) to support work on the drivers and barriers to the uptake of new technologies such as the toxicant para-amninopropiophenone (PAPP). The 2010 survey also investigated landholder perceptions of wild dog and fox severity, social and economic impacts and management actions taken by landholders, government and wild dog management groups.

The 2014 survey, supported by AWI, replicated the 2010 survey as much as possible to enable longitudinal analysis of change in wild dog severity, social and economic impacts, control methods and management actions of landholders, government and wild dog management groups. The approach used to collect data in 2014 was a paper based mail survey sent to landholders involved in livestock production in wild dog affected areas across Australia, based on 2007 distribution data. The target population for the survey represents 17 per cent of total Australian farms across sheep, beef, and mixed livestock/cropping production. For further details about the approach, see Appendix A: Methods.

The survey was focused on the following research questions, which were developed in consultation with AWI:

- how has wild dog predation on livestock changed over time?
- how have landholder perspectives of wild dog impact and management changed?
- how have wild dog management (control methods) and outcomes changed over time?
- what are the structure, function and activities of wild dog management groups in which landholders are involved?
- what have been the outcomes of activities (for example reduced predation, increased skills and knowledge, better collaboration)?
- what have been the most effective actions, initiatives and management structures to support land managers affected by wild dogs?

In addition to providing longitudinal data, the 2014 survey has built on findings from the participatory study (see Figure 1) to further investigate and quantify the functioning and effectiveness of wild dog management groups.

Report structure

Chapter 2 of this report describes the survey results in detail and includes a number of national maps. The survey results are presented in four sections: the survey respondents; scale and impact of wild dog problems; management activities and effectiveness; and wild dog management group activities and outcomes. At the end of each section is a comparison of 2010 and 2014 survey results to track change that has occurred in relation to each topic. Chapter 3 summarises the key findings and overall project outputs. The Appendices provide more information on the sample frame and survey method (Appendix A) and statistical analyses (Appendix B).

Background information about wild dogs and social issues in collective management are covered in detail in the literature review (Thompson et al. 2013) and participatory study report (Ecker et al. 2015) and is not repeated here.

2 Results

Survey respondents

The survey covered 1 010 properties with sheep, cattle or both. This mixture reflects the industry classes used in the sample selection. While the project focuses on producers in the wool/sheep industry, survey results are also reported for cattle landholders. Wild dog problems range across farming enterprises and land tenures and require coordinated action by all landholders; and there are indications that some landholders have changed from sheep to cattle because of wild dog attacks. Map 1 shows the distribution of survey respondents across Australia. Parts of Queensland and the Outback region of northern South Australia had the highest numbers of respondents, with more than 10 in an SA1 unit (see Glossary).

Map 1 Survey coverage and respondent numbers, 2014



Note: Coverage for the survey frame and sample were based on coincidence of sheep and beef farming industries and spatial distribution of wild dogs (Invasive Animals CRC 2007). This surveyed target population represents 17 per cent of total Australian farms across sheep, beef, and mixed livestock/cropping. Respondent numbers are presented at the SA1 geographic scale (Statistical Area Level 1 – see Glossary) Source: ABARES

Eighty-three per cent of respondents were male with an average age of 56 years, and 86 per cent were the owners of the property. Half of the landholders surveyed reported their property as within close proximity to a national park and/or state forest (Table 1).

Proportion male		Proportion owner- operator a	Mean age b	Close proximity to national park/ state forest c	
	%	%	years	%	
All respondents	83	86	56	50	

Notes: **a** Other than owner operators, remaining respondents were managers or employees (13 per cent), or lessees and partners of owners (less than 1 per cent). **b** Age of respondents ranged from 22 to 86. **c** 'close proximity' was not defined in the survey.

Source: ABARES survey 2014

Property characteristics

The size of properties surveyed ranged from 14 hectares to 2.02 million hectares. Nationally, the median size of properties surveyed was 2 930 hectares, with the smallest property sizes in Victoria and the largest in the Northern Territory (Table 2).

	unit	NSW	VIC	QLD	SA	WA	NT	Australia a
Total surveyed properties	no.	211	228	230	139	124	73	1 010
Median property size	ha	1 092	459	21 039	4 639	40 170	162 700	2 930
Property numbers by stock on property b								
Sheep, 1 - 300	no.	20	41	15	4	6	1	88
Sheep, 301 - 2000	no.	39	45	6	36	13	0	139
Sheep, 2001 - 6000	no.	43	21	12	43	34	0	153
Sheep, above 6000	no.	30	14	8	34	9	0	96
Sheep (all)	no.	132	121	41	117	62	1	476
Cattle, 1 - 300	no.	100	97	14	34	17	3	265
Cattle, 301 - 2000	no.	86	107	101	22	20	13	352
Cattle, 2001 - 6000	no.	10	7	61	13	23	26	141
Cattle, above 6000	no.	0	0	43	5	17	27	92
Cattle (all)	no.	196	211	219	74	77	69	850
Goats, 1 - 300	no.	1	5	3	1	2	2	15
Goats, 301 - 2000	no.	2	0	5	0	3	0	10
Goats, above 2000	no.	3	0	1	2	1	0	8
Goats (all)	no.	6	5	9	3	6	2	33

Table 2 Size and stock characteristics of properties surveyed, by state, 2014

Note: Small numbers of other stock including horses, camels, deer and alpacas are excluded from this summary. **a** Summed property numbers by jurisdiction differ to the Australian total shown because landholders on 5 properties did not disclose a location. **b** Ten properties had zero stock or did not report any stock. Source: ABARES survey 2014 Cattle were the most common type of livestock on properties, reported on 850 of the 1 010 properties surveyed. The most common cattle herd size nationally was between 300 and 2 000 head, with more properties with larger herds in Queensland, the Northern Territory and Western Australia. Sheep were reported on 476 properties. Nationally the most common flock size was between 2 000 and 6 000, with most properties with more than 6 000 sheep in New South Wales and South Australia (Table 2). Goats were also important on some properties. All properties with goats also had either sheep or cattle. Other stock reported included horses, camels, deer and alpacas. Many properties surveyed had a mixture of sheep and cattle, as shown in Figure 2. Around half of the surveyed properties had cattle only (510 properties or 50 per cent). A smaller proportion had sheep only (13 per cent) and 34 per cent had both sheep and cattle.

In the following sections, selected results are presented for properties with any sheep (and including cattle) and for properties with cattle only.



Figure 2 Breakdown of surveyed properties (counts) by current livestock composition, national, 2014

The properties surveyed in New South Wales, Victoria and South Australia had substantially higher sheep than cattle numbers. In the Northern Territory, cattle were the predominate stock (Figure 3).



Figure 3 Mean stock numbers per property, by state, 2014

2010 to 2014 comparisons

For the group of landholders surveyed in both years (the longitudinal cohort of 234 landholders), there was a small increase in the mean number of cattle carried per property, and a small decrease in the mean number of sheep carried. There was also a slight increase in the number of properties carrying cattle and a slight decrease in the number of properties carrying sheep (Table 3). In both years, around one third of the properties surveyed carried both sheep and cattle and around 50 per cent had only cattle.

		2010		2014
	Number of properties	Mean livestock no.	Number of properties	Mean livestock no.
Cattle	191	2 043	200	2 213
Sheep	116	3 845	113	3 266
Goats	15	1 097	11	1 178

Table 3 Livestock numbers on properties surveyed, longitudinal tracking

Note: Total longitudinal cohort surveyed, n=234. Number of properties and means are for properties reporting numbers of that stock in respective survey year.

Source: ABARES surveys

Scale and impact of wild dog problems

Landholders were asked about their awareness of wild dog and fox attacks in their area and how they knew about attacks. They were asked to rate the severity of wild dog and/or fox problems on their property and how these problems, if any, had changed over the previous four years.

Awareness

In the surveyed areas nationally, 71 per cent of landholders reported they knew of wild dog attacks occurring in their area, compared with 52 per cent who reported knowing of fox attacks in their area. The term 'your area' was not defined. The highest knowledge of wild dog attacks was in the Northern Territory where 99 per cent of respondents knew of wild dog and fox attacks, followed by Queensland with 91 per cent. Knowledge of attacks in the area was lowest in South Australia, with 46 per cent (Figure 4).



Figure 4 Knowledge of attacks in area, national, 2014

In South Australia and Victoria, landholders more commonly knew of fox attacks than wild dog attacks. Landholders located in close proximity to national parks were more likely to report knowing of wild dog attacks in their area (77 per cent) than those not near parks (65 per cent).

The largest proportion of respondents (71 per cent) knew of attacks in the area because they occurred on their own property; these landholders had witnessed attacks or seen evidence such as dead/injured stock or bites. Others knew via their neighbours, observing attacks on other properties and through the media (Figure 5). Local wild dog coordinators, dog trappers, dog fence board and NRM groups were other sources of knowledge about attacks.



Figure 5 Source of knowledge of attacks, national, 2014

Note: Covers knowledge of wild dog and/or fox attacks in landholder's area.

2010 to 2014 comparisons

For the group of landholders surveyed in both years, knowledge of wild dog attacks in their area has remained at similar levels, at around three quarters of the landholders (Table 4). The longitudinal cohort were slightly more likely to know of wild dog attacks than were the entire sample of landholders surveyed in both years (72 per cent in 2010, and 71 per cent in 2014), which suggests people who participate in consecutive surveys may also be more likely to have heightened awareness of, or interest in wild dog attacks and their impacts. Knowing about attacks by seeing them on other properties has increased slightly, while knowing about them through attacks on their own property has decreased in 2014, compared with four years earlier.

Table 4 Knowledge of wild dog attacks in area, longitudinal tracking

	2010	2014
	%	%
Know of wild dog attacks	76	77
Source of knowledge of attacks a		
Attacks on own property	81	68
Observation of attacks on other properties	21	25
Through the media	16	18
Through neighbours	80	56

Note: Data in table are for landholders surveyed in both years (n=234). **a** In both years the question on how landholders knew of attacks in their area, applied to wild dogs/foxes in combination. Source: ABARES surveys

Severity of wild dog problems

Around 67 per cent of all landholders surveyed in 2014 reported having a wild dog problem on their property in the past 12 months. Problems were defined by a rating between minor and extremely severe. This question was separate to the one about knowledge of attacks in the area. Nationally across the areas surveyed, 26 per cent of landholders reported either a severe or extremely severe wild dog problem on their property (Figure 6). The proportion of landholders with a fox problem on their property was slightly lower at 64 per cent, and 15 per cent rated fox problems as severe or extremely severe. More than 30 per cent of landholders reported having either a wild dog or fox problem, but only around 11 per cent had no wild dog or fox problems at all. Problem severity was more likely to be rated as severe or extremely severe for wild dogs than for foxes.



Figure 6 Severity of wild dog and fox problems, national, 2014^a

Note: **a** Severity of problems rated by surveyed landholders, on their property. Landholders answering this question: n=941 (Wild dog problem); n=840 (Fox problem). Source: ABARES survey 2014

When data are related to livestock held, some differences are apparent in the reported severity of wild dog problems. This may be connected with the location of properties or individual landholders may rate problems on their property in different ways. For those properties with any sheep (and including cattle), 56 per cent reported a wild dog problem and 18 per cent rated it as severe or extremely severe (Figure 7).



Figure 7 Severity of wild dog problems on properties with sheep, national, 2014

Note: Landholders answering this question: n=411 properties with any sheep. Source: ABARES survey 2014

On properties with only cattle, 78 per cent of landholders reported a wild dog problem, and 32 per cent rated it as severe or extremely severe (Figure 8).



Figure 8 Severity of wild dog problems on properties with only cattle, national, 2014

Note: Landholders answering this question: n=499 properties with cattle only. Source: ABARES survey 2014

Nationally, landholders in close proximity to a national park and/or state forest were slightly more likely to report higher severity of wild dog problems on their property, than those landholders on properties not close to these national parks or state forests (Figure 9). The difference is more noticeable in Victoria, New South Wales and South Australia.

Figure 9 Degree of severity of wild dog problem, by property proximity to national park/state forests, by state, 2014



Note: Mean degree as rated by landholders between 1 (no problem) and 5 (extremely severe problem). Ratings of 'not sure' excluded. Landholders answering this question: n=469 close to parks; n=456 not close to parks. Source: ABARES survey 2014

Spatial distribution of wild dog problems

The distribution and severity of wild dog problems as assessed by landholders on their own property varies considerably across Australia (Map 2). Pockets of areas where problems were on average rated as most severe are in parts of the Northern Territory, Queensland and areas of the Great Dividing Range in Victoria. Aggregated across the Northern Territory, 75 per cent of landholders rated problems on their property as either severe to extremely severe. In Queensland, this figure was 34 per cent and in Western Australia, 24 per cent. South Australia had the lowest proportion of landholders who rated problems as severe to extremely severe (13 per cent).

Map 2 Wild dog problem rated by landholders, 2014



Note: Wild dog problem severity is mapped by SA1 geographic region (see Glossary), using the mean severity rating by landholders surveyed in the SA1 region. Ratings were between 1 (no problem) and 5 (extremely severe problem). Insets shown for Victoria and New South Wales detail—see Map 3 and Map 4. Source: ABARES



Map 3 Wild dog problem rated by landholders – Victoria detail

Map 4 Wild dog problem rated by landholders – New South Wales detail



2010 to 2014 comparisons

As a group, around 91 per cent of the longitudinal cohort surveyed had either a wild dog or fox problem on their property in 2014 compared with 81 per cent in 2010. A change in the specific wild dog problem between 2010 and 2014 cannot be reported as dogs and foxes were not reported separately in the 2010 survey. Severity ratings, however, were recorded separately for each pest in the surveys and wild dog problem ratings were broadly similar in both years (Table 5). A greater proportion of landholders rated the severity of wild dog problems on their property as moderate, and a smaller proportion rated the severity as minor, in 2014 compared with 2010. The proportion of the longitudinal cohort who rated their wild dog problem as severe was similar in both years.

Table 5 Severity of wild dog problems, longitudinal tracking^a

	2010	2014
Rating	%	%
Minor problem	36	27
Moderate problem	26	35
Severe problem b	35	37
not sure	2	1

Note: **a** Landholders answering this question: n=164 (2010), n=161 (2014). **b** For 2014 'Severe problem' combines landholders' survey ratings of 'severe' and 'extremely severe' problem.

Source: ABARES surveys

Changes in severity of wild dog problems

The 2014 survey asked landholders specifically about how the severity of problems on their property had changed, compared with four years earlier. This contrasts with the question reported above, where landholders gave a snapshot rating of the problem in each year.

Nationally, while 39 per cent of landholders reported wild dog problems had stayed the same compared with four years earlier, 35 per cent reported they had become more severe. Only 19 per cent reported they had become less severe (Figure 10). Fox problems had changed less, with a majority of landholders reporting they had stayed the same compared with four years earlier (54 per cent).



Figure 10 Perceived change in wild dog and fox problem severity to 2014, national

Note: Landholders answering this question: n=708 (Wild dog problem); n=601 (Fox problem). Landholders reported how severe problems had been on their property in the past 12 months, compared with four years earlier. Source: ABARES survey 2014

Map 5 indicates more specific areas of long term change according to SA1 geographies (see Glossary). There are areas within each state/territory, other than South Australia, where wild dog problems were reported as more severe compared with four years earlier. In some areas, there was considerable variation in the changes reported. Some landholders in the same SA1 region reported the problem had become less severe on one property and more severe on another. This might be the case because wild dog problems can vary between properties as a result of differences in geography, land use, wild dog management regimes, climate, and feed conditions, as well as variation in individuals' perceptions of change.

Map 5 Perceived change in wild dog problem severity to 2014



Note: Change in severity is mapped by SA1 geographic region, using the mean rating by landholders surveyed in the SA1 region. Ratings were either 1 (less severe), 2 (stayed the same) or 3 (more severe). Insets shown for Victoria and New South Wales detail—see Map 6 and Map 7. Source: ABARES survey 2014



Map 6 Perceived change in wild dog problem severity to 2014 – Victoria detail

Map 7 Perceived change in wild dog problem severity to 2014 – New South Wales detail



On a state basis, landholders in the Northern Territory and Queensland were more likely to report an increase in severity (47 and 42 per cent respectively) than those in other states compared with four years earlier. Landholders in Victoria appear to be achieving relative success with more landholders reporting wild dog problems as becoming less severe, than more severe. Western Australia also had a relatively higher proportion reporting lessening dog problems than other states (Figure 11). These data suggest that landholders rated wild dog problems as becoming more severe over the four years to 2014 in areas dominated by cattle production—Queensland and Northern Territory. In all other jurisdictions, the more common perception was that wild dog problems had stayed the same.



Figure 11 Perceived change in wild dog problem severity to 2014, by state

Figure 12 also reflects these differences, with landholders on properties with only cattle more likely to have reported worsening dog problems over the four years to 2014 than properties with sheep.



Figure 12 Reported changes in wild dog problem severity in four years to 2014, by stock composition

Note: Landholders answering this question: with sheep n=287, with cattle only n=403 Source: ABARES survey 2014

Note: Data for all properties; reported change in severity compared with four years earlier. Source: ABARES survey 2014

2010 to 2014 comparisons

Around 48 per cent of the longitudinal cohort of landholders surveyed in 2010 rated wild dog problems on their property as being more severe than in previous years. In 2014, however, a smaller proportion of these landholders thought the problem was more severe. A greater proportion thought problems had stayed the same in the years to 2014 than in the years to 2010 (Table 6). Overall, the mean score for change in severity was slightly lower in 2014 (2.2) than in 2010 (2.3).

These results suggest there has been a shift to stabilising, rather than worsening wild dog problems across this group of landholders. However, in many cases problems may remain the same and may be severe.

Table 6 Perceptions of change in wild dog problem severity from previous years, longitudinal tracking

	unit	2010 a	2014
Less severe	%	18	19
Stayed the same	%	34	41
More severe	%	48	39
'Change in severity' score $ {f c}$	mean rating	2.3	2.2

Note: Landholders answering this question: n=165 (2010 and 2014). a In the 2010 survey, landholders were asked to rate problems compared with 'previous years', while the 2014 survey asked them to rate problems compared with 2010. c Ratings for 'less', 'same' and 'more severe' were scored as 1, 2 and 3 respectively. Source: ABARES surveys

The results on severity—the comparisons at 2010 and 2014, as well as landholder perceptions of change over a number of years—show that wild dog problems have remained at broadly similar levels, although there are differences between states and territories and within regions.

Financial impacts and wild dog management inputs

The direct loss of and damage to stock was an important financial concern of landholders affected by wild dogs. The diversion of time and effort into wild dog management activities, and the expenses associated with these actions, were also important financial impacts.

Killed and injured stock

Stock losses can be severe but also highly variable between properties. The median number of stock killed was also higher for sheep (40) compared with cattle (11), for properties with a wild dog problem. Because flock and herd sizes vary between properties, a useful measure of the impact on a property basis is the percentage of current stock lost. Table 7 gives a summary of reported losses and injury rates for properties with a wild dog problem.

To describe numbers of stock lost or injured, some landholders wrote comments in the survey, such as 'unsure but would be many', 'too hard to say', or 'property too large to count'. In these cases, percentage losses could not be determined, but the property was counted as having had stock killed or injured. Some landholders described or quantified reductions in lambing and calving rates. These comments indicated that young stock in particular, both sheep and cattle, were prone to wild dogs attack.

On properties with wild dog problems, 82 per cent of landholders reported losing sheep to wild dogs or foxes and 58 per cent had lost cattle. Sheep losses as a proportion of current stock averaged 8 per cent per property across all areas surveyed, with the highest rates in Queensland (16 per cent) and Victoria (11 per cent), and lower rates in South Australia and New South Wales. Overall cattle losses as a proportion of current stock averaged two per cent per property across the areas surveyed, with higher rates in South Australia and the Northern Territory (Table 7).

Landholders in Queensland reported a relatively higher proportion of adult sheep killed, with only 43 per cent being less than 12 months old, compared with around 75 per cent in southern states. While sheep can be killed when older, cattle losses are more likely as calves, shown by the average figure of 91 per cent killed being less than 12 months old. In the Northern Territory, 17 per cent of cattle killed were more than 12 months, perhaps reflecting the high problem severity ratings there.

	NSW	VIC	QLD	SA	WA	NT	Australia
Killed stock b							
% landholders reported any sheep killed	86	89	76	67	83	100 f	82
Average % sheep killed (per property) ${f c}$	4	11	16	4	7	3 f	8
Average % sheep killed, under 12 months	59	74	43	75	81	100 f	66
% landholders reported any cattle killed	30	36	69	45	69	96	58
Average % cattle killed (per property) ${f c}$	2	1	1	4	1	3	2
Average % cattle killed, under 12 months	95	92	93	100	93	83	91
Injured stock							
% landholders reported any sheep injured	46	35	32	36	38	100 f	39
Average % sheep injured (per property) c	2	2	12	1	8	13 f	4
% landholders reported any cattle injured	16	21	69	26	56	86	49
Average % cattle injured (per property) ${f c}$	1	1	1	4	1	3	1
Management inputs							
Days a year spent on management actions $ {f d} $	24	28	20	21	32	44	26
Average annual property expenses for management actions (\$) e	3 975	3 526	7 625	4 902	9 096	14 903	7 197

Table 7 Financial impacts and management inputs for landholders with a wild dog problem, by state, 2014^a

Notes: **a** This table includes data only for landholders who reported having wild dog problems and excludes landholders who reported only a fox problem. Stock impacts cover losses resulting from wild dog and/or fox attacks in the past 12 months. **b** Stock killed includes those needing to be destroyed/euthanized. **c** % stock killed/injured on a property calculated from number reported killed or injured as a proportion of current stock, where these numbers were reported. **d** Excludes time spent by outside contractors. **e** Excludes family labour. **f** Northern Territory figures for sheep based on one surveyed property with sheep.

Source: ABARES survey 2014

Landholders noted how injuries, particularly for cattle, lowered the market value of their stock. Bite marks on cattle even if healed, or loss of tails or ears can reduce carcass values or make them unsaleable. One commented that 'meat processors penalise you 10 cents/kilogram if dog damage is present, which equates to a minimum of \$30–\$40 loss or more per carcass'.

Time and management expenses

The time involved in managing wild dogs is one of the greatest costs raised by affected landholders. This was highlighted in the participatory study by Ecker et al. (2015), along with time constraints affecting involvement in groups. When asked in the survey how many days a year they and their family spend on management actions, a number of respondents said this is a constant task requiring attention, described in comments such as '365 days' of the year, 'vigilant every day', 'taken into account in daily routine', 'always on the lookout on water runs', and they 'check during lambing season daily'. On properties with a wild dog problem, of those who provided a number of days, it ranged from 0 to 350 with an average of 26 days a year (Table 7). Around half of those landholders who reported not having any wild dog or fox problem on their property, spent time undertaking management actions, suggesting they may be trying to prevent problems, or that they are involved in broader area management actions.

Expenditure on management actions can represent a significant economic impost for landholders in affected areas. Costs can include baiting, trapping, shooting materials, paid contractors, fencing, compulsory pest control levies and rates. On properties where there was a wild dog problem, landholders reported expenses ranging from \$0 to \$300 000 a year, with an average of \$7 197 spent a year (Table 7). Most of the properties with the highest expenses were large cattle stations in central Northern Territory and Queensland with up to 28 000 head of cattle. Landholders in Victoria and New South Wales reported the lowest annual expenses. This question excluded family labour as an expense, but this input is reflected in the time spent on management actions.

2010 to 2014 comparisons

Results for the longitudinal cohort suggest that there has been an increase in direct financial impacts in terms of stock killed as a result of wild dog or fox attacks. The proportion of properties reporting sheep killed increased from 64 per cent in 2010 to 76 per cent in 2014 (Table 8). In both years, fewer properties reported that cattle were killed (compared with properties with sheep), but the proportion still increased, from 42 per cent in 2010 to 53 per cent in 2014. The proportion of landholders reporting injured stock, both cattle and sheep, was lower in 2014 than four years earlier.

Because of differences in the design of this survey question from 2010 to 2014 it was not possible to reliably compare percentage stock losses on a per property basis, or the percentage of stock killed that were under 12 months old.

Management inputs in terms of both landholders' time and other expenses directly on wild dog and/or fox management actions have, on average, increased between 2010 and 2014 on properties with wild dog problems. Annual expenses on management controls appear to have increased more substantially than time spent, as shown in Table 8. A breakdown by states/territory cannot be given reliably for data on management inputs, because of the smaller number of respondents in the longitudinal cohort than the full sample. Table 8 Financial impacts and management inputs for landholders with a wild dogproblem, longitudinal tracking

	2010	2014
Killed stock a, b		
% landholders reported any sheep killed	64	76
% landholders reported any cattle killed	42	53
Injured stock a, b		
% landholders reported any sheep injured	58	32
% landholders reported any cattle injured	46	41
Management inputs a		
Days a year spent on management actions $ {f c}$	32	33
Average annual property expenses for management actions (\$) d	4 946	8 895

Notes: **a** Table includes data only for landholders with a wild dog problem, as indicated by them giving a rating for wild dog severity (in respective survey year). **b** Impacts on stock are for the 12 months preceding the survey, cover stock of any age, and may be the result of wild dog and/or fox attacks. Whether stock were killed or injured on a property was based on the reporting of numbers for each category. **c** Excludes time spent by outside contractors. **d** Excludes family labour. Source: ABARES surveys

Flow-on and secondary impacts

Wild dogs and foxes have social impacts on landholders and those in rural communities as well as impacts on agricultural production (Wicks et al. 2014). As noted in the participatory study (Ecker et al. 2015), financial and social impacts are strongly linked. To explore these social and financial impacts further, the 2014 survey asked landholders a series of questions about how the presence of wild dogs had affected them, including whether they had concerns about their viability on the land, feared for their personal safety and if they experienced feelings of distress and anger—alongside reduced lambing or calving rates and changing livestock composition. The psychological components were included because they were key factors identified in an earlier study of the psychological stress caused by wild dog attacks (described in Wicks et al. 2014).

Reduction in lambing or calving rates is a key impact of wild dogs, with this being reported by 42 per cent of all landholders (Figure 13). Feeling angered and worried about their viability on the land were the most common individual personal impacts reported (30 per cent and 20 per cent respectively).

Twelve per cent of respondents to the 2014 survey said they had changed their livestock composition, while 5 per cent said they had left the wool industry, because of the presence of wild dogs. The comments in the open text responses reflected these changes. A number of people described how they had moved out of sheep into cattle production because of wild dog problems that had made running sheep unviable. For example, 'You can no longer run small animals here, dogs will wipe you out'; 'We sold all the merino sheep'; 'We've had to change from a cattle/sheep operation to sole cattle operation due to sheep losses'; 'We destocked sheep in 2008 and are just moving into cattle, but this is beautiful sheep country'; 'Sold out of sheep 8 years ago because of dingos'; and 'Not game to run sheep on some of our paddocks anymore'. Around 6 per cent were thinking of leaving the wool industry at the time of the survey in 2014.



Figure 13 Impacts of wild dogs on landholders, national, 2014

Note: All landholders surveyed (n=1 009). Landholders were asked how the presence of wild dogs in their area has impacted on them. Source: ABARES survey 2014

Source: ABARES Survey 2014

Other impacts raised by landholders were cattle being agitated by working cattle dogs after wild dogs had chased them, cattle stampedes causing damage to fences, increased workloads in relocating or locking sheep up at night, as well as impacts on wildlife.

Connected impacts

Several landholders, particularly those living in proximity to national parks, commented about how other pests relate to wild dog problems. In north eastern Victoria (Wangaratta, Mt Beauty), landholders described how deer hunters exacerbate the wild dog problem by leaving animal carcasses (which attract dogs) and letting out hunting dogs. Pigs were also discussed, with comments that it was harder to bait for dogs because of an influx of wild pigs, for example 'Pigs are so widespread they eat the baits before dogs get to them, it means putting out a lot of wild dog baits over a large area in an attempt to get the bait to the wild dog and not a herd of hungry pigs'. In the highland Queensland area, pig hunters also reported they were encountering wild dogs. Others noted that the control of wild dogs has exacerbated problems with pigs.

2010 to 2014 comparisons

The comparison of the longitudinal cohort indicated that the impacts of wild dogs on landholders have continued in a similar pattern, particularly for reduced lambing or calving rates. The effect on livestock remained the most commonly reported impact by over 40 per cent of landholders, although in 2014 it was selected by a smaller proportion (Table 9). Other impacts had changed minimally over the four years. Around 20 per cent of the longitudinal cohort reported they had changed the composition of their livestock or left the industry.

The results show how the presence of wild dogs is affecting landholders' involvement in the wool industry over time, with a considerable increase in the proportion thinking of leaving the industry. While in broad terms, landholders' ratings of wild dog severity and changes in severity are similar over the four year period, a cumulative effect of the problem is apparent. Feelings of anger and fear for personal safety have slightly increased from 2010 to 2014. Contrasting with

these negative aspects, in 2014 more landholders indicated they had no impacts from wild dogs, than in 2010.

	2010	2014
	%	%
Changed livestock composition or left the industry	19	21
Thinking of leaving the industry	1	9
Fear for workers' safety	3	6
Fear for family safety	6	7
Lambing/calving rate reduced	56	42
Seeing stock mauled and killed affected me personally	31	28
Left me very distressed/anxious	19	18
Left me angry	30	33
No impact	15	21

Table 9 Impacts of wild dogs on landholders, longitudinal tracking

Note: Data in table is for landholders surveyed in both years (N=234). Landholders were asked a series of questions about how the presence of wild dogs in their area had impacted on them, and could select more than one response. Source: ABARES surveys

Management activities and effectiveness

The survey asked landholders about the factors that influenced their decisions about wild dog management, the control actions they and other stakeholders in their area undertook, and their views on the overall effectiveness of wild dog management. They were also asked to provide their views about actions that could improve overall management in their area.

Overall, 88 per cent of surveyed landholders reported undertaking management actions for wild dogs and/or foxes. This includes contracting external services, such as shooters or trappers. Of those landholders with wild dog problems on their property, 95 per cent undertook management actions. For those with neither dog nor fox problems on their property, 45 per cent still indicated they undertake management actions.

Motivations and barriers influencing management

Of the 88 per cent of landholders overall who undertook wild dog/fox management, the most common reason reported (81 per cent) was to reduce stock losses (Figure 14). The next most common reasons were to support other landholders in their area (68 per cent), to ensure viability of their livestock enterprise (67 per cent) and because of the impacts wild dog/foxes have on native wildlife (44 per cent).

Figure 14 Reasons for undertaking wild dog and/or fox management, national, 2014



Note: All respondents, regardless of pest problem level on property or stock composition (n=approx 980 across sub-parts). Stock composition was assumed to not be an influence on reasons for management. The reason 'To support other landholders in the area' was added in the 2014 survey. Source: ABARES survey 2014

A small number of landholders (4 per cent) described additional reasons, including: to reduce spread of disease and weeds (dogs and foxes act as a vector); for proactive control (as sudden incursions in numbers can cause more severe losses); recreational shooting; to protect pets; and livestock welfare (to prevent their stock suffering).

2010 to 2014 comparisons

The predominant reason for undertaking management action remains as reducing stock losses, indicated by the cohort surveyed in both years (Table 10). Undertaking management 'because of the impacts wild dog/foxes have on native wildlife' was the most notable change, increasing over the four years. In 2010 around 23 per cent said this was a reason, compared with 49 per cent in 2014, in the longitudinal cohort. This could suggest landholders are giving greater consideration to environmental/wildlife impacts, as well as to the effects on their stock.

	2010	2014
	%	%
Reduce stock losses	91	82
Ensure viability of livestock enterprise	63	74
Minimise psychological impact	26	31
Because of the impacts wild dog/foxes have on native wildlife	a 23	49

Table 10 Reasons for undertaking management, longitudinal tracking

Note: Proportions are for all landholders surveyed in 2010 and 2014 (n=234). Reasons cover both dog/fox management. **a** In 2010 this item said 'impact on native species'.

Source: ABARES surveys

Reasons for not undertaking management

Asking landholders about their reasons for not undertaking wild dog management gives information on individuals' motivations, and also, the possible barriers to participation in dog control programmes. Several issues that were noted by AWI as potential obstacles to landholder participation in dog control strategies, that were not in the 2010 survey, were added to this question in the 2014 survey. These additional questions included views on the role of dogs and

dingoes in the environment, the impact of controls (such as baiting) on native wildlife, and animal welfare.

Figure 15 shows that the most common reason landholders gave for not undertaking wild dog/fox management was that the problem was 'not great enough'. Around 14 per cent reported that it was 'too time consuming' and 7 per cent regarded the impact that control methods might have on native wildlife as a reason not to undertake management activity. Four per cent of respondents nominated concern over the humaneness of controls as a reason. Several landholders noted factors that were limiting their use of baits such as: baits killing working dogs, the organic certification of their business preventing the use of baits, and difficulty with permits in the Northern Territory. Some of those landholders who gave reasons for not managing also reported that they did take management action on an as needs basis.



Figure 15 Landholders' reasons for not undertaking management actions, national, 2014

Note: Data presented for those landholders who gave any reason for not undertaking wild dog/fox management (n=155). Source: ABARES survey 2014

2010 to 2014 comparisons

The key reason for not undertaking management action remained that wild dogs/foxes were 'not enough of a problem', at more than 60 per cent (Table 11). There has been a notable decrease in 2014 in the proportion of landholders who see management as not part of their responsibility, from 15 per cent in 2010 to 3 per cent. This could suggest a movement towards wider acceptance of accountability or responsibility for wild dog management. Factors relating to time, expenses and lack of effective control methods have been increasingly reported in 2014 as reasons for not undertaking management.
	2010	2014
	%	%
Not great enough problem	65	61
Too time consuming	4	12
Too expensive	4	15
Wild dogs/foxes keep other pests down	23	15
No effective control method	4	12
Not my responsibility	15	3

Table 11 Reasons for not undertaking management, longitudinal tracking

Note: Proportions are for all landholders surveyed in 2010 and 2014 (n=234). Reasons cover both dog/fox management. Source: ABARES surveys

Actions undertaken by landholders on their properties

For landholders who undertake wild dog/fox management, shooting was the most common method used on their property. Across all properties surveyed nationally in 2014, shooting was used by 84 per cent of landholders, followed by 68 per cent using ground baiting. On properties where there was a wild dog problem, 89 per cent and 78 per cent of landholders used these methods respectively (Table 12). On properties with sheep, trapping, exclusion fencing and guard animals stand out as being used more commonly, compared with properties with cattle only. A factor influencing this may be property size and the practicalities of fencing and trapping. Landholders with cattle only were more likely to participate in aerial bating than those with sheep.

Around 25 per cent of landholders surveyed in 2014 were in a wild dog management group. A feature of groups is that landholders coordinate activities on their properties. This may be reflected in the reporting of methods, differentiated by group involvement (Table 12). Being in a group and pooling of resources may give individuals greater ability to access coordinated aerial and ground baiting programmes, or use relatively costly activities such as fencing and trapping contractors.

	All properties a	Properties only with a wild dog problem						
		All	All By stock composition		By wild do grou	og management 1p involvement		
			Sheep c	Cattle only	In a group	Not in a group		
Method b	%	%	%	%	%	%		
Shooting	84	89	89	88	92	87		
Ground baiting	68	78	82	74	92	69		
Trapping	29	40	49	36	58	31		
Aerial baiting	18	27	22	30	41	20		
Exclusion fence	11	14	28	6	21	9		
Guard animal	9	9	17	4	11	8		

Table 12 Summary of wild dog/fox management actions on property, national, 2014

Note: **a** All properties in surveyed wild dog affected areas. **b** Order here ranked by method, all properties. **c** Sheep = properties with any sheep (may have cattle too).

Source: ABARES survey 2014

There were some notable differences in methods used between states, for example, there was a much lower usage of ground baiting on properties in Victoria (Figure 16). The highest use of ground baiting was in Northern Territory and South Australia. Landholders in Queensland and Western Australia reported higher usage of trapping and aerial baiting on their properties than in other states. Exclusion fencing and guard animals, such as maremma dogs, were more commonly used by landholders in Victoria (around 23 per cent and 15 per cent of properties) than elsewhere.



Figure 16 Management actions by landholders on property, by state, 2014

Note: Wild dog/fox management actions undertaken, as reported by all respondents. Source: ABARES survey 2014

The pattern between states is similar for properties with only a wild dog problem and no fox problem. Figure 16 presents data for all respondents, for consistency with comparisons on actions reported as used by government and groups in the area (which would be applied beyond property boundaries).

Other actions by landholders included contracting and passing information to doggers/shooters, camera monitoring to assist shooting, helicopter shooting, ripping dog dens, and removing or composting carcasses to eliminate food sources for wild dogs.

Actions undertaken by government

Landholders reported some uncertainty about methods the government was undertaking in their area, with around 25 per cent stating they were not sure. The type of government was not specified and actions may include those on public land and national parks as well as individuals' properties. Of those who indicated government activities were being undertaken in their area, ground baiting was the most widely reported method (51 per cent nationally). High levels of aerial baiting were reported in Queensland, Western Australia and New South Wales with more than 40 per cent of landholders reporting the government using this method (Figure 17). In the Northern Territory, around 5 per cent or less of landholders were aware of any actions undertaken by the government in their area. Levels of shooting, trapping and ground baiting were relatively high in Victoria. This may be reported in terms of government doing the management directly, or supporting actions through bounties.

Exclusion fencing was reported by 16 per cent of landholders surveyed nationally as an action undertaken by governments.



Figure 17 Management actions undertaken by government in area, by state, 2014

Note: Wild dog/fox management actions undertaken by government in landholder's area (which may include on public lands/parks), as reported by all respondents. Source: ABARES survey 2014

Landholders' comments about other actions that government(s) undertook, mostly covered:

- supplying free or subsidised 1080 baits and/or bait injection for meat that landholders provide, mostly through Local Land Services/NRM bodies and local councils
- training to prepare baits and coordinating ground baiting.

Landholders' comments also described negative aspects of government actions, mostly:

- lack of action, or information about government actions
- limited effectiveness or maintenance of dog fences
- disparities between jurisdictions, for example: payment of bounties varies between states and territories (see also Potential management improvements); in the Northern Territory landholders 'need accreditation to inject 1080 [bait] to fresh meat, while in all other states this is a government service'; and 'aerial baiting is not permitted in South Australia' north of the dingo fence
- limited dog management on public land such as national parks and forests.

Actions undertaken by groups

This question gave a perspective from all landholders of the collective actions undertaken in their area by formal or informal neighbour or landholder groups, committees or syndicates. This provides some comparison with further views of those involved themselves in a wild dog management group. See Wild dog management groups—activities and outcomes.

Nationally, the dominant methods landholders reported groups using in their area were ground baiting (reported by 67 per cent) and shooting (60 per cent) (Figure 18). Trapping was used less often by groups (36 per cent), but the level was more than on an individual property basis. Groups were also commonly engaged in aerial baiting (38 per cent). There was also some uncertainty about groups' actions, with around 23 per cent of respondents saying they were not sure if groups were undertaking any management activities in that area. However, there was

relatively less uncertainty about shooting and ground baiting by groups than government use of



Figure 18 Management actions undertaken by groups in area, by state, 2014

Note: Wild dog/fox management actions undertaken by a group (informal or formal groups, syndicates and neighbour groups dealing with management) as reported by all respondents. Source: ABARES survey 2014

Landholders' comments indicated awareness of other actions that groups use, including:

- lobbying for dog trapper positions or obtaining resources for fencing
- providing bounties and baiting services locally
- camera surveillance.

these actions.

Not having a group in their area or being close enough to a group was mentioned as a problem for some landholders.

2010 to 2014 comparisons

There was a small increase in the proportion of all landholders who reported undertaking any wild dog/fox management actions, from 88 per cent in 2010 to 89 per cent in 2014. For those with a wild dog problem (indicated by rating its severity), in both survey years around 95 per cent reported undertaking management actions. Shooting remained the most common control method used by landholders on their property between 2010 and 2014, reported by 82 per cent of the longitudinal group in 2014 (Table 13). The most notable change was a reduction in the reporting of the use of ground baiting, down to 69 per cent of landholders in 2014, from 81 per cent in 2010. There was an increase in the reporting of trapping used by landholders themselves in 2014.

From 2010 to 2014 there was an increase in reporting of usage of all control methods by government, with the highest increase in trapping. While this could reflect increased actions by government, it could also reflect simply more awareness of government actions to manage wild dogs. More landholders in 2014 reported being unsure of whether government was undertaking a particular action in their area, with this most commonly reported for aerial baiting (Table 13).

		2010		2014
	%	%	%	%
On property by landholder a	Yes	unsure	Yes	unsure
Shooting	87	-	82	-
Ground baiting	81	-	69	-
Trapping	31	-	37	-
Aerial baiting	26	-	24	-
Exclusion fence	12	-	12	-
Guard animal	5	-	5	-
By government in area b	Yes	unsure	Yes	unsure
Shooting	13	11	36	19
Ground baiting	47	11	59	16
Trapping	22	10	47	16
Aerial baiting	31	11	51	20
Exclusion fence	8	6	22	17
By groups in area c	Yes	unsure	Yes	unsure
Shooting	59	8	64	12
Ground baiting	65	10	72	12
Trapping	20	12	48	18
Aerial baiting	32	8	48	18
Exclusion fence	9	10	29	22
Guard animal	12	20	19	23

Table 13 Reported wild dog/fox management actions by landholders, government andgroups, longitudinal tracking

Note: All respondents surveyed, regardless of wild dog problem presence. **a** Order of actions is ranked by use on property. **b** Awareness by landholders of fertility control and biological control actions by government was asked in 2010 but was excluded in 2014 because there were no reports of usage in 2010. Use of guard animals by the government was not asked in either 2010 or 2014. **c** Groups include formal and informal groups, syndicates and neighbour groups dealing with management.

Source: ABARES surveys

In terms of reported actions undertaken by management groups and groups of neighbours in the area, ground baiting continued to be the most common method used. More landholders reported that management groups and neighbour groups were undertaking wild dog management activities in their area in 2014 than in 2010. The most substantial increase in group activity was in the use of trapping and exclusion fencing, which was reported by 29 per cent of landholders in 2014 compared with 9 per cent in 2010 (Table 13).

Together the results indicate a similar pattern of methods being used by landholders, government and management groups over the four year period. But there are relative increases in trapping activities (by all), exclusion fencing by groups and wild dog shooting by government. This suggests a slight trend away from the dominance of ground baiting, even though it is still an important control method. The survey did not collect more detailed information on how each method is being used, such as baiting rates.

Effectiveness of management actions

At the national level, around 55 per cent of landholders considered that overall wild dog management actions being undertaken by all stakeholders in their area were 'moderately effective' to 'very effective' (Table 14). This question left open to respondents what effectiveness meant and reflects peoples' perceptions rather than any physical measure such as dog numbers.

Around 31 per cent thought overall management was 'not effective' or 'a little effective' and the remainder were not sure. The numbers were very similar for views about effectiveness of fox management actions. Those landholders who participated in a wild dog management group gave higher ratings for the effectiveness of overall management in their area, than those not in a group. Those who are not involved in a group were more likely to be unsure about the effectiveness of actions in their area.

	All respondents a	By wild dog mana	gement group involvement
		In a group b	Not in a group c
Rating	%	%	%
Not effective	9	8	10
A little effective	22	21	22
Moderately effective	41	47	38
Very effective	14	23	10
Not sure	15	2	20

Table 14 Wild dog management effectiveness rated by landholders, national, 2014

Note: Question is about overall management actions by all stakeholders in landholders' area. **a** All respondents (n=829). **b** Landholders answering this question and participate in group (n=238). **c** Landholders answering this question and participate in group (n=577)

Source: ABARES survey 2014

In Queensland, South Australia and the Northern Territory landholders were more likely to report wild dog management actions as 'moderately effective' to 'very effective' (Figure 19). Those in Victoria indicated the highest level of uncertainty about effectiveness. Landholders in Western Australia gave the lowest ratings of effectiveness, on average, for actions undertaken by all stakeholders in their area compared with other jurisdictions.



Figure 19 Effectiveness of overall wild dog management actions, by state, 2014

Note: Grouped ratings of effectiveness by all landholders surveyed (n=825, Australia total) Source: ABARES survey 2014

Map 8 provides a national picture of how landholders rated effectiveness, based on the mean score in each SA1 geographic region (excluding ratings of 'not sure'). As can be seen, there is a high degree of variability in the perceived effectiveness of wild dog management across states and territories.

Map 8 Effectiveness of wild dog management, 2014



Note: Perceived effectiveness of overall actions mapped by SA1 geographic region, using the mean rating by landholders surveyed in the SA1 region (excluding 'not sure'). Insets shown for Victoria and New South Wales detail—see Map 9 and Map 10. Source: ABARES



Map 9 Effectiveness of wild dog management – Victoria detail

Map 10 Effectiveness of wild dog management – New South Wales detail



2010 to 2014 comparisons

In 2014, around 60 percent of the longitudinal cohort said management was moderately or very effective, compared with 48 per cent who said it was effective in 2010 (Table 15). Based on individual comparisons, a Wilcoxon signed ranked test showed there was a statistically significant difference between the perceived effectiveness of all wild dog and fox management actions in 2010 and 2014 (Z = -7.518, p = .000).

Table 15 Overall management effectiveness of management actions, longitudinal tracking

	2010		2014
	%		%
Not effective	44	Not effective/ a little effective	30
Effective	48	Moderately to very effective	60
Unsure	9	Unsure	10

Note: Data for 2014 are average of dog/fox separate parts, and summed individual categories to compare with Not/Effective in 2010. In 2010, effectiveness of wild dog/fox management actions was asked together and hence can't be separated. Longitudinal cohort n=234

Source: ABARES surveys 2010 and 2014

In summary, these results suggest that—while wild dog problems may not be lessening, based on severity ratings and perspectives on change (as discussed in this report)—landholders are in general seeing management as more effective.

Perceptions of the most effective control methods

Landholders were asked an open ended question about their views on the most effective wild dog management control method. Most landholders thought that a combination of control techniques was the most effective way of managing wild dogs. Many said they were combining ground or aerial baiting with other control methods, most commonly trapping and/or shooting. Aerial baiting tended to be used for large or pastoral area coverage, while shooting and trapping were often used for follow up management or for smaller or targeted areas, such as water points. Shooting was considered an important opportunistic method, with landholders able to shoot dogs on site while they were undertaking day-to-day farm maintenance activities.

While baiting was overall the most mentioned specific method, a range of problems was raised with baiting, including:

- it is losing effectiveness because dogs learn not to take baits
- the amount of poison in baits is not strong enough
- there are off-target deaths of domestic dogs and working dogs that are valuable to landholders
- deaths of native animals (for example sand goannas) that take baits
- the complexity (red tape) of obtaining permits to undertake baiting.

Tips were also provided, including that baiting is more effective if the poison is injected into baits rather than covering the exterior of baits.

A significant proportion of landholders said that exclusion fencing was an important method for them, including repairing and maintaining existing fences, as was combining fencing with other control methods used inside the fence, like strategic trapping.

Many landholders said competent and vigilant professional trappers, doggers and shooters play an important role in wild dog management. These included both contract and government professionals.

Coordinated action by neighbours, groups of landholders and other stakeholders in a district was seen as a critical way of achieving effective wild dog management. Typically the types of actions included coordinated baiting, shooting and trapping by all stakeholders. One landholder wrote, 'dogs and foxes do not stop at fences, so for control measures to be effective, a broad area must be covered at the same time'. Conversely those who said there was not a coordinated effort across land tenures, also said that wild dog management was less effective. Issues raised were the need for public land managers to control dogs on their land, for example national parks; and for Aboriginal communities to control wild dog breeding on their lands and destroy un-needed camp dogs.

Communication between landholders about dog activity was seen as an important factor in wild dog management. One landholder pointed out the importance of being 'aware of what's on your property, to notify neighbours of sightings, tracks and kills as soon as possible so that baiting and trapping and shooting can be carried out'.

Potential management improvements

All respondents were asked for their views on actions that could be taken to improve overall management of wild dogs/foxes in their area. The key aim of this section was to understand what actions are seen as relatively more important than others. Figure 20 shows that the most important action nominated by landholders surveyed nationally was more management actions on public land, rated by more than 90 per cent as either important or very important, followed by government support to apply different technologies. For those who said more management actions on public land was very important, a notable proportion (44 per cent) of landholders were not located in close proximity to a national park and/or state forest. This suggests that it is landholders broadly and not just those with land adjoining parks, who see more management on public land as important. The need for management on public lands ties in with the issue of coordination being critical to effectiveness, noted in the previous section.

Landholder comments indicated government support to apply different technologies can relate to regulations (for example for trapping) and approvals for new types of baits, or traps with 'better welfare outcomes for dogs/foxes'. One comment called for the release of new products being developed for use in traps, specifically a M44 ejector (also known as Canid Pest Ejector) and PAPP, para-aminopropiophenone. As at June 2015, PAPP had not been registered by the government regulatory body, the Australian Pesticides and Veterinary Medicines Authority. There was one specific mention of biological control, '[something] like rabbit calicivirus that domestic dogs could be vaccinated against'. There were no mentions of fertility controls.



Figure 20 Importance of potential actions to improve overall management, national, 2014

Note: Order from left to right based on actions ranked of most importance. Source: ABARES survey 2014

The mean rating by landholders for each of these actions across all jurisdictions was between important and very important (between 3 and 4), shown in Table 16. More management on public land received the highest ratings in all areas except the Northern Territory. In the Northern Territory most actions were rated with higher importance than in other jurisdictions, and there was a particular emphasis on increased accessibility to baits. Landholders in Victoria placed more importance on relaxing trapping legislation as a potential action than those elsewhere; one noted that a key problem with legislation now is, 'doggers are having to do more miles as they cannot leave traps for too long'. Better coordination of groups was ranked the highest by landholders in New South Wales and lowest in Western Australia.

Table 16 Perceived importance of actions to improve overall management of wild dogs/foxes, 2014

	NSW	VIC	QLD	SA	WA	NT	Australia
	mean rating						
More management actions on public land (e.g. national parks, state forests)	3.7	3.7	3.5	3.6	3.6	3.8	3.6
More government support to apply different technologies	3.5	3.6	3.4	3.5	3.5	3.5	3.5
More effective baiting programmes	3.5	3.5	3.4	3.5	3.4	3.7	3.5
Improved cooperation between public and private land managers	3.5	3.4	3.3	3.3	3.3	3.5	3.4
More accessibility to baits	3.2	3.3	3.2	3.4	3.3	3.8	3.3
Better group/syndicate coordination	3.4	3.1	3.3	3.1	3.0	3.3	3.2
More coordination of landholders' management activities	3.3	3.1	3.3	3.1	3.1	3.4	3.2
Relax legislation on trapping	3.2	3.4	3.1	3.0	2.9	3.0	3.2

Notes: a Values are mean ratings by landholders in the state/territory between 1 (not important) and 4 (very important). ('Not sure' excluded). This table includes data for all landholders regardless of level of wild dog or fox problems they reported, because these categories are considered to apply generally. Ranked in table by descending importance (Australia).

Source: ABARES survey

A large proportion of comments by landholders suggesting 'other' actions that could be taken to improve management were related to more baiting or more effective baiting programmes (19/148 responses). Improvements suggested included:

- more access to baits, cheaper or free baits
- more baiting stations
- strategic ground baiting and aerial baiting, applied together
- compulsory baiting in all properties in a district, including on government land (for example national parks, state forests) and Aboriginal Land Trusts
- better and different types of baits, with comments such as, '1080 bait doesn't kill all wild dogs', 'stronger baits', and '(for foxes) would like to see more investment in an effective and safer bait than 1080'.

Further to the points about baiting, technologies and government supports, landholders raised these other areas for improved management.

- Introducing bounties (in areas without one) or increasing bounties (11/148 responses) as well as having the same bounty in all local government areas. Better resourced and trained dog trappers and the reinstatement of crown trappers were also seen as improvements. (note, currently bounties of \$100 are used in Victoria and Western Australia, in Queensland (various amounts); and there are no bounties in New South Wales, South Australia and the Northern Territory).
- Achieving compliance (10/148 responses). This meant enforcing or taking legal action against landholders who take no action to manage wild dogs or who refuse to participate in co-ordinated management action ('Still too many landholders do nothing and are in dog syndicates'). Specifically mentioned were landholders without livestock, such as those with vineyard or tree plantations, and those with mining sites.
- Education and communication. Improved communication between wild dog co-ordinators and more community education were suggested. Community education included raising public awareness of the damage to native wildlife from feral animals, and increasing understanding of the interaction of dogs and the environment, including a suggestion to 'map wild dog trails'.
- Subsidised exclusion fencing (for example for groups). Comments included, 'When fences are up neighbours start to build from these as the cost becomes more acceptable' and 'Financial support for cluster fencing would be a great help and very effective'.

2010 to 2014 comparisons

For the group of landholders surveyed in both 2010 and 2014, more management actions on public land continued to be the most commonly selected action that would improve overall management in their area (Table 17). In 2014 more than 90 per cent of landholders ranked this as either important or very important. Government support to apply different technologies and more effective baiting remained the next most selected actions identified. While all actions were identified by more landholders in 2014 than in 2010, actions with the largest relative increase were to relax legislation on trapping and greater accessibility to baits. The importance placed on trapping legislation may be linked to an increase in usage of trapping by those involved in wild dog management. Better coordination of groups was also increasingly selected between 2010 and 2014, and this may suggest more widespread understanding of the benefits of coordination in management and the role that groups are playing.

There is considerable variation between states (particularly noticeable for actions around trapping, baits access and programmes). In 2010 as in 2014, 'relax legislation on trapping' was most commonly nominated in Victoria and New South Wales (around half of landholders surveyed). In 2014 'more effective baiting programmes' was rated with the highest importance in the Northern Territory.

Table 17 Actions to improve overall management selected by landholders, longitudinal tracking

	2010	2014 a
	(Yes)	(Important or very important)
	%	%
More management actions on public land (e.g. national parks, state forests)	79	94
More government support to apply different technologies	66	91
More effective baiting programmes	60	87
More accessibility to baits	41	81
Better group/syndicate coordination	46	82
Relax legislation on trapping	34	78

Note: All respondents, regardless of wild dog problem presence. **a** For 2014, landholders' ratings of importance showed a general dichotomous distribution (clustered as either not important and slightly important, or important and very important) and therefore based on that division, combined important and very important ratings are used here to compare with 2010. In 2010 landholders did not rank importance, but ticked what actions 'could be taken'. Source: ABARES surveys

Wild dog management groups—activities and outcomes

The 2014 survey asked landholders if they were members of a wild dog management group or syndicate. Nationally, 25 per cent of respondents indicated that they participated in a wild dog management group (252 out of 1 010 landholders). Participation varied across Australia with the highest rate in the Northern Territory (32 per cent) and the lowest rate in Victoria (20 per cent). Map 11 shows the distribution of surveyed landholders in management groups across Australia.

Group membership 1 or more respondents in a group(s) respondents not in group (but a group may exist) wild dog fence 800 1,200 400 Kilometres no survey data

Map 11 Location of surveyed landholders involved in wild dog management groups

Source: ABARES survey 2014

Landholders who were involved in a group were asked a series of questions about their groups' characteristics, activities, mix of stakeholders, and the groups' effectiveness in achieving desired outcomes. They were also asked to provide their views on four factors thought to influence group function and effectiveness.

The four factors thought to influence the functioning and effectiveness of wild dog management groups were initially identified in the participatory study (Ecker et al. 2015). These were: participation, decision-making, cooperation and group support. Landholders were asked to indicate the extent to which they agreed or disagreed with 23 statements related to these factors (question 30). This section presents the findings of this assessment by landholders.

Group characteristics

There were approximately 120 different wild dog management groups identified by landholders. A small number of landholders indicated they were involved in more than one group. Some groups were highly formalised with 25 per cent of landholders indicating their group is incorporated, while other groups were less formal consisting of a network of landholders and their neighbours. The length of time wild dog management groups had been operating ranged from a number of months to 111 years, with an average length of 12 years.

The majority (59 per cent) of landholders indicated the wild dog management groups they were involved in had a local leader. Only 36 per cent of landholders indicated that their group received external funding. Paying fees, either compulsory or voluntary, was not a feature of most wild dog management groups (Table 18). In terms of group stakeholder composition, most groups have two or more different stakeholders represented (Figure 21). The majority of wild dog management groups have representation by livestock (sheep and cattle) farmers, while nearly half reported government staff representation. Other landholders (for example hobby farmers and absentee landholders), conservation groups, non-agricultural industries (for example mining and forestry), national parks authorities, and Indigenous traditional landowners are also represented on some wild dog management groups.

Group functions	All (n=244)	Respondents with any sheep (n=116)
	%	%
Management committee	45	-
Elect representatives	34	-
Regular meetings	42	-
Local leader	59	-
External leader	28	-
Pay voluntary fees	14	-
Pay compulsory fees	24	-
Receive external funding	36	-
Incorporated entity	28	
Group composition		
Sheep farmers	66	97
Cattle farmers	92	85
Other landholders, hobby etc	22	22
Government staff	44	47
Conservation group	19	20
Non-agricultural industries (e.g. mining and forestry)	14	10
Number of members	18 (mean) 1 (min), 120 (max)	
Number of years operating	12 (mean) < 1 year (min), 111 years (max)	

Table 18 Characteristics of wild dog management groups

Source: ABARES survey 2014



Figure 21 Number of stakeholder types represented in wild dog management groups, 2014

Note: Individual landholders indicated how many stakeholder types were in their group (n=255). Source: ABARES survey 2014

Activities

The majority of landholders indicated that all group activities, except for consultation with the local council, were important. Sourcing funds (59 per cent) and developing management plans (51 per cent) were considered the most important activities of wild dog management groups (Table 19).

	Very important	Important	Slightly important	Not important	Mean importance a
	%	%	%	%	mean rating
Surveying and mapping	29	28	23	14	2.6
Group meetings	28	40	16	11	2.8
Field days, training and forums	28	35	23	10	2.7
Monitoring and evaluating group effectiveness	23	49	16	9	2.8
Trials of control methods	35	35	17	8	2.9
Consultation with council	19	29	21	22	2.0
Developing management plans	51	30	12	4	3.2
Sourcing funds	59	28	5	5	3.3

Table 19 Group activities—importance

Note: **a** where 1 = not important, 2 = slightly important, 3 = important and 4 = very important, as rated by landholders surveyed.

Source: ABARES survey 2014

Group function and effectiveness

The participatory study (Ecker et al. 2015) identified key factors that influenced the functioning and effectiveness of wild dog management groups, which can be categorised as: participation, decision-making, cooperation and support. These factors were explored further in the 2014 landholder survey through the development of 23 statements relevant to participation, decision-making, cooperation and support. Landholders were asked to indicate their degree of agreement or disagreement with each statement in regard to the wild dog management group they participated in on a five-point (discreet visual analog) scale of strongly agree to strongly disagree. Results are outlined here, and presented in Table 20 and Table 21.

Participation

Landholders reported that it was somewhat difficult to recruit new members, that active participation and motivation within groups is high, and that it was very important to have people with local knowledge. Slightly more landholders felt that their group needed a greater mix of people and greater government representation than those that did not.

Decision-making

The majority of landholders agreed with the six statements regarding group decision-making indicating that this feature of internal functioning is working well within wild dog management groups. However, government regulations are considered too restrictive and this is having an effect on decision-making.

Cooperation

Cooperation within groups also appears to be high in terms of different stakeholders being able to work together and in the resolution of conflict. However, equity in the sharing of responsibilities appears to be an issue in some groups.

Support

Security of long-term funding, adequate resources to operate, and time constraints are issues for management groups. Access to specialist skills is adequate for most groups, while linkages and relationships with industry and government appear to be established and functional.

Table 20 Group functioning—participation and decision-making

48

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	NA	Mean a
	%	%	%	%	%	%	mean rating
Participation							
It's easy to recruit new members	3	14	31	34	8	10	2.7
Most members actively participate	17	56	14	11	1	2	3.8
The motivation of the group is consistently high	16	50	19	12	1	2	3.7
It's important to have people with local knowledge	60	38	0	0	0	2	4.6
Our group needs a greater mix of people	8	23	36	21	4	9	3.0
We need greater government representation in our group	15	23	29	20	8	5	3.2
Decision-making							
Members agree on goals	22	61	10	4	0	4	4.0
The group usually comes to a decision easily	17	61	12	4	1	5	3.9
The decisions are clear to everyone	19	60	12	4	0	5	4.0
Members of the group follow up on actions	14	56	18	7	1	5	3.8
All members get to have a say	21	60	11	4	1	4	4.0
Government regulations are too restrictive	39	27	22	7	1	5	4.0

Note: **a** where 1 = strongly disagree, 2 = disagree, 3= neither, 4 = agree, and 5 = strongly agree, as rated by landholders surveyed Source: ABARES survey 2014

Table 21 Group functioning—cooperation and support

49

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	NA	Mean a
	%	%	%	%	%	%	mean rating
Cooperation							
Group members representing different interests work together well	11	51	21	7	1	9	3.7
Responsibilities are not equally shared by group members	8	31	29	19	4	9	3.2
When conflicts arise they get resolved	6	51	27	5	1	11	3.7
Support							
Long-term funding is secure for our group	6	10	22	42	14	6	2.5
We have adequate resources to operate	4	24	25	33	12	3	2.7
Time constraints limit group members' involvement	16	57	15	7	2	3	3.8
We receive adequate support for strategic planning	4	34	28	21	8	6	3.0
We have access to specialist skills	4	47	21	16	7	6	3.3
We have access to relevant scientific research	2	39	29	19	5	7	3.2
We have good relations with industry groups	8	54	26	5	2	5	3.7
We have good linkages with government agencies	8	49	29	9	4	2	3.5

Note: **a** where 1 = strongly disagree, 2 = disagree, 3= neither, 4 = agree, and 5 = strongly agree, as rated by landholders surveyed Source: ABARES survey 2014

Key components influencing effective group functioning

A large number of potential indicators can be regarded as having an influence on group functioning. Of the list in Table 20 and Table 21, some 23 indicators (relating to the conceptual components of participation, decision-making, cooperation and support), were regarded as having an influence on the effective functioning of wild dog management groups. Principle components analysis (PCA) was applied to determine which variables can be used to form coherent subsets that are thought to reflect the underlying processes affecting group functioning.

PCA was used on all 23 indicators. The results (Appendix B) determined that the four conceptual components (participation, decision-making, cooperation and support) could be reduced to two components that contribute to group effectiveness (see Table 25, Appendix B). The first component represents the internal group functions (participation, decision-making and cooperation) that contribute to group effectiveness, while the second component represents the group's support requirements (funding, skills, planning, knowledge and industry and government) that contribute to group effectiveness. That is, the effectiveness of wild dog management groups consists of positive internal group functioning and adequate access to support.

This result provides guidance on where effort and investment should be directed, that is towards supporting wild dog management groups in:

- securing long-term funding
- strategic planning, and access to specialist skills (for example mapping, surveying, data collection and monitoring), knowledge and scientific research
- building relationships with industry and government agencies.

Group outcomes

Landholders who were members of groups were asked to provide their views on whether or not the existence of their wild dog management group had contributed to reducing the wild dog problem and if the group provided better support for affected landholders. They were also asked to describe what they saw as the main benefits of having a wild dog management group.

Group has contributed to reducing the wild dog problem

Slightly more landholders (42 per cent) agreed or strongly agreed that the existence of the wild dog management group had contributed to reducing the wild dog problem than those who didn't agree (38 per cent). However, 20 per cent neither agreed nor disagreed that the problem had been reduced (Figure 22).



Figure 22 Management group outcome—we have reduced the wild dog problem

Group has provided better support for landholders

Slightly more landholders (45 per cent) agreed that the existence of their wild dog management group provided better support to those landholders in their area affected by wild dogs, than those who didn't agree (34 per cent). However, 20 per cent neither agreed nor disagreed their group provided better support to affected landholders (Figure 23).



Figure 23 Management group outcome—there is better support for landholders

Source: ABARES survey 2014

Overall there was slightly stronger agreement that wild dog management groups provided better support for affected landholders, compared with a reduction in the dog problem. This complements findings of the participatory study that indicated that a group's success could be seen in terms of social and support networks provided to affected landholders, rather than solely in terms of reducing wild dog numbers.

Relationship between the effectiveness of groups and wild dog management outcomes (regression analysis)

To further assess these relationships, a multiple regression was conducted to see if group effectiveness factor score coefficients (independent variables) representing component 1 (internal group functions) and component 2 (resources and support) from the PCA predict respondents' perceptions of group effectiveness (dependent variable) in terms of the outcomes of: reducing the wild dog problem; and better supporting affected landholders (Figure 24). A standard multiple regression using the 'Enter method' was employed.

The results (see Appendix B) indicate that wild dog management groups with positive internal group functioning and access to adequate support contribute to achieving a reduction in the wild dog problem. In addition, if groups have access to adequate resources and support, it improves the group's ability to provide better support for landholders affected by wild dogs.



Figure 24 Relationship between the effectiveness of groups and wild dog management outcomes (regression model)

Note: Solid line indicates significant relationship between the independent and dependent variables. These 15 survey statements were found to constitute the two components in the principle components analysis (see Appendix B Table 25).

Benefits of wild dog management groups

Landholders described what they saw as the main benefits of having a wild dog management group, and these are summarised here.

Coordination of activity

The most frequently mentioned benefit of management groups was being able to coordinate the use of baits across a wider area or district thus achieving a better wild dog kill over a larger area. This left fewer 'safe havens' for dogs to breed in and led to more success in reducing livestock deaths and injuries. Many landholders highlighted the advantage of being able to coordinate the timing of ground and aerial baiting with neighbouring stations, so that baits are put out on the same day and the job is done in a shorter time. Key to this was the ability of management groups to obtain a good supply of injected fresh meat baits when required, in some cases, through the donation of meat for baits.

A major benefit of group coordination was ensuring all landholders work together in a region across various land tenures, such as pastoral, forestry and national parks. As one landholder pointed out, 'baiting is now very organised and coordinated within the shire and coordination with other shires is improving'.

Participation and motivation

A large proportion of landholders said they were motivated to take continued action to manage wild dogs because of being involved in group or social activities (for example injecting baits as a group). It was easier to deal with the problem collectively and people were encouraged to participate. One respondent noted that the presence of a group puts pressure on non-compliant landholders to participate, especially where 'funds are coming from levies on shire rates and landholders are not directly contributing'.

Resources and support

Another benefit that was frequently mentioned was access to government agencies and the ability to raise funds, afforded by wild dog management groups, such as through AWI grant money. Some saw the group as having more strength and credibility to negotiate with governments than individuals because there was 'one voice not 30 different voices'. The ability to pool funding and resources was also mentioned. One respondent, for example, said that they had benefited through funding raised for a cluster fence for dingoes. Many landholders pointed out how this enabled access to and funding for contract doggers and trappers. Two respondents also described the important psychological support provided to affected landholders by the group, which helped 'reduce the isolation and stress of facing dog attacks alone'.

Sharing knowledge

Another commonly mentioned benefit of management groups was the ability to share knowledge about the dog problem, learn from others' experiences and keep up to date on the baiting programme. A handful of group members said that they had gained a better awareness of other people's problems, how they deal with them, and learned tips for better practice, for example setting traps and baits and the legalities involved. Other benefits group members raised were:

- sharing information about dog presence, movement, and location of 'trouble spots'
- corrective data about baiting effectiveness so as to adjust baiting or target problem areas
- monitoring dogs shot or trapped (for group bounty purposes)
- learning (for example from experts) about current and new methods to control dogs.

Controlling wild dog impacts

A considerable number of group members said that the activities of the management group had enabled a reduction in the impacts of wild dog predation in their area. Group management activities had kept dog numbers down or under control or prevented dogs from moving into new areas. One group member said, 'We are past eradicating wild dogs; we can only try to control their numbers, so they don't affect the cattle too much. There are only about 200 sheep left in the area'.

One sheep farmer pointed out how important the management activity was to maintaining their ability to keep farming sheep, 'Without wild dog management in our area, within 1 to 2 years we would be unable to run any breed of sheep due to the dogs. This would for sure drive us off the land—we are fifth and sixth generation farmers'.

3 Key findings and project outcomes

This chapter summarises key findings from the analysis of landholder surveys presented in this report, firstly focussing on findings from the 2014 survey and then on findings about longitudinal change between 2010 and 2014. It also outlines the overall project outputs, in the context of the research package.

Survey findings—2014

- The target population for the 2014 survey was sheep and cattle industries in wild dog affected areas—which represents 17 per cent of total Australian farms across sheep, beef, and mixed livestock/cropping industries. The survey was completed by landholders from 1 010 properties from a total sample of 2 177, and covered a mixture of landholders with sheep, cattle or mixed livestock. The response rate of 46 per cent provides coverage at the national level that is statistically representative of the target population.
- Nationally across the wild dog affected areas surveyed, 67 per cent of landholders reported having a wild dog problem on their property and 26 per cent of landholders rated the problem as severe or extremely severe. Thirty five percent of landholders reported wild dog problems had become more severe, while 39 per cent said they had stayed the same compared with four years earlier.
- The distribution of wild dog problems varied considerably across and within states and territories, and also within regions. Knowledge of wild dog attacks was highest in the Northern Territory (NT) and Queensland and lowest in South Australia (SA). Seventy five per cent of landholders in the NT rated the wild dog problem on their property as severe or extremely severe; this figure was 34 per cent in Queensland and 24 per cent in Western Australia (WA).
- Landholders with properties in close proximity to national parks and state forests reported a higher severity of wild dog problems than those with properties not located in those areas—and this was especially the case in NSW, Victoria and SA.
- Median livestock killed on properties with a wild dog problem was 40 sheep and 11 cattle a year. Nationally, across the areas surveyed, sheep losses as a proportion of current stock (per property) averaged eight per cent with higher rates in Queensland and Victoria, and lower rates in SA and NSW. Cattle losses as a proportion of current stock averaged two per cent per property, with higher rates in SA and the NT.
- Young sheep and cattle less than 12 months old are highly vulnerable to wild dog predation; 66 per cent of all sheep killed and 91 per cent of all cattle killed across the areas surveyed, were aged less than 12 months.
- Landholders reported flow-on production and personal impacts from the presence of wild dogs in their area, which went beyond the direct loss of and damage to livestock.
 - Reduction in lambing or calving rate was reported by around 42 per cent of surveyed landholders, while 20 per cent were concerned about the viability of their business, and 12 per cent had changed livestock composition.
 - Around 10 per cent of landholders reported they were thinking of leaving the wool industry or had already left because of the presence of wild dogs.
 - A number of landholders described how they had moved out of sheep into cattle production because wild dog problems had made running sheep unviable.
 - Landholders were personally affected by wild dogs, leaving them angry (30 per cent) and distressed (16 per cent).

- Most surveyed landholders (88 per cent) reported taking actions to manage wild dogs and/or foxes, while for those with no wild dog or fox problems on their own property almost half (45 per cent) indicated they take management actions.
- The time involved in managing wild dogs is significant for many landholders; it can be one of the key barriers to taking management actions. On average across the surveyed wild dog affected areas, landholders are spending 26 days and \$7 197 a year on wild dog management. Management costs can be a significant financial impost for landholders, and include activities such as baiting, trapping, shooting, materials, paid contractors, fencing, compulsory pest control levies and rates.
- In wild dog affected areas in 2014, shooting, ground baiting and trapping were the most common wild dog/fox control methods used by landholders, wild dog management groups and government.
 - There were some notable differences in methods used between states, with a much lower usage of ground baiting on properties in Victoria and highest use in NT and SA.
 - Landholders in Queensland, WA and NSW reported higher usage of trapping and aerial baiting on their properties than in other states.
 - Use of exclusion fencing and guard animals by landholders was more common in Victoria than elsewhere.
- A key message from landholders was that a combination of control techniques is the most effective way of managing wild dogs, most commonly through combining ground or aerial baiting, with trapping and/or shooting often used for follow up management in targeted areas. Shooting is an important opportunistic method in day-to-day monitoring.
- In wild dog affected areas around 55 per cent of surveyed landholders rated the overall wild dog management actions undertaken by all stakeholders in their area as 'moderately effective' to 'very effective'. Around 31 per cent thought overall management was not or only 'a little' effective.
- Landholders rated more actions on public land as the most important action to improve overall management of wild dogs in their area. Government support to apply different control technologies and improvements in baiting programmes were also rated as highly important. Access to baits and bait injecting services (in the Northern Territory), better baits and compliance/strategic alignment in baiting were seen as key improvements needed.
- The survey identified approximately 120 wild dog management groups operating across Australia in wild dog affected areas. Around 25 per cent of landholders surveyed participate in a management group.
 - Some groups are highly formalised, being incorporated or having management committees, while others are loosely connected groups of neighbours.
 - Most groups have two or three stakeholder types represented; most frequently represented are sheep and/or cattle producers, government agencies, and other landholders.
 - Other than organising dog control actions, sourcing funding and developing management plans are the most important group activities. Having a local leader and input of local knowledge was seen as a key group feature for many landholders.
- Wild dog management groups with positive internal group functioning and access to adequate resources and support, are more likely to contribute to achieving a reduction in the wild dog problem. If groups have access to adequate resources and support, this improves the group's ability to provide support for landholders affected by wild dogs.

Summary about management—2014

Table 22 summarises selected key survey results that characterise landholders' perspectives on the extent and severity of wild dog problems and the effectiveness of wild dog management in their area.

	NSW	VIC	QLD	SA	WA	NT	Australia
	%	%	%	%	%	%	%
Know of wild dog attacks in area	67	61	91	46	67	99	71
Reported wild dog problem on property	54	51	93	49	71	99	67
Problem severe or extremely severe	16	18	34	13	24	75	26
Problem getting more severe a	33	25	42	32	31	47	35
Undertake management actions (dogs and/or foxes)	86	79	94	92	90	93	88
Involved in a wild dog management group	26	20	27	22	28	32	25
Rated overall wild dog management actions moderately to very effective	51	48	66	56	40	58	55

Table 22 Wild dog problems and management, 2014 (summary)

Note: Data are percentages of all landholders surveyed within state/territory, in wild dog affected areas. **a** Landholders rated wild dog problem severity compared with four years earlier.

Source: ABARES survey 2014

Longitudinal tracking findings—2010 to 2014

Some key comparisons between the results from the 2010 to 2014 surveys, based on the 234 landholders who were surveyed in both years are provided here.

- Ratings of the severity of wild dog problems were broadly similar in 2010 and 2014, aggregated across the surveyed areas. However, a slightly greater proportion of landholders rated severity on their property as moderate rather than minor, in 2014 compared with 2010. This is based on snapshot rating of the problem in each year. Based on landholders' views of change over the years preceding each survey, wild dog problems appear to have stabilised somewhat; in 2014 a smaller proportion thought problems had become more severe, compared with the proportion in 2010.
- The most common view across the areas surveyed was that wild dog problem severity had stayed the same between 2010 and 2014, however in Queensland and the Northern Territory a higher proportion of landholders reported it had increased. Victoria had the highest proportion of landholders reporting lessening wild dog problems.
- Flow-on production and personal impacts remained fairly similar between 2010 and 2014. Notable changes were a smaller proportion of landholders reporting reduced lambing and calving rates, and an increase of 8 percentage points in the number of landholders who were considering leaving the industry because of wild dogs.
- Stock losses remained the predominant reason why landholders take action to manage wild dogs. However, there was an increase between 2010 and 2014 in the proportion who said that they take action 'because of the impacts wild dog/foxes have on native wildlife'.
- In 2014, there was a decrease in the proportion of landholders who saw management as 'not their responsibility', from 15 per cent in 2010 to 3 per cent.
- Between 2010 and 2014 there was a decrease reported in the use of ground baiting (from 81 to 69 per cent), an increase in government action across all control methods, and an

increase in all control methods being employed by groups, particularly trapping and exclusion fencing. There was an increase in the time spent and management expenses used for management actions.

• There was an increase in landholders rating the overall wild dog management actions in their area as relatively effective, from 48 to 60 per cent in 2014. This suggests that although wild dog problems may be serious or staying at the same level, the improved effectiveness of regional management may be helping to stabilise wild dog problems.

Summary about management—2010 to 2014

Table 23 summarises selected key survey results that characterise changes in landholders' perspectives on the extent and severity of wild dog problems and the effectiveness of wild dog management, between 2010 and 2014.

	unit	2010	2014
Awareness & severity of problem			
Know of wild dog attacks in area	%	76	77
Reported wild dog/or fox problem on property	%	81	91
Wild dog problem – severe a	%	35	37
Wild dog problem – getting more severe \mathbf{b}	%	48	39
Stock losses & flow-on impacts			
Reported any sheep killed	%	64	76
Reported any cattle killed	%	42	53
Changed livestock composition or left the industry	%	19	21
Thinking of leaving the industry	%	1	9
Lambing/calving rate reduced	%	56	42
Management actions & inputs			
Undertake management actions (dogs/or foxes)	%	88	89
Time spent on management actions $ {f c}$	days/ year	32	33
Average annual property expenses for management actions $ {f d}$	\$	4 946	8 895
Management effectiveness			
Rated overall wild dog management actions moderately to very effective e	%	48	60

Table 23 Changes in wild dog problems and management, 2010 to 2014

Note: Data in the table are for landholders in the longitudinal cohort who responded to both surveys (n=234). **a** For 2014, the category 'severe' combines landholders' ratings of 'severe' and 'extremely severe' problem. **b** In the 2010 survey, landholders were asked to rate problems compared with in 'previous years', while in the 2014 survey they rated problems compared with 2010. **c** Excludes time spent by outside contractors. **d** Excludes family labour. **e** Data for 2014 are average of separate dog/fox parts. In 2010, effectiveness of wild dog/fox management actions was asked together and hence can't be separated. Ratings are 'effective' (for 2010) and summed categories 'moderately effective' and 'very effective' (2014). Source: ABARES surveys

Project outcomes and outputs

This study built on the first two stages and outputs of the overall research package funded by AWI, which examined: literature around the social impacts of wild dogs and social issues in collective management (Thompson et al. 2013); and the nature of wild dog management groups, their approaches and views about collaboration in management (Ecker et al. 2015). Both of these stages helped identify supports that groups may need, and factors contributing to effective management and participation.

This study has added to the knowledge base by examining, from the perspective of individual landholders, temporal and spatial changes in the impacts and management of wild dogs. The approach used was to combine results from a survey ABARES conducted in 2010 and a survey developed for the current project, in 2014.

Key outcomes of this study, as the final phase in the research project are:

- a collection in 2014 of national scale data on wild dog impacts and management that is representative of sheep and cattle landholders in areas affected by wild dogs. The report contains findings and analysis of longitudinal change that can inform AWI initiatives and programmes supporting communities in wild dog management. The results provide understanding of the factors that influence wild dog management group effectiveness and achievement of outcomes—from the perspective of landholders participating in groups
- a detailed dataset combining two surveys that is available to be explored in further depth in specific regions or case study areas, if required. The dataset includes impacts and management of foxes
- an up-to-date understanding of wild dog impacts and issues, and findings of broader interest for the Australian Government on pest animal management and implications for livestock industry productivity
- development of a refined survey tool that measures components of group functional effectiveness and outcomes for wild dog management. This can be used to build longitudinal data collections in future.

These outcomes are expected to assist in understanding and monitoring changes in the impacts of wild dogs on sheep and cattle industries and effectiveness of wild dog management over recent years. For AWI this has value in the context of a programme started in 2010 supporting landholders and community groups to manage wild dogs, with an overall aim of supporting producers to remain in the wool industry. The outcomes also highlight potential avenues for improving coordination and outcomes across industry and other stakeholders in wild dog management.

Appendix A: Methods

Survey design

In 2010, a national survey of the social and economic impacts of wild dogs (and foxes) on landholders was undertaken for the ABARES project: *Understanding the drivers and barriers to participation in wild canid management in Australia – implications for the adoption of a new toxin, para-aminopropiophenone (PAPP)* (Southwell et al. 2013). The 2010 survey focused on the attitudes of landholders to wild canid management and adoption of new management tools. The survey involved 525 private land managers across sheep, beef, sheep/beef and mixed livestock/cropping enterprises in all States and Territories (except for Tasmania and the Australian Capital Territory).

The 2014 survey design was based on the 2010 survey, to enable longitudinal analysis over the intervening four years. Findings from the second stage of the current project, a participatory study on the practices of wild dog management groups, also aided the design of the survey.

The 2014 survey was developed around the following themes:

- knowledge and severity of wild canid problem
- personal and economic impacts of wild canid attacks including stock losses and composition changes, management costs
- control methods and management actions used by individuals, groups and governments.

A section was added on wild dog management groups and specifically the functioning and effectiveness of those groups' activities. The new section explored:

- group characteristics and structure
- group activities
- group functioning participation, decision-making, cooperation and support
- group effectiveness
- benefits of management groups.

The Australian Bureau of Statistics (ABS) Statistical Clearing House reviewed, amended and approved the survey (approval number: 02123-02). It was designed to be done in 40 minutes using information at hand for landholders, and contained 35 questions. The complete questionnaire is presented in Appendix C.

Sampling procedure

The survey frame was designed by ABARES based on a database of agricultural establishments held by the ABS. The survey frame was stratified according to the Australian and New Zealand Standard Industrial Classification (ANZSIC) 2006 categories 0141 (Sheep Farming (specialised), 0142 (Beef Cattle Farming (specialised), 0144 (Sheep–Beef Cattle Farming), and 0145 (Grain–Sheep or Grain–Beef Farming), and by known spatial distributions of wild dogs. Distribution data was from the 2007 National Invasive Animals Assessment audit, for the Invasive Animals Cooperative Research Centre (http://www.feral.org.au/).

The survey frame included agricultural establishments from the 2010 survey (where the businesses still existed) and replacement agricultural establishments that met the survey frame criteria. All states and territories in Australia were represented, with the exception of Tasmania and the Australian Capital Territory. The survey frame contained a total of 11 713 agricultural establishments that met the stratification criteria, in wild dog affected areas (Table 24). This frame—the target population for the survey—represents 17 per cent of a total 68 405 Australian farms across sheep, beef, and mixed livestock/cropping production in 2011 (Figure 25).

0 1 1 ,	,						/	
	unit	NSW	VIC	QLD	SA	WA	NT	Total
Target population (survey frame) by industry type a								
Sheep Farming (specialised)	no.	621	121	119	333	112	0	1 306
Beef Cattle Farming (specialised)	no.	2 257	1 186	3 499	117	321	189	7 569
Grain–Sheep or Grain–Beef Farming	no.	103	61	262	356	363	1	1 146
Sheep-Beef Cattle Farming	no.	903	311	333	108	37	0	1 692
Total farm businesses (wild dog affected areas)	no.	3 884	1 679	4 213	914	833	190	11 713
Survey sample by industry type								
Sheep Farming (specialised)	no.	78	33	4	93	28	-	236
Beef Cattle Farming (specialised)	no.	212	269	462	36	129	176	1 284
Grain–Sheep or Grain–Beef Farming	no.	25	22	33	98	146	1	325
Sheep-Beef Cattle Farming	no.	155	101	35	30	6	-	327
Total farm businesses	no.	470	425	534	257	309	177	2 172
Responses by industry type								
Sheep Farming (specialised)	no.	33	21	4	58	13	-	129
Beef Cattle Farming (specialised)	no.	94	135	198	20	63	73	583
Grain–Sheep or Grain–Beef Farming	no.	9	10	14	48	45	-	126
Sheep-Beef Cattle Farming	no.	75	62	14	13	3	-	167
Total farm businesses b	no.	211	228	230	139	124	73	1 005
Response rate	%	45	54	43	54	40	41	46

Table 24 Target population, survey sample and respondents (farm businesses)

Notes: Industry types are from ANZSIC 2006 categories. **a** Target population, the survey frame, is farms in wild dog affected areas, across four industry types. **b** Total Australian survey response was actually 1 010 businesses, but 5 did not disclose a location so their jurisdiction and industry type could not be identified and are not shown in this table. Source: Sample drawn from Australian Bureau of Statistics, Agricultural Census 2011

A random sample was drawn by the ABS from the survey frame that met the stratification criteria. The survey sample yielded 2 177 farm establishment records, including 373 farm establishments that had been surveyed in 2010.

Figure 25 Relationship of survey respondents, sample and target population to total Australian industry

Total Australian farms – in Sheep, Beef Cattle, Sheep–Beef Cattle, and Grain–Sheep or Grain–Beef Farming (N=68 405)				
TARGET POPULATION – properties in Sheep, Beef Cattle, Sheep–Beef Cattle, and Grain–Sheep or Grain–Beef Farming, in Wild dog affected areas (N=11 713)				
SURVEY SAMPLE – random sample drawn from target population (N=2177)				
SURVEY RESP (N=1010)	CONDENTS, 2014 Longitudinal cohort surveyed in 2010 and 2014 (N=234)			

Note: N refers to total farm business numbers. Population and sample from Australian Bureau of Statistics, Agricultural Census 2011.

Survey data collection and response

The survey was administered as a paper based mail survey to the farm establishments in the sample, using a modified version of the Dillman Total Design method (Dillman 1978). The process involved first sending welcome cards to introduce landholders to the survey. Two weeks after posting the welcome cards survey packs were mailed out containing an introductory letter, survey and reply paid envelope. Reminder cards were sent at three intervals between December 2014 and February 2015. Landholders who were part of the longitudinal sample and had not returned surveys by January 2015 were contacted by phone to encourage participation in the survey. In some cases surveys were posted again or emailed out. Surveys were received until the cut-off date in early March 2015.

The survey aimed for an overall response from 623 farm establishments to ensure results were representative of wild dog affected areas at the national level (confidence level 99 per cent and confidence interval of 5 per cent). From the sample of 2 172 farm establishments, valid surveys were received from 1 010 farm establishments, which equates to a response rate of 46 per cent. The response rate excludes surveys that were 'returned to sender' or where individuals contacted the research team to be removed from the survey database.

The 1 010 responses comprised 234 who had also been surveyed in 2010 and 776 new recruits. The response rate for those repeating the survey of 63 per cent was higher than the general response because of the use of reminder cards and then phone calls, for the purpose of maximising the return rate from the longitudinal group.

Survey data, analysis and reporting

Results were entered into the Statistics Program for Social Sciences (SPSS) as two main datasets—one for the 2014 survey; and a longitudinal dataset for the 234 farm establishments that repeated the survey in 2010 and 2014. All data was checked for errors and anomalies. Results are analysed producing descriptive and inferential statistics. Inferential tests used were: Wilcoxon signed ranked tests; Principle Components Analysis (PCA) and multiple regressions. Results have been presented at a number of scales; national, state, Statistical Area 2 (SA2) (see Glossary) and Statistical Area 1. Not all questions from 2010 and 2014 were comparable; therefore the longitudinal analysis only contains a sub-set of questions.

Appendix B: Principal components and regression analysis

Principle components analysis—group functioning and effectiveness

Principle components analysis (PCA) is a statistical technique that is commonly applied to a set of variables to discover which variables in the set form coherent subsets that are correlated with one another, but largely independent of other subsets of variables (Tabachnick & Fidell 2007). The technique can summarise a large number of original variables into a smaller set of composite dimensions, or components, that are thought to reflect the underlying processes affecting the concepts of interest.

The 23 items in question 30 of the survey were subject to principle components analysis (PCA) using SPSS 19. Prior to performing PCA the suitability of the data for analysis were assessed. Inspection of the correlation matrix revealed numerous coefficients above .3, the Kaiser-Meyer-Oklin (KMO) value was .824 and the Bartlett's (1954) Test of Sphericity (Tabachnick & Fidell 2007) reached statistical significance, supporting the factorability of the data. Items that did not reach the threshold coefficient of .3 were removed, while one item that exceeded .8 was removed. This left a final set of 15 items.

Principle components analysis revealed 4 components with eigenvalues exceeding 1, explaining 32.3 per cent, 19.2 per cent, 8.8 per cent and 6.8 per cent of the variance respectively. Inspection of the scree plot revealed a clear break after the third component. However, the three items in the third component cross loaded on the first or second components. It was therefore decided to force a two component solution. The two component solution explained a total of 51.6 per cent of the variance with Component 1 contributing 32.3 per cent and Component 2 contributing 19.2 per cent. To assist the interpretation of the components a Varimax rotation was performed. The rotated solution produced a simple structure, with both components showing a number of strong loadings, and all items loading substantially on only one component (Table 25).

	Components		
	1	2	
Most members actively participate	.657		
Motivation of members is high	.672		
Members agree on group goals	.796		
The group comes to decisions easily	.827		
Members follow up on actions	.822		
All members get a say	.746		
Members with different interests work together well	.696		
Conflicts are resolved	.735		
Long term funding is secure for the group		.514	
The group has adequate resources to operate		.648	
The group has adequate support for strategic planning		.793	
The group has access to specialist skills		.815	
The group has access to scientific research		.641	
The group has good relationships with industry groups		.529	
The group has good linkages with government agencies		.607	

Table 25 Final varimax rotated two component solution

Note: See Glossary for explanation of varimax rotation method.

Source: ABARES survey 2014

Regression analysis—group outcomes

A regression analysis is a statistical method that is commonly used to assess a relationship between a number of variables. In this case, we are interested in whether the factors (determined by the PCA) that contribute to effective functioning of a wild dog management group are in any way related to reducing the wild dog problem in the area of the group's operation. Also of interest is whether wild dog management groups which function well provided better support to landholders who are affected by wild dogs than groups that do not function well.

The results were:

1) Component 1 (internal group functions) and component 2 (resources and support) explain a significant amount of the variance in 'reducing the wild dog problem' F(2, 153) = 10.066, p<0.005, explaining 11.6 per cent of its variance ($R^2 = .116$).

The analysis shows that component 1 (internal group functions) makes a significant unique contribution to the prediction of reducing the wild dog problem (beta = .199, p = 0.010), as does component 2 (resources and support) (beta = .280, p = 0.000).

2) Component 1 (internal group functions) and component 2 (resources and support) explain a significant amount of the variance in 'better support for landholders' F(2, 153) =15.316, p<0.005, explaining 16.8 per cent of its variance (R² = .168)

The analysis shows that component 2 (resources and support) is making a significant unique contribution (beta = .392, p = 0.000) to the prediction of better support for affected landholders, however component 1 (internal group functions) does not significantly (beta = .124, p = 0.96) predict better support for affected landholders.
Appendix C: Survey instrument





Wild dog and fox management

Sheep and cattle landholder survey



Australian Government Statistical Clearing House Approval Number: 02123-02

Thank you for your interest in this survey. You are an important source of knowledge about the impacts of wild dogs/foxes and management activities in Australian agricultural regions.

If you receive a survey for more than one property you manage or own, please fill in a survey for each property.

This survey is being conducted by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) to assist Australian Wool Innovation Ltd. (AWI) in better understanding current wild dog/fox impacts and the effectiveness of wild dog/fox interventions. We value your opinions. The information that you are providing will assist AWI in developing programs in future. This survey is part of an overall project aimed at collaborative approaches to managing wild dogs/foxes, thus supporting producers to remain in the wool industry.

The information within the survey will be analysed and presented as summary results only and no individual(s) will be identified. All information collected is confidential and will be stored securely by ABARES.

Who should fill out this survey?

The person or persons who have the best knowledge about your property and surrounding area should fill out this survey. This is likely to be the owner/manager of the property, or specifically anyone who is involved in wild dog/fox management activities on your property. The survey should be filled out by a person over the age of 18 years.

What information will you need to fill out this survey?

You will find it easier to fill out this survey if you have a sense of change on your property in the last 4 years, particularly in terms of management of wild dogs or foxes (if any) and livestock numbers. The questions have been designed to be straightforward for you to answer, based on your current knowledge. You may need access to:

 business records for 2013/14 (e.g. expenses/days spent on wild dog or fox management, and farm income).

How long will it take?

The survey should take approximately 40 minutes to complete.

What do I do with the survey once completed?

Please use the reply paid envelope to mail back your survey.

If you would prefer someone to go through the survey with you over the phone, please phone Robert Kancans, Bill Binks or Nyree Stenekes from the ABARES research team on **1800 186 029**.

SECTION A: YOUR PROPERTY AND AREA

Q1. What is the size of your property?

hectares
acres

Q2. Please indicate the number of livestock that you currently have on your property in the following categories.

	Number
Cattle	
Sheep	
Other [please specify e.g. goats, deer etc]	
Other [please specify e.g. goats, deer etc]	
Other [please specify e.g. goats, deer etc]	

- Q3. Is your property located within close proximity to a National Park and/or State Forest? [tick appropriate response]
- Q4. Are you aware of wild dog attacks in your area? [tick appropriate response]
- Q5. Are you aware of fox attacks in your area? [tick appropriate response]

1	Yes 🛛	No 🛛
ck	Yes 🛛	No 🛛
(Yes 🛛	No 🛛

If you answered no to Q4 and Q5, GO TO QUESTION 7.

Q6. How do you know about those attacks? [tick all that apply]

Had attacks on own property	
Observed attacks myself on other properties	
Through the media	
Through neighbours	
Other [please specify]	

Q7. On the scale below, please rate the degree of the wild dog/fox problem **on your property** in the past 12 months (from 1 to 5, with 1 being no problem and 5 being extremely severe)

[tick the most appropriate box]

	1 No problem	2 Minor problem	3 Moderate problem	4 Severe problem	5 Extremely severe problem	Not sure
Wild dogs						
Foxes						

If you answered in Q7 that you have *No wild dog/fox problem*, GO TO SECTION C.

Q8. If you had a wild dog/fox problem on your property in the past 12 months, has it been less severe or more severe than it was 4 years ago? [tick the most appropriate box]

	Less severe	More severe	Stayed the same	Not sure
Wild dogs				
Foxes				

SECTION B: IMPACT

Q9. How has the presence of wild dogs in your area impacted on you? *[tick all that apply]*

Have had no impact (i.e. not a problem)		
I worry about my viability on the land		
My lambing/calving rate has been reduced		
I have had to change the livestock composition of my property (e.g. changed from sheep to cattle)		
I'm thinking of leaving the wool industry		
I had to leave the wool industry		
I fear for my workers' safety		
I fear for my family's safety		
Seeing stock mauled & killed has affected me personally		
Has left me very distressed/anxious		
Has left me very angry		
Other [please specify]		

Q10. How many livestock were either **killed** (including those needing to be destroyed) **or injured** in the past 12 months on your property due to wild dog AND/OR fox attacks, in the following categories?

	Number killed (include those destroyed)	Number injured
Cattle (12 months or older)		
Cattle (younger than 12 months)		
Sheep (12 months or older)		
Sheep (younger than 12 months)		
Other [please specify e.g. goats, deer etc]		
Other [please specify e.g. goats, deer etc]		
Other [please specify e.g. goats, deer etc]		

SECTION C: MANAGEMENT

Q11. Do you undertake any wild dog/fox management actions? [tick appropriate response]

Yes 🛛 🛛 No 🗋]
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If no, please GO TO QUESTION 16.

Q12. What wild dog and/or fox management actions are undertaken on your property by yourself or your family? *[tick all that apply]*

Actions undertaken on your property by yourself or your family	Yes	No	Not sure/ don't know	
Aerial baiting				
Ground baiting				
Shooting				
Trapping				
Exclusion fencing				
Guard animal				
Other action taken [please specify]				

Q13. If you undertake wild dog/fox management, what are the reasons? *[tick all that apply]*

To reduce stock losses	
To ensure future viability of my livestock enterprise	
To support other landholders in the area	
To minimise psychological impact on my family and me	
Because of the impacts wild dogs/foxes have on native wildlife	
Other [please specify]	

Q14. How many days a year do you and/or your family spend

undertaking wild dog and/or fox management actions? (Exclude outside contractors, like trapping contractors)

_____days

\$

Q15.	Please estimate your property's annual expenses	for	wild
dog a	nd/or fox management actions.		
(Exclu	ude family labour)		

Q16. If you don't undertake wild dog/fox management, why not? [tick all that apply]

Wild dogs and/or foxes are not a great enough problem	
Wild dogs and dingoes are a legitimate part of the ecosystem	
Too time consuming	
Too expensive	
Wild dogs/foxes keep numbers of other pest species down	
No effective method to control them	
Some control methods can be inhumane	
Control methods impact on native wildlife	
Not my responsibility	
Other [please specify]	

Q17. What wild dog and/or fox management actions are undertaken in your area by the government? (This may include on public lands/parks) [tick all that apply]

Actions undertaken in your area by the government (either state or local)	Yes	No	Not sure/ don't know
Aerial baiting			
Ground baiting			
Shooting			
Trapping			
Exclusion fencing			
Other action taken [please specify]	·		·

Q18. What wild dog and/or fox management actions are undertaken in your area by a group?

(A group here refers to a collection of neighbours, landholders or other parties in a formal or informal group, committee or syndicate dealing with wild dog/fox management)

Actions undertaken in your area by a group	Yes	No	Not sure/ don't know				
Aerial baiting							
Ground baiting							
Shooting							
Trapping							
Exclusion fencing							
Guard animal							
Other action taken [please specify]							

Q19. How effective do you consider the **overall** wild dog and/or fox management actions undertaken by all stakeholders in your area? Please rate effectiveness, where 1 is not effective at all and 4 is very effective.

[tick the most approp	priate box]					
	1 Not effective	1 2 Not A little effective effective		4 Very effective	Not sure don't kno	
Wild dogs						
Foxes						

w

Q20. What do you think is the most effective **wild dog management** control method?

[Please comment]	 	 	

[tick all that apply]

Q21. Please rate the importance of the following actions that could be taken to improve the overall management of wild dogs and/or foxes in your area. (Use the scale below, with 1 being not important and 4 being very important)

[tick the most appropriate box]

	1 Not important	2 Slightly important	3 Important	4 Very important	Not sure/ don't know	
More management actions on public land (e.g. National Parks, state forests)						
Better group/syndicate coordination						
More coordination of landholders' management activities						
Improved cooperation between public and private land managers						
More government support to apply different technologies						
More accessibility to baits						
More effective baiting programs						
Relax legislation on trapping						
No further management actions						
Other [please explain]						

SECTION D: WILD DOG MANAGEMENT GROUP INVOLVEMENT

Q22.	Do you participate in a wild dog management group? appropriate response]	[tick	Yes 🗌	No 🗖	More than one 🗖
lf you	ı are not involved with a wild dog	manage	ement group, p	lease GO TO S	SECTION E.
Q23.	What is the name of the group(s)	?			
Q24.	How long has your group been op	perating	for?		/ears

Q24. How it	How long has your group been operating for?		years		
Q25. Is you	r group incorporated?	Yes 🗖	No 🗆	Unsure 🗌	

Q26. How many members does your group have?*

* A member is someone who is involved in the group through participating in meetings and/or wild dog control activities, and may pay a membership fee (if applicable).

members

Q27. Which types of stakeholders or individuals are members of your wild dog management group? [tick all that apply]

Sheep farmers	
Cattle farmers	
Other landholders (e.g. hobby farmers, absentee landholders)	
Government agency staff	
Conservation group representatives	
Mining industry representatives	
Other non-agricultural industries	
Other [please specify]	

Q28. Please indicate which of the following features are applicable to your wild dog management group. *[tick all that apply]*

It has a management committee	
We elect representatives	
There are regular meetings	
It has a local leader	
It has an external leader or coordinator	
We pay voluntary fees	
We pay compulsory fees	
We receive external funding	
Other [please specify]	

Q29. How **important** are these group activities for managing wild dogs? (Use the scale below, with 1 being not important and 4 being very important) [tick the most appropriate box]

	1 Not important	2 Slightly important	3 Important	4 Very important	n/a	
Surveying or mapping						
Group meetings						
Field days, training or forums						
Monitoring/evaluating group effectiveness						
Trials of control methods						
Consultation with/reports to council						
Developing wild dog management plans						
Sourcing funds for group activities						
Other important activity [please specify]						

Q30. Thinking about how your group functions, to what extent do you agree or disagree with the following statements about your group?

	1 Strongly disagree	2 Disagree	3 Neither agree or disagree	4 Agree	5 Strongly agree	n/a
PARTICIPATION						
It's easy to recruit new members						
Most members of my group actively participate						
The motivation of group members is consistently high						
It's important to have people with local knowledge in the group						
Our group needs a greater mix of people involved						
We need greater government representation in our group						
DECISION-MAKING						
Members agree on the group's goals						
The group usually comes to a decision easily						
The decisions are clear to everyone						
Members of the group follow up on actions						
All members get to have their say						
Government regulations are too restrictive						
COOPERATION						
Group members representing different interests work together well						
Responsibilities are not equally shared by group members						
When conflicts arise they get resolved						

[tick the most appropriate box for each statement]

Q30. (cont')

	1 Strongly disagree	2 Disagree	3 Neither agree or disagree	4 Agree	5 Strongly agree	n/a
SUPPORT						
Long term funding is secure for our group						
We have adequate resources to operate						
Time constraints limit group members' involvement						
We receive adequate support for strategic planning						
We have access to specialist skills when we need them (e.g. mapping, data collection, monitoring)						
We have access to relevant scientific research						
We have good relationships with industry groups						
We have good linkages with government agencies						

Q31. To what extent do you agree or disagree with the following statements about your group's wild dog management **outcomes**?

[tick the most appropriate box]

	1 Strongly disagree	2 Disagree	3 Neither agree or disagree	4 Agree	5 Strongly agree
We have reduced the wild dog problem					
There's better support for affected landholders					

Q32. What do you see as the main benefit of having a wild dog management group?

[Please comment]	

SECTION E: PERSONAL INFORMATION

This section is optional. It assists in the segmentation of results for reporting purposes.

Q33. What category below best describes your role on the property? *[tick appropriate response]*

Owner operator			
Manager/employee			
Other [please specify]			
Q34. Are you male or female?	Male 🗌	Female	
Q35. What is your age?	y	ears	

ANY OTHER COMMENTS

Please provide any other comments you may have about wild dog/fox impacts, or wild dog/fox management.

THANK YOU FOR TAKING THE TIME TO COMPLETE OUR SURVEY

If you have any questions about the survey, please use the toll free number **1800 186 029** to contact a member of the research team from the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES).

SURVEY #

Glossary

Longitudinal cohort	The group of survey respondents who participated in the 2010 and 2014 wild dog management surveys for this study (n=234).
Multiple regression	A statistical method used for estimating the relationships among variables.
Principle Components Analysis (PCA)	Principle Components Analysis (PCA) is a statistical technique commonly applied to a set of variables to discover which variables in the set form coherent subsets of variables, or components, that are thought to reflect the underlying processes affecting the concepts of interest (Tabachnick & Fidell 2007).
Qualitative analysis	Non-numerical examination of supplied textual data.
Sample	A selection of elements from a target population to conduct a survey. In this project, the sample included landholders with sheep and/or cattle livestock on their properties located in wild dog affected areas in Australia.
Sample frame	A list of all those within a population who can be sampled or selected to be in or out of scope of a survey.
Statistical Area (SA)	A geographical unit of the Australian Statistical Geography Standard. Statistical areas represent a community that interacts together socially and economically. There are 4 levels of SAs (SA1, SA2, SA3 and SA4). SA1s have a population range of 200 to 800 persons, and there are 54 805 SA1 regions in Australia. Further information can be found in: <u>1270.0.55.001 – Australian Statistical Geography Standard (ASGS)</u> <u>Volume 1</u>
Statistical significance	A way of determining if the observed differences between a sample and the population it was drawn from are due to random sampling error, or whether it actually reflects the characteristics of the population.
Variance explained	A measure of the proportion to which a mathematical model accounts for the variation in a given data set.
Varimax rotation	Varimax is a commonly used method of rotation in factor analysis, and in Principle Components Analysis, the aim of which is to maximise high correlations between factors, or components, and variables, and minimise low ones (Tabachnick & Fidell 2007).
Wilcoxon signed ranked test	A statistical test used when comparing two repeated measurements on a single sample to assess whether their population mean ranks differ.

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