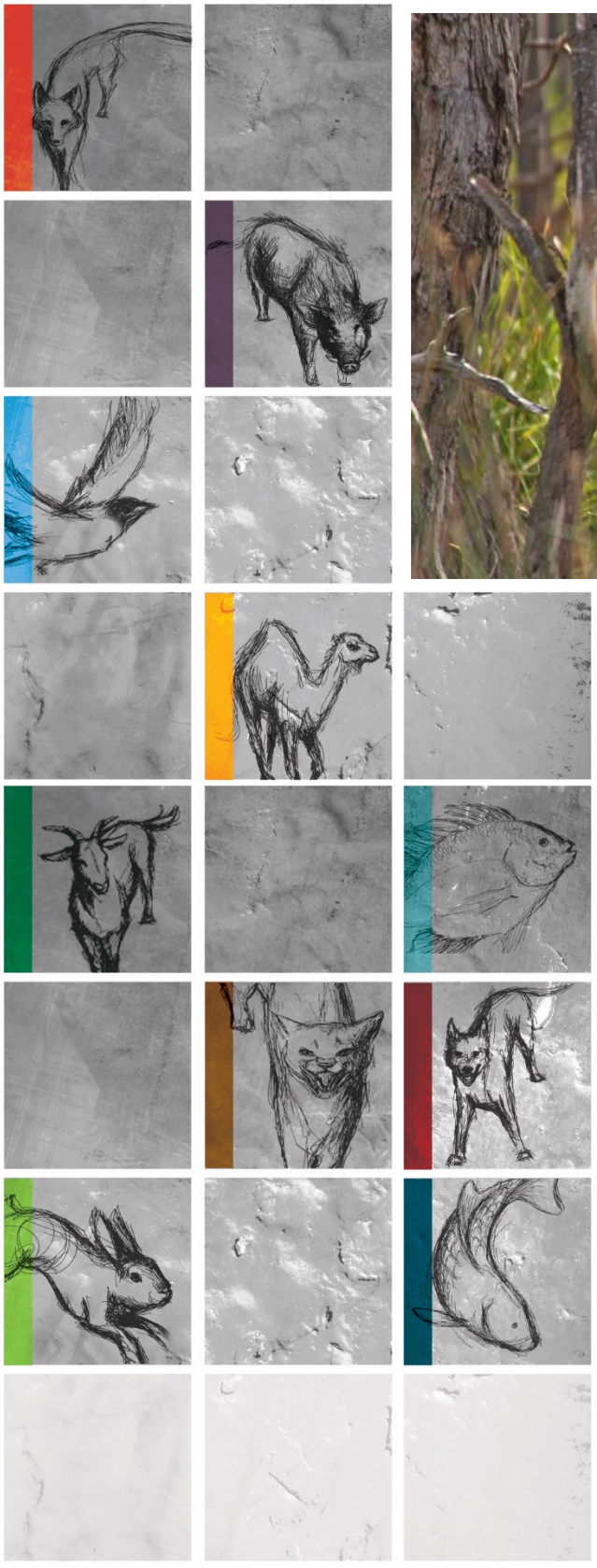

2016 National Wild Deer Management Workshop Proceedings

South Australian Aquatic Sciences Centre, Australia
17-18 November, 2016

D Forsyth, T Pople, B Page, A Moriarty, D Ramsey, J Parkes, A Wiebkin & C Lane (Eds)

Invasive Animals CRC
NSW Government Department of Primary Industries
Australian Government Department of Industry and Science
Business Cooperative Research Centres Programme

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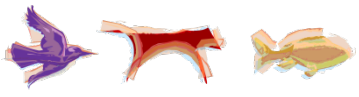

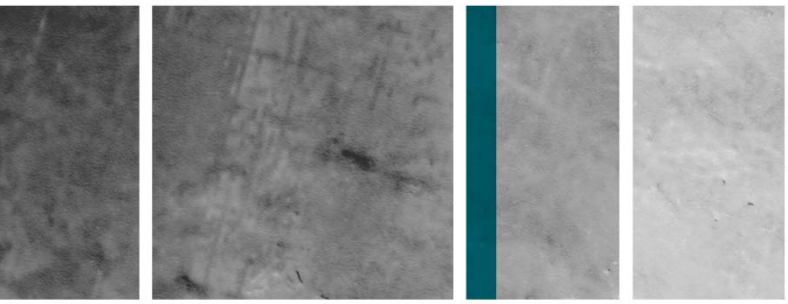

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Telephone: (02) 6201 2887
Facsimile: (02) 6201 2532
Email: contact@invasiveanimals.com

Web: www.invasiveanimals.com, www.pestsmart.org.au

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Front cover photo: Red deer – Ayden Doumtsis

Contents

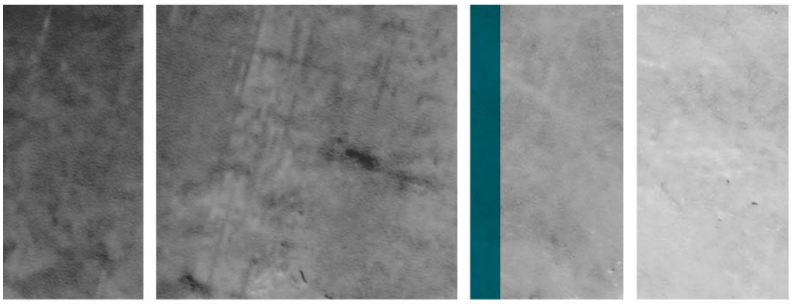
Summary

Six introduced deer species occur in the wild in Australia, with all states and territories having at least one species present. In comparison to other introduced ungulates in Australia the impacts of wild deer have not been well documented. Globally, wild deer can have a wide variety of negative economic, social and environmental impacts – and some of these impacts are being reported in parts of Australia. However, investment in research and innovation to understand and minimise the negative impacts of wild deer has been *ad hoc*, with no national coordination. This workshop was held to identify national priorities for research and innovation to improve understanding and management of wild deer impacts in Australia.

These proceedings outline high-impact research and innovation priorities within four key areas: impacts, management tools and systems, monitoring deer distribution and abundance, and community engagement. A collection of abstracts briefly summarises current research and innovation for managing wild deer impacts in Australia.

The workshop identified significant gaps in knowledge that must be addressed to effectively manage wild deer impacts in Australia. Better information on impacts is required, in particular on agriculture and how those impacts change with deer density. A wide variety of tools and systems are being used to monitor and manage wild deer in Australia, and there is a need to identify the most cost-effective and socially acceptable of these in a best-practice guide. Further development of current and potential control tools (primarily aerial and ground shooting, trapping, baiting, fencing, and guardian dogs) is recommended. It is also unclear whether recreational and commercial hunters can reduce the impacts of deer. Improved tools for monitoring the distributions and abundances of deer are needed, and there is a need to evaluate the usefulness of emerging technologies such as thermal imaging and species recognition algorithms. There is a more general need to understand where wild deer will spread to in the coming decades. A community engagement model would be useful for managing deer in potentially contentious settings, such as peri-urban areas.

It is hoped that these proceedings will assist key groups, particularly the Commonwealth and State governments and Ministers, the Invasive Plants and Animals Committee, the Invasive Animals Cooperative Research Centre, universities and conservation and community groups to prioritise funding and resources to better understand and minimise the impacts of wild deer in Australia.



Priorities for future work

The workshop used break-out groups to identify and prioritise research and innovation to improve the management of wild deer impacts in four themes. Consideration was given to the benefits, costs, feasibility and time frame of the research and innovation, and those of highest priority were (in no particular order):

Impacts

- Review of impacts of deer on agriculture and metrics for monitoring those impacts.
- Improved understanding of damage/density relationships and control thresholds required to protect assets.

Management tools and systems

- Assess animal welfare outcomes of aerial shooting.
- Evaluate efficiency of using suppressors during ground shooting to reduce community concern and improve management effectiveness.
- Improve understanding of lures and options for baiting deer.
- Build capacity and training of contractors to control deer with dogs and ground shooting.
- How cost-effective are guardian dogs and fences at protecting crops?
- *Understand motivations of recreational hunters to shoot more females / more deer.
- Can the commercial use of deer products be used to reduce deer impacts?
- *Best-practice guide for monitoring and controlling deer and their impacts.
- Improved trapping techniques.

Monitoring deer distribution and abundance

- *Best-practice guide for monitoring and controlling deer and their impacts.
- Assess and validate emerging techniques (e.g. thermal imaging, drones, species recognition algorithms) for monitoring distribution and abundance.
- Improve understanding of how fast and where deer will spread.

Community engagement, use and awareness

- Develop a community engagement model.
- *Understand motivations of recreational hunters to shoot more females / more deer.

* This knowledge gap was identified in two themes.

Workshop planning, aim and objectives

Workshop steering committee

Dave Forsyth (Chair) – NSW Department of Primary Industries

Tony Pople – Biosecurity QLD

Brad Page – Biosecurity SA

Andrew Moriarty – NSW Department of Primary Industries

David Ramsey – Arthur Rylah Institue, VIC

John Parkes – Kurahaupo Consulting, New Zealand

Workshop facilitator

Annelise Wiebkin – Biosecurity SA

Workshop administration

Chris Lane – Invasive Animals CRC

Workshop aim

To identify national priorities for research and innovation to improve understanding and management of wild deer impacts in Australia.

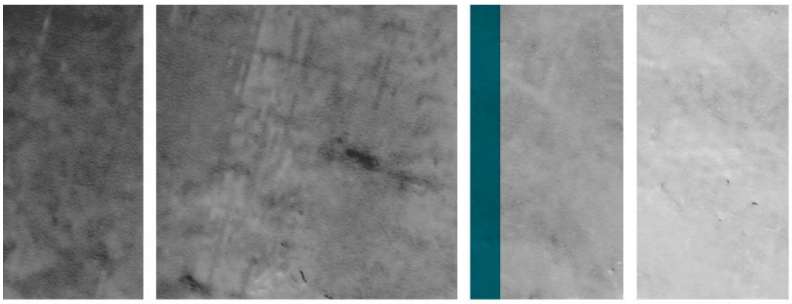
Workshop objectives

Specifically, the workshop will:

1. Review existing knowledge of distributions, impacts, monitoring, and strategies and tools for managing wild deer in Australia,
2. Understand current wild deer research and innovation projects, their objectives and progress,
3. Identify future actions and research and management priorities that have the potential to make management of wild deer impacts more effective and efficient, and
4. Gain agreement from participants for program of research to improve understanding and management of wild deer impacts in Australia.

In addressing these objectives consideration will be given to:

- Setting innovation and management priorities with consideration of benefits, costs, feasibility and timeframe (short, medium, long-term), and
- Building collaborations between key stakeholders.



Attendees:

The objectives will be met by bringing together representatives from management and research agencies from Australian states and territories, and New Zealand. Attendees are listed on pages 43–44.

Location:
Conference Room, South Australian Aquatic Sciences Centre, 2 Hamra Avenue, West Beach, Adelaide, South Australia.

Date:
17–18 November 2016.

Workshop program

Day 1: Thursday 17th November 2016

12:00pm	**Lunch**	
13:00	**Welcome**	**Andreas Glanznig, Chief Executive, Invasive Animals CRC**
13:05	Workshop aims and approach	Facilitator
Overview		
13:15	A national overview of deer management	Andrew Moriarty
13:30	Similarities and differences in state approaches to deer management (legislation)	All – facilitated discussion
Understanding and monitoring deer impacts		
13:45	Understanding and monitoring the environmental impacts of wild deer	Naomi Davis
13:55	Agricultural and economic impacts of wild deer	Brad Page
14:05	Wild deer and disease risks to domestic livestock	David Ramsey
14:15	Negative social impacts of wild deer in Australia	Matt Amos
14:25	Why and how to monitor deer distribution and abundance	Neal Finch
14:35	Facilitated discussion: prioritizing impacts of deer	All
15:35	Afternoon tea	
Options for managing deer		
15:55	Strategies for managing deer: from doing nothing to eradication	John Parkes
16:05	Tools for managing deer: ground shooting in the Northern Illawarra Wild Deer Management Program	Michelle Dawson
16:05	Tools for managing deer: ground shooting in the Alpine National Park Deer Control Trial	Daniel Brown
16:15	Tools for managing wild deer: aerial shooting in NSW	Grant Eccles
16:25	Managing wild deer in Queensland by trapping	Tony Pople
16:30	Tools for managing deer: fencing	Ben Fahey
16:35	Tools for managing deer: poisoning	Rob Hunt
16:40	What are the opportunities/constraints of current management strategies and tools?	All – facilitated discussion
17:30	What does management success look like?	All – facilitated discussion
18:15	Dinner	

Day 2: Friday 18th November 2016

8:45	Recap of Day 1	Facilitator
Prioritising research and innovation to strengthen management		
9:00	List and prioritise research and innovation to address knowledge gaps relating to management of deer	Break-out groups
10:30	**Morning tea**	
Where do we want to be?		
11:00	Groups report back research and innovation to address knowledge gaps relating to management of deer	Spokesperson of each group
12:20	Next steps	Dave Forsyth and John Tracey
12:30	**Close**	

Photo: Workshop participants (see pages 43–44 for names and affiliations).

Abstracts

A national overview of deer management

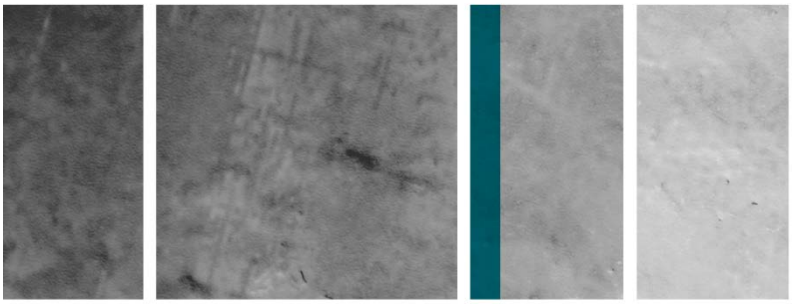
Andrew Moriarty

Game Licensing Unit, NSW Department of Primary Industries

A wise man once wrote "Deer mean many things to many people". This excerpt from Arthur Bentleys 1967 book "The Deer of Australia" is perhaps more relevant today than almost 50 years ago when it was first coined. Over this time period deer have moved from an insignificant and geographically limited member of the Australian biota to now be a widespread and common group of species which inhabits much of Australia's east coast and ranges.

Compounding the apparent 'rise' of deer species in this country is the political, legislative and social complexity that surrounds these species in Australia and indeed much of the world. This complexity includes poorly constructed legislation that is incongruous across States and Territories and subsequent conflicting management approaches that has often lead to a stalemate and a lack of coordinated effort to manage these species and their impacts across landscapes.

Clearly a strategic 'reset' is required for the management of deer species across the Australian landscape. The top down politically driven ideology that plagues our past and current efforts needs to be replaced with a bottom up approach involving greater coordination and evidence based scientific knowledge informing both policy and management directions.



Understanding and monitoring the environmental impacts of wild deer

Naomi Davis[A], Ami Bennett[A], David M. Forsyth[B], David M. J. S. Bowman[C], Edward C. Lefroy[D], Samuel W. Wood[C], Andrew P. Woolnough[E], Peter West[B], Jordan O. Hampton[F], and Christopher N. Johnson[C]

[A]*School of BioSciences, The University of Melbourne*

[B]*Vertebrate Pest Research Unit, NSW Department of Primary Industries*

[C]*School of Biological Sciences, University of Tasmania*

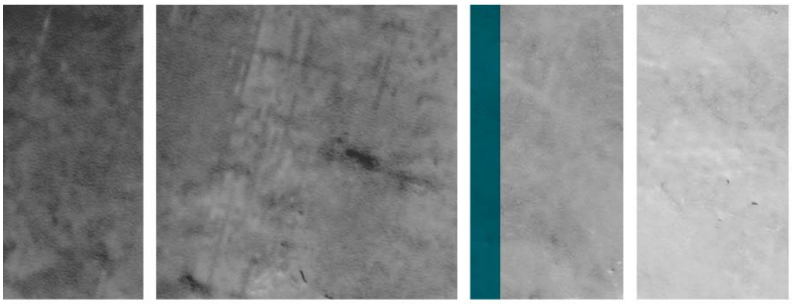
[D]*Centre for Environment, University of Tasmania*

[E]*Department of Economic Development, Jobs, Transport and Resources, Victoria*

[F]*College of Veterinary Medicine, Murdoch University*

Internationally, the detrimental effects of deer on natural ecosystems have been extensively documented, yet there is a lack of knowledge regarding the nature, extent and severity of deer impacts in Australia. We recently conducted a systematic review of the evidence regarding impacts of the six species of wild deer in Australia (Davis et al. 2016, *Wildlife Research*: doi.org/10.1071/WR16148). Our review showed that deer have the potential to impact on the Australian environment by: (1) changing plant communities; (2) competing with native fauna; (3) modifying habitat; (4) interacting with predators; (5) acting as vectors of diseases and pathogens; and (6) altering water quality, soil properties and nutrient cycling. The strongest evidence of the impacts of deer herbivory was provided by exclosure and enclosure studies. Exclosure and enclosure studies showed that deer defoliate, strip bark and break stems, reduce plant biomass, density and cover, impede growth and regeneration, alter community composition and reduce diversity. Supporting evidence for impacts of deer herbivory was provided by comparative studies, diet analysis and qualitative observations. Vegetation surveys demonstrated that antler rubbing can damage and kill plants. Greenhouse trials demonstrated that deer disperse seeds of exotic and native plant species. The creation of patches of bare ground by rutting and fighting has also been documented. The high potential for resource competition between deer and native herbivores is indicated by five studies that demonstrated moderate to high dietary overlap, and several studies that demonstrated overlap in habitat use using faecal pellet counts or direct observations. Only two comparative studies have examined the impacts of habitat modification by deer. These studies suggested that deer reduce small mammal species richness, abundances of some small mammals and reptile captures. Research into interactions between deer and predators is limited to a diet study that recorded deer in the diets of wild dogs, dingoes and red foxes, and a camera trapping study that documented

scavenging of hunter-shot sambar carcasses by wild dogs and foxes. The only study that examined deer impacts on soil properties suggested that high levels of deer activity can cause localised soil erosion. Overall, evidence of deer impacts is largely observational, or from small-scale, short-term, single-species case studies that do not quantify community- or ecosystem-level impacts. Robust demonstration of the type and extent of impacts is essential to justify investment in deer management and to gain social acceptability and stakeholder support.



Agricultural and economic impacts of wild deer

Brad Page[A], Grant Pelton[B], Jeremy Austin[C], Kristian Peters[B], David M. Forsyth[D], Annelise Wiebkin[A], Ellen Freeman[E], Barry Howlett[F], Lee Williams[G], Geoff Williams[G], Michelle Waycott[B], and Andrew Woolnough[H]

[A]*Department of Primary Industries and Regions, South Australia*

[B]*Department of Environment, Water and Natural Resources, South Australia*

[C]*School of Biological Sciences, University of Adelaide, South Australia*

[D]*Department of Primary Industries, New South Wales*

[E]*Central Queensland University, Queensland*

[F]*Australian Deer Association*

[G]*Mundulla West, South Australia*

[H]*Department of Economic Development, Jobs, Transport and Resources, Victoria*

The numbers of unconfined, wild deer (hereafter 'deer') are increasing in many parts of Australia due to intrinsic growth of populations, escapes from deer farms and illegal releases for hunting. Several studies have inferred agricultural, human safety, water quality, infrastructure, vectors of stock disease and other economic impacts of deer. These are based on observations of them feeding on crops, pastures or forestry plantations as well as surveys of landholders' perceptions, but the magnitude and range of the impacts are contested (Finch and Baxter 2007, reviewed in Davis et al. 2016). Deer can also have positive economic benefits for rural and regional communities, with both direct and indirect expenditure associated with hunting. Reaching a balanced understanding of the total economic impacts of deer requires the input and cooperation of many stakeholders.

To inform landholders and other stakeholders about the current and potential future impacts of deer this paper proposes indicators to estimate the cost of deer impacts across Australia.

Studies from the USA indicate that some of the most costly impacts of deer result from collisions with cars (Drake et al. 2005, Bissonette et al. 2008, Solusbury and White 2016). Similarly, surveys of landholders' perceptions in South Australia ranked "traffic hazard" as the most serious risk that deer pose to human safety (Peacock 2008, Wiebkin unpublished data). The number of deer hit by cars each year in Victoria between 2011 and 2015 increased in 3 of the 4 years, but the total number of accidents was dominated by collisions with kangaroos (RACV 2015). In 2003, the estimated cost of each road traffic accident fatality was $1.83 m (Connelly and Supangan 2006). Moreover, a fatal accident involving a rusa deer adjacent to Royal

National Park in NSW influenced the policy and management of deer in that park. We propose that the number and estimated cost of accidents involving deer be used as indicators of their economic impact relating to human safety.

It is widely accepted that deer impact some agricultural industries in some parts of Australia (e.g. Lindeman and Forsyth 2008, reviewed in Davis et al. 2016), but there is little information on the relative importance of different crops, pastures, garden plants, weeds and native plants used by deer.

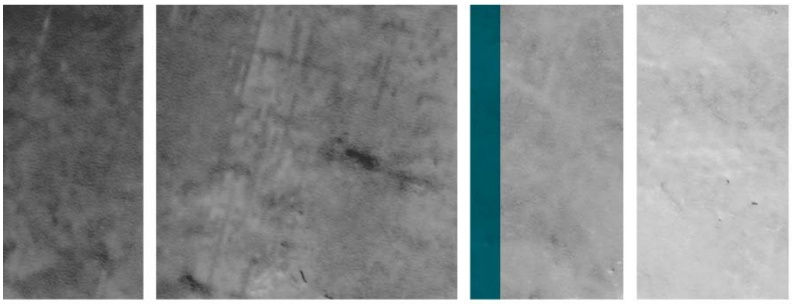
To measure the crop impacts caused by deer, information on their diet, energy requirements, distribution and abundance could be modelled and mapped for different seasons, locations, landscapes and species of deer. Simple maps could highlight the dollar value of any agricultural crop they use. The modellled distribution and abundance of deer species are additional proposed indicators to assess their economic impact (reviewed in Davis et al. 2016).

Until recently, information on the diets of herbivores has been difficult and costly to obtain. Recent advances in DNA metagenomic barcoding and analyses mean that deer diet can now be determined relatively cheaply (e.g. Czernik et al. 2013), providing information to value the impacts of deer on crops, pastures, forestry and other plants–the final proposed indicator to assess their economic impacts. Alternatively, the impacts could be estimated using field trials in crops and locations of interest.

Few diseases have been reported in wild or captive deer in Australia (Davis et al. 2016) and so this paper has not proposed any indicators to value these potential economic impacts. Additional research into the potential for deer to spread disease is required.

For both wild and captive deer, this paper also proposes that indicators be developed to report the cost and effectiveness of government policies, including compliance. The compliance approaches in Australia are different. They range from regulating the keeping of deer (e.g. Western Australia) to enforcement of deer hunting regulations (e.g. Victoria).

Because the policy space for deer management is often contested (game resource versus pest), it is important that the total costs are considered in an economic analysis. For example, deer hunting is estimated to contribute $57m to the Gross State Product of Victoria with additional flow-on effects to the broader community (Department of Environment and Primary Industries 2014). Further, this represents significant contributions to local economies. Hunting, for example, contributes 2.5% of the local government area economy in Mansfield in Victoria (Department of Environment and Primary Industries 2014). Since the economic benefits are an important part of the total economic impacts of deer, we propose that there needs



to be detailed cost benefit analyses that consider the total impact and not just a positive or negative perspective. This will help inform policy.

The effort required to measure the proposed indicators may be influenced by stakeholder pressure to do so, the degree to which the impacts are contested, the variety of plants used by deer, and by the management goals, which may range from ecological sustainable use to eradication.

The indicators proposed here would be used to inform decisions about the location and scale of deer management, and also to predict and assess the outcomes of management. In addition to quantifying the current impacts of deer, these indicators could be used to predict the future impacts of larger populations of deer and to compare their impacts to those of over-abundant native herbivores. The information could also better inform and target deer control efforts to particular seasons and locations, maximising their efficiency.

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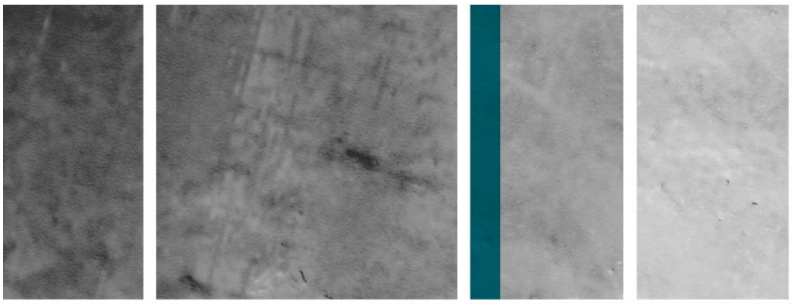

Wild deer and disease risks to domestic livestock

Dave Ramsey, Jemma Cripps and Carlo Pacioni

Arthur Rylah Institute, Department of Environment, Land, Water and Planning, Victoria

The transmission of pathogens between wildlife populations and livestock is a widely recognised threat to agricultural industries and human health globally. Multi-host pathogens are very prevalent among the infectious agents of domestic mammals, with estimates suggesting that 77% of pathogens infecting mammalian livestock are generalists that can infect multiple host species (Cleaveland *et al.* 2001). As deer species (family Cervidae) are closely related ungulates to economically important livestock species including cattle (*Bos taurus*), sheep (*Ovis aries*) and goats *(Capra hircus*), it is unsurprising that they share many parasites and pathogens, including several of major agricultural importance. These include diseases such as Foot and Mouth Disease (FMD - *Aphthae epizooticae*), Brucellosis (*Brucella spp*), bovine Tuberculosis (*Mycobacterium bovis*) and Johne's disease (*Mycobacterium avium*).

In Australia, deer populations of several species are well-established and increasing in geographic range. An emerging issue with the increase and spread of deer populations is the potential for impacts on agricultural productivity including the transmission of exotic or endemic diseases of livestock. There are several examples worldwide where populations of wild deer have been directly implicated in disease transmission to domestic livestock. In both New Zealand and the USA, populations of wild deer (principally red deer and white-tailed deer, respectively) are implicated in ongoing transmission of bovine Tb to livestock populations, which continue to hamper management of the disease. An outbreak of FMD in livestock in Bulgaria in 2011 also involved spread to roe deer and wild boar indicating the risk that wild deer populations could pose in an exotic disease outbreak.

We review the current status of deer in Victoria and examine the potential threats to the livestock industry posed by increasing populations of wild deer through either exacerbating transmission of endemic disease or as a potential host during an exotic disease outbreak. Future research to examine possible transmission pathways between deer and domestic livestock as well as intraspecific transmission and spread will also be discussed.

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Negative social impacts of wild deer in Australia

Matt Amos, Tony Pople and Michael Brennan

Biosecurity Queensland

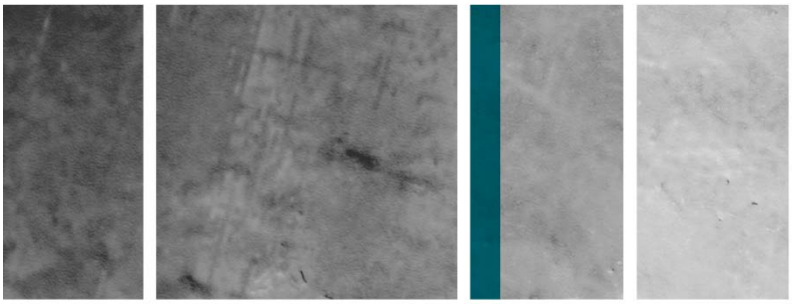
There are at least four broad categories of social impact of wild deer. Other wildlife can have similar impacts, but deer pose unique problems.

Traffic accidents

A major cost of wild deer is as a traffic hazard. This has been well documented overseas and numerous countermeasures have been proposed. In the United Kingdom, 40-70,000 deer-vehicle-collisions (DVCs) are estimated to occur annually causing 450 injuries and several fatalities each year. In the USA, over a million DVCs were estimated per year in the early 1990s and over a 100 fatalities per year from animal-vehicle collisions. These figures will obviously be a function of traffic volume and deer density. They nevertheless indicate the scale of the problem and the potential at least in some areas in Australia from a growing deer population. In Australia, DVCs occur in urban and rural areas and a number of fatalities have been recorded from collisions with sambar deer on one expressway. Countermeasures must thus be tailored to a range of environments. Signage, speed limit reduction, fencing and culling are employed in Australia to reduce DVCs. Other measures have been employed overseas with mixed results. In some cases, considerable data have been collected on the efficacy of countermeasures, providing clear guidance for managers. Collisions occur with other wildlife in Australia, particularly macropods, but deer are larger with a higher centre of gravity, providing a greater hazard.

Illegal hunting

Deer are attractive quarry for hunters and, while landholder permission is often sought by hunters, illegal hunting is often reported. Illegal hunters are accused of leaving gates open, shooting at domestic livestock, cutting fences, stealing fuel and causing unease to landholders. There are reports of illegal hunters using social media to report where high deer densities occur which attracts other illegal hunters to the site. Illegal hunting also damages the reputation of hunters generally (and those organisations that represent them) among landholders, the general community and management agencies.



Domestic nuisance

Deer, particularly in suburban areas, are blamed for damaging gardens, small crops and fruit trees, knocking over rubbish bins, wrecking turf, chasing dogs and competing with domestic livestock (usually horses) for feed. In extreme cases, horses have reportedly been gored by stags whilst being chased away from feed (more likely rusa stags than the other species).

Zoonotic disease

Deer in areas of the USA are preferred hosts of *Ixodes* ticks that are vectors of Lyme disease, caused by *Borrellia* bacteria. The disease is transmitted to people by tick bites and causes chronic debilitating symptoms. There is debate in the USA over the value of reducing deer populations to reduce the risk of contracting Lyme disease. True Lyme disease has not been recorded in Australia, but a Lyme-like disease has been reported and has been the subject of a recent Senate inquiry. The Lyme causing bacterium has not been recorded in Australia from recent, extensive analysis of ticks across Australia. However, other bacteria were recorded that could be responsible for the Lyme-like disease symptoms. Importantly, ticks carrying these bacteria are not unique to deer and the species of *Ixodes* ticks carrying Lyme disease in the northern hemisphere do not occur in Australia. Deer potentially carry other diseases harmful to people, but appear to not be a greater a zoonotic threat than other wildlife in Australia.

Conflicting community views on management

There are conflicting views in the community over the need for deer management. Opposition to deer control programs has included blockades preventing culling and interfering with traps and free-feeding. These disputes, which can be spiteful, compromise and complicate the management of deer by relevant authorities and landowners. The declaration of deer and their control in some states has also caused conflict and misunderstanding between hunting organisations and government agencies responsible for their management.

Why and how to monitor deer distribution and abundance

Neal Finch

Queensland Department of Environment and Heritage Protection

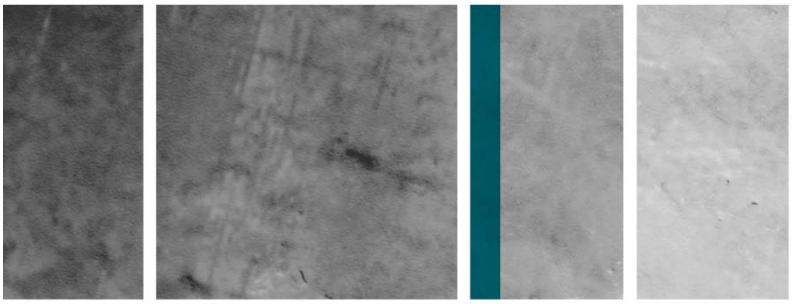
Considerable resources are expended each year in Australia managing introduced mammals. However, the use of monitoring as an integral part of pest control activities in Australia is at best a small component of the total expenditure of available resources and at worst non-existent (Reddiex et al. 2006). Understanding the consequences of management programs requires the adoption of experimental designs yet this is not widely adopted in Australia (Reddiex and Forsyth 2006).

Despite the presence of wild deer in the country for over a century, there have been few ecological research projects in Australia focussed on any of the six species. Management actions undertaken using public funding has been limited to date, especially in contrast to expenditure on other introduced mammals. This situation is changing as both the distribution of wild herds and the abundance of existing herds increases (McLeod 2009).

Public debate on the perceived or real impacts of wild deer is currently greater than ever in most Australian states. It is likely that public funding of management of wild deer will increase in line with the increasing public interest and debate. An increase in available public funding for such work will afford the wildlife management community the opportunity to follow scientific methods to produce results that are unambiguous and defensible.

Knowing population distribution and abundance is important for understanding many management actions. It is important to remember that the reason for management actions should be based on clearly stated objectives (Sinclair et al. 2006). Wild deer control methods should not become the objective (Caughley 1983). Equally important to note is that carrying capacity, particularly in relation to wild deer, is an arbitrary value based on the objectives of people more than any inherent quality of a habitat (Sinclair 1997).

There are many well established survey methods available to monitor wild deer (Amos et al. 2014). Methods fall into two broad categories, indices of relative abundance and estimates of total abundance. An index quantifies abundance without actually stating how many deer there are whilst an estimate of abundance will state the actual number. The choice of method depends on many factors including: deer species, habitat, available resources, and the actual objective to be achieved by a management action.



To be useful, an index of relative abundance must increase or decrease in relation to the actual density of deer. Deer can be highly cryptic (i.e. difficult to detect) and the habitats they live in can be very dense, and in these situations only spoor such as tracks or scats can usually be quantified. A spoor index assumes that more deer equals more spoor and less deer equals less spoor. For many management applications an estimate of actual numbers is not required and an index of relative abundance is sufficient. An index can be used to compare different areas at the same point in time or to track changes in the same area at different points in time. This ability makes indices useful for tracking the outcome of management actions.

When it is possible to actually see deer or quantify them as individuals in some way then it is usually possible to estimate the actual density or number of animals present in a defined area. Surveys designed to achieve this require that animals are not counted accidentally more than once and that individuals don't arrive or leave during the survey period through immigration, emigration, births or deaths. Hence, a total abundance survey must be conducted within a clearly defined timeframe.

Table 1. Some common survey types applicable to wild deer.

Relative abundance indices	Estimates of absolute abundance
Passive soil plots	Strip transect
Faecal pellet index	Line transect (Distance sampling)
Catch-per-unit-effort	Mark recapture
Spotlight counts	Index-manipulation index
Remote camera data	Change of ratio method
Walked line counts	Known to be alive

All surveys have inherent bias. Bias can arise from the habitat, weather, sampling effort, observer ability and survey method. A good survey design identifies all possible bias that may be present in the survey and attempts to reduce this by stratification and standardising effort. Accepting there is bias means management decisions can be made accordingly. For instance, many survey results will underestimate the number of animals due to inherent limitations of observing wild deer. These surveys are biased towards a conservative index of relative abundance or estimate of total abundance.

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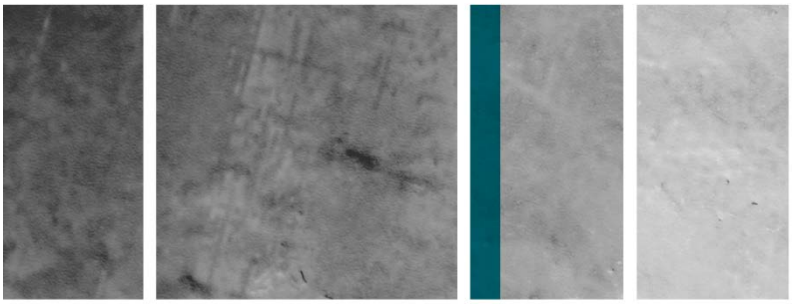


Strategies for managing deer: from doing nothing to eradication

John Parkes

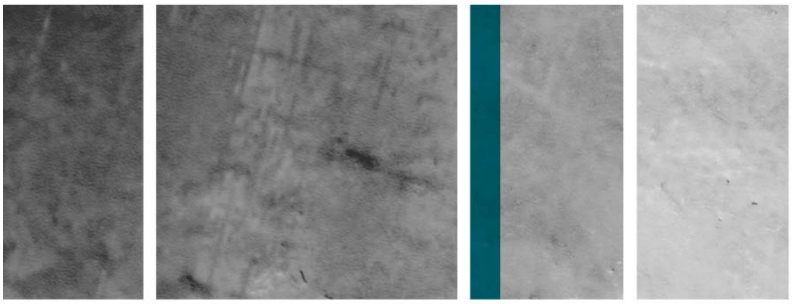
Kurahaupo Consulting, Christchurch, New Zealand

There are many ways to manage deer populations, generally by various forms of shooting or trapping, to achieve a desired state of deer numbers or of their impacts on biodiversity or productive assets. A strategy in this sense is defined by this desired state of the deer population and so by the scale and frequency of harvest or culling (control in pest terminology) required to reach and maintain the target population size. All of this is either determined by or it sets the legal, policy and practical instruments for each jurisdiction.

Strategies fall into two basic types. The first sets target densities of zero deer. Australian Federal law regulates the importation of new cervid species and takes note of the VPC's risk assessments. It is unlikely that any new species (e.g. several small Asian deer species such as muntjac) would be permitted outside zoos. Deer species currently within Australia are not present in all States/Territories, so an internal border strategy is possible for populations that require human assistance to expand their range (e.g. hog deer out of Victoria). Limiting dispersal of current populations is a potential, if difficult, strategy for some deer populations. Finally, current populations might be eradicated provided some basic rules can be met – basically no re-invasion, kill-rates higher than rates of increase across the whole population, and various social and financial conditions are not constraining.

The second type of strategy requires some on-going harvest or cull of the deer – sustained control in pest management terms. Ideally managers need to be able to set a target density for the residual population and then periodically harvest a proportion or number of deer to maintain the population at or below this level. How to achieve the target density and how to maintain the harvest are tactical questions that cause much debate between people who see deer as a resource and those who see them as a pest. It is debateable whether management of recreational hunting to achieve targets set by pest managers is an effective use of the latter's budgets. One target density is zero but when re-invasion is certain the strategy is extirpation rather than eradication. A weakness in all current sustained control projects for Australian deer is the lack of clear target densities set by the relationships between deer densities and asset conditions. These may be difficult to set in Australia given the impacts on vegetation by extrinsic events (rain and fire) and by the influence of sympatric native and exotic herbivores in many areas with deer. A precautionary approach setting low densities, with monitoring and adaptive management is the best way to apply the control strategy under such circumstances.

Finally, managers might decide to do nothing to control deer and let nature and recreational hunting to take their course with whatever outcome falls out.



Tools for managing wild deer: ground shooting in the Northern Illawarra Wild Deer Management Program

Michelle Dawson

South East Local Land Services, New South Wales

The Northern Illawarra Wild Deer Management Program was established in 2011 to address the increasing negative impacts of deer in the Northern Illawarra region of NSW. The core problem was that the number and distribution of deer (primarily Rusa) were increasing, resulting in impacts including:

- car accidents and other traffic hazards;
- accidents and delays on the rail network;
- damage to property, such as residential gardens and fences;
- decreasing agricultural productivity through competitive foraging;
- browsing, trampling and rutting damage to native species; and
- indirect impacts from illegal hunting.

The program manages deer numbers primarily through ground-shooting by professional contractors across multiple land tenures (347 individual landholdings are in the program). A recent evaluation (First Person Consulting 2016) shows that there has been a stable or downward trend in impacts.

The program's success is largely attributed to a risk-based operations plan that establishes and maintains a safe, integrated and cooperative control program. The primacy of safety in the objectives relates to the operating environment – using firearms to control deer in rural, peri-urban and urban areas. The key risks in this operating environment are loss of life or significant injury as a result of the incorrect use of firearms, and injury to people or animals should shots miss targeted deer. Public perception is also a very important element – that it not only has to be safe, but it has to be understood to be safe by community members and other stakeholders.

The safety risks have been managed through a Health, Safety and Environmental Management Plan, with additional work required to meet corporate land manager requirements (i.e. industrial sites).

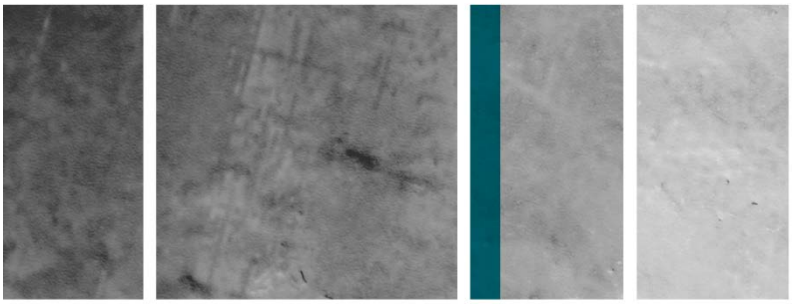
Planning and delivery of shooting operations includes the:

- Accreditation of shooters with the Firearms Safety and Training Council and all relevant qualifications and licences.

- Assessment of each shoot site in daylight hours and site-specific operations plans. This includes identifying risks, hazards and safe shooting zones (where bullets will hit a safe background if they miss their target).
- Collection of detailed, real-time monitoring data about shoot activities on portable electronic devices (e.g. sites visited, deer observed, shots taken, deer killed, staff present).
- Trialling new equipment to improve the safety of operations.

Reference

First Person Consulting (2016) *Evaluation of the Northern Illawarra Wild Deer Management Program*. Report prepared for South East Local Land Services by First Person Consulting Pty Ltd.



Tools for managing wild deer: ground shooting in the Alpine National Park Deer Control Trial

Daniel Brown

Parks Victoria

In the past decade, Parks Victoria has seen evidence suggesting an expansion of deer populations within the Alpine National Park and increasing damage to vegetation and waterways, particularly at higher elevations.

Deer are having a negative impact on significant environmental assets, including Alpine Peatlands, an endangered ecological community listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* and *Victorian Flora and Fauna Guarantee Act 1988*.

Alpine Peatlands are boggy wetlands which occur at the headwaters of waterways in the Alps. They play an important role in maintaining the healthy functioning of water catchments in the Alps and provide critical habitat for a number of threatened flora and fauna species. Deer are degrading these fragile alpine environments through grazing, trampling and forming wallows in drainage lines.

Little is known about controlling deer to maintain or improve the condition of alpine peatlands in the Alpine National Park as it has not been attempted before. To develop a greater understanding of the impacts of deer on alpine peatlands and to determine the best methods of mitigating them, Parks Victoria is implementing a deer control trial. The trial uses a structured 'learning by doing' approach

to facilitate an adaptive, evidence-based assessment of options for long-term deer management. At the conclusion of the trial, the results and lessons learned will be used to provide future directions for ongoing deer control in the park.

The aim of the deer control trial is to investigate whether ground shooting can reduce deer impacts on the alpine peatlands in the Alpine National Park, and if so, what are the most efficient and effective techniques.

There are 2 trial sites within the Alpine National Park: The Bogong High Plains (near Falls Creek) and; The Howitt Wellington Plains (north of Licola).

Two 'treatments' have been implemented at each of the trial sites:

(1) Targeted deer control: Remove as many deer as possible using several of the ground shooting methods available, including stalking, stalking with gundogs and spotlighting, on foot or in a vehicle, using white light, thermal imaging and/or night vision equipment. Targeted deer control is being carried out by volunteers from the Australian Deer Association (ADA) and the Sporting

Shooters Association of Australia (SSAA), and contractors, all under the supervision of Parks Victoria staff. The efficiency and effectiveness of each of the methods is being measured and will be used to determine those that should be used as part of any future ongoing deer control program.

(2) Non-treatment control: No deer control will be undertaken, except recreational hunting where this is already permitted.

These areas will provide an opportunity to assess the effectiveness of targeted deer control because they allow comparison with areas where no targeted deer control is being conducted to areas where it is being conducted.

Deer abundance, density and habitat use are being monitored before and after control, and 'catch per unit effort data' is being collected, using a number of techniques including:

- remote infrared-triggered camera traps;
- faecal pellet counts (or FAR—faecal accumulation rate);
- recording of the locations, date and time of all deer seen and killed; and
- collection of GPS track logs by hunters while undertaking control operations.

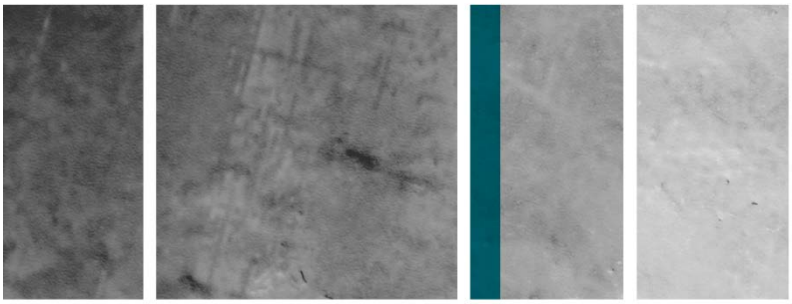
Deer impacts are being monitored using 'peatland impact surveys' that measure:

- the severity and density of pugging, deer trails and wallows; and
- changes to the vegetation structure at browse height.
- targeted wallow and natural pool surveys will also be undertaken.

Volunteers from the Australian Deer Association (ADA) and the Sporting Shooters Association of Australia (SSAA) have been working in a treatment area on the Bogong High Plains since May 2015. A total of 35 individuals have participated so far in 8 operations, mainly over weekend periods. Many of the volunteers have assisted in several operations. Volunteers have removed 25 deer thus far. A contractor has also been used, undertaking a 4 night and 6 night operation thus far and removing 49 deer. Parks Victoria staff supervise all control work.

Current results indicate that:

- Night operations, particularly using thermal imaging and night vision equipment, are the most productive.
- The highest numbers of deer are encountered in February, March, April and early May.
- Deer appear to leave the high plains following heavy snowfall and return gradually as the snow melts.



- Preliminary analysis of the camera data shows the deer population on the Bogong High Plains has more males than females, and that there are very few very old males.

Implementation of the trial continues. The program will adapt and improve a better understanding of which approaches are the most efficient and effective is developed.

Parks Victoria has a range of other trial deer control programs currently operating in icon parks across the state including: Dandenong Ranges National Park; Yellingbo Nature Conservation Reserve; Warramate Nature Conservation Reserve; and across Eastern Victoria at Mitchell River National Park, Wilsons Promontory National Park and the Alpine National Park. Planning is underway to expand the program to include other icon parks in western and northern Victoria.

Tools for managing wild deer: aerial shooting in NSW

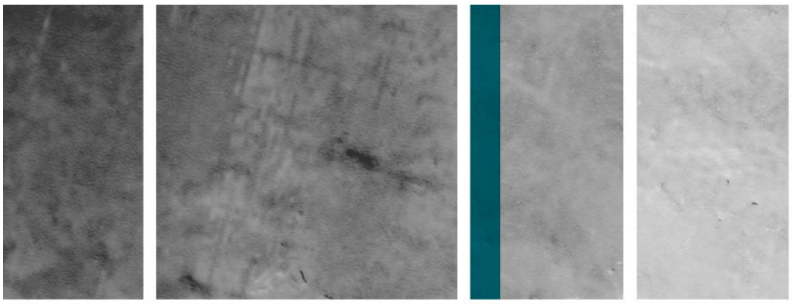
Grant Eccles

NSW National Parks and Wildlife Service

Wild deer can cause significant environmental damage in NSW, especially within National Parks and Reserves. Herbivory and environmental degradation caused by feral deer is key threatening process in NSW.

In NSW, aerial shooting is carried out by NSW Government employees who are members of the NSW Feral Animal Aerial Shooting Team (FAAST). Prior to 1990, seeing or controlling deer from the air was a rare event. Thus deer have historically only been opportunistically controlled in aerial programs in NSW during programs targeting other animals such as goats or pigs. However, in recent years, this opportunistic control while shooting large numbers of pigs or goats has reversed within some locations. Some programs are now controlling more deer than any other species.

The three main species of deer controlled from the air in NSW are Fallow, Red and Sambar. Given the right terrain, aerial shooting allows effective and efficient control of theses species in large numbers over a large area. This will be discussed and expanded upon during the presentation.



Managing wild deer in Queensland by trapping

Tony Pople[A], Jim Mitchell[B] and Byron Kearns[C]

[A]*Biosecurity Queensland*

[B]*FeralFix*

[C]*NQ Dry Tropics*

Traps offer a number of advantages for deer management. Animals can be captured live for potential sale, a trap can be target specific by allowing non-targets to be released and it may be the only publically-acceptable technique. The disadvantages are that the technique is relatively labour intensive and slow, not all deer are trappable, particularly if high quality food is naturally available, and traps may be vandalised or stolen. There are animal welfare concerns because, while trapped animals can be euthanised humanely, the act of trapping may be considered inhumane. Two styles of traps have been used in Queensland, large 'corral' traps capable of catching multiple animals, and box-like 'clover' traps designed to capture individual animals. Both traps require deer to be lured in by food and, for the larger traps, water. There are other live capture techniques such as drop nets, drive nets and rocket nets that have been used successfully overseas.

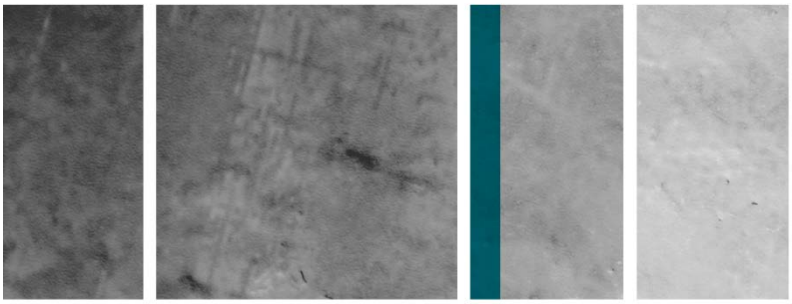
Corral traps are ideally large (2–4 ha) and may be permanent fixtures, but there are smaller portable designs. Gates can be triggered remotely or by a trip wire, or there may be a one-way 'jump-down' or funnel entrance. The recommendation is for 2-m high netting, extended to 2.5m with a top wire or further netting, plus hessian or shade cloth on the sides to minimise injuries and form a visual barrier. Large numbers of chital deer were caught in north Queensland in the 1980s using a 4.1 ha permanent trap and then trucked to Townsville and flown live to Victoria to stock deer farms. This was a successful sustained harvest with a strong financial incentive to make it work. The technique was revisited in late 2014 to help landholders control a large and growing chital deer population north of Charters Towers. There was also interest in commercial use of the animals, but the primary motivation was control. Trapping was recommended from landholder discussions and was hoped to supplement ground shooting. A 0.32-ha permanent trap was trialled for 12 months. It took a number of months to identify lucerne hay (rather than corn or Rhodes grass hay) as the most attractive bait and correct design flaws. Agile wallabies also entered the trap, but narrow spaces under the gate would provide an escape route for them and not deer.

Two corral traps are in constant use by one local government in southeast Queensland. They are portable structures (2.7m high and 176m^2) with gates triggered by SMS following receipt of a photo from a trail camera. Corral traps are being used

elsewhere in Queensland, but there is not strong interest because of small numbers of captures, animal welfare concerns (e.g. euthanizing large numbers of trapped deer), difficulty in attracting deer into the trap including an often lengthy pre-feeding period, non-target capture and greater success of alternative control methods such as ground shooting.

Clover traps (named after their designer) are a type of cage trap that have a metal or wooden box frame with netting sides and a sliding door that drops when a trip cord is triggered. The netting minimises injuries and a deer is more likely to enter a trap with see-through rather than opaque sides. A disadvantage is that the deer are unprotected from predators and other disturbances. As with corral traps, they require a suitable bait and a period of pre-feeding. They are portable and relatively inexpensive. However, they have had limited use in southeast Queensland. Around Brisbane, they account for ~7% of removed deer. They tend to be used mostly in urban areas where shooting is problematic and may be the only option in some situations. They have been used with variable capture success in the wet tropics in north Queensland, where rough terrain and thick vegetation makes it difficult to access animals to shoot.

Some assessment is needed on the cost-effectiveness of trapping and optimal trap design in different environments in Australia, particularly peri-urban areas. Local pest managers are often reaching identical conclusions on optimal control techniques and strategies, but their research and development efforts are unnecessarily being duplicated. A set of best practice guidelines would help avoid that. The value of trapping will depend on the feasibility of alternative control methods, which is influenced by various factors including the nature of the environment, acceptability of technique to the local community and availability of suitable weapons (e.g. suppressors).



Tools for managing wild deer: fencing

Ben Fahey

Parks Victoria

In 2015, researchers conducting surveys for the vulnerable Alpine Tree Frog in the Mount Bullfight Nature Conservation Reserve in the Victorian high country recorded significant damage to fragile alpine bogs by wallowing sambar deer.

Sambar deer are widespread and established throughout this reserve and all adjoining state forest. To protect the small, isolated alpine bog habitats and their populations of Alpine Tree Frog, deer exclusion fencing was installed to eliminate continued deer impacts and provide a chance for recovery in already damaged bogs. This project is intended to provide evidence on cost, utility and efficacy in using fences to protect alpine bogs in areas where deer are not eradicable and large scale control not practical.

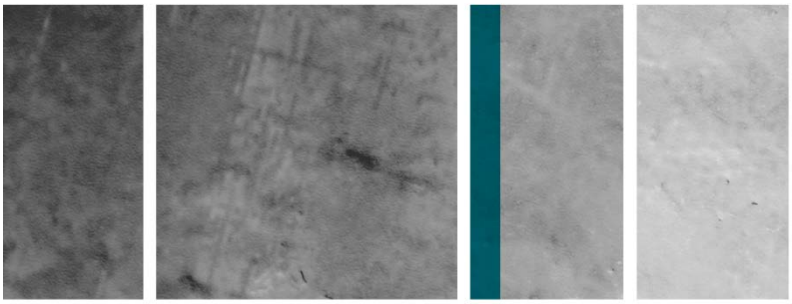
Tools for managing wild deer: poisoning

Rob Hunt

NSW National Parks and Wildlife Service

Use of toxicants for control of pest animals is widely undertaken by managers of both private and public lands across Australia. NSW National Parks and Wildlife Service has designed, developed and trialled a target selective feed structure for potential control of feral goats and deer.

Field trials have identified consistent site attendance by both feral goats and deer at feed structures when presented with an unpoisoned bait. Despite this high level of attendance by both species only feral goats consistently triggered a simple closed box mechanism to access free feed within a target selective feed structure. Additional field work will now be undertaken to explore previous bait presentation techniques where a higher level of interaction between feral deer and non-toxic bait was recorded. This will be discussed and expanded upon during the presentation.



Workshop discussion summary

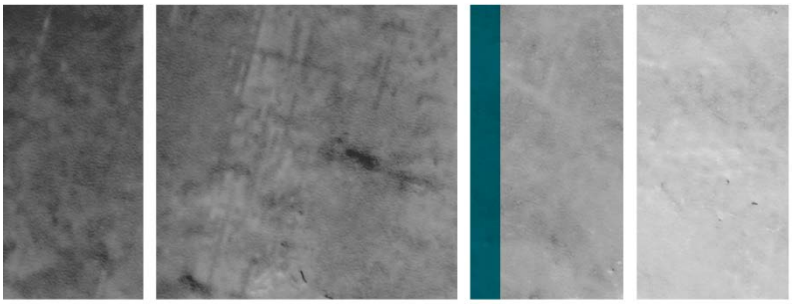
Theme 1: Impacts of wild deer

Potential impacts of wild deer

- Revegetation programs
- Native plant communities
- Native fauna (direct predation and indirect via consumption of plant material)
- Food for predators (wild dogs and foxes)
- Water quality
- Listed threatened species
- Crops
- Pasture
- Vehicle collisions
- Endemic diseases
- Exotic diseases
- Zoonotic diseases
- Nuisance (peri-urban settings)
- Illegal hunting (including stress to landholders and others, economic costs of damage and theft by illegal hunters)

Potential indicators for measuring key impacts of wild deer

Impact	Indicator	Cost to measure
Agricultural & (pasture crops)	• Dry sheep equivalents (DSEs) • Deer density and distibution • $ cost of lost crops	Low (data available)
Social	• Number of vehicle collisions from police reports or insurance companies (relative to collisions by macropods) • Number of concerned people	Low (data available)
Disease	• Number of chronic infestations of deer-specific diseases (in sentinel sites)	Medium-High (samples from shot deer and analyses required)
Water quality	• Water quality in areas where deer are in high density	Medium (sampling and analyses required)
Environment	• Number of threatened plant species preferred/eaten by deer • Changes in ecological communities	High (field surveys)

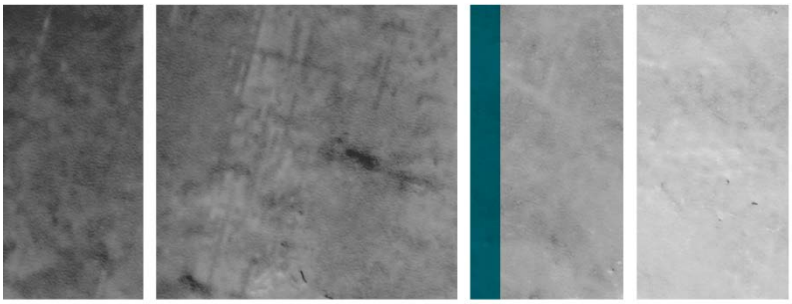


Impacts: Knowledge gaps prioritised as high (H), medium (M), low (L) or not identified (?).

Knowledge gap	Priority	Cost	Feasibility	Appropriate to fill gap	Timeframe (years)
Review of impacts of deer on agriculture (e.g. diet and spatial overlap with livestock), and metrics to monitor them in relation to changes in abundance and distribution of deer. What are assets most at risk and how are they measured ($ value, DSE, area impacted)?	H	L	H	H	1–2
Improved understanding of damage-density relationships and control thresholds required to protect assets (incl. decision support tool), including water quality and habitat damage.	H	?	?	?	?
Improved understanding of interactions of deer with other species that lead to environmental change (native species, pests, fire, climate change)	M	H	M	H	>5
*Develop a disease response strategy • Determine diseases likely to be high risk? • Monitor disease prevalence (survey) • Contact rates between deer and livestock • Investigate using disease as biological control	M	M	H	H	2–5

Knowledge gap	Priority	Cost	Feasibility	Appropriate to fill gap	Timeframe (years)
Understanding of how deer carcasses affect predators (wild dogs) and disease (transfer) risks	L-M	M	H	L	2–5
Determine rate of human injury/fatality in car collisions from deer relative to macropods (perceptions v. data)	L	L	H	H	1

** This knowledge gap was shared with the 'Management tools and systems' theme.*



Theme 2: Management tools and systems

Potential management options for wild deer

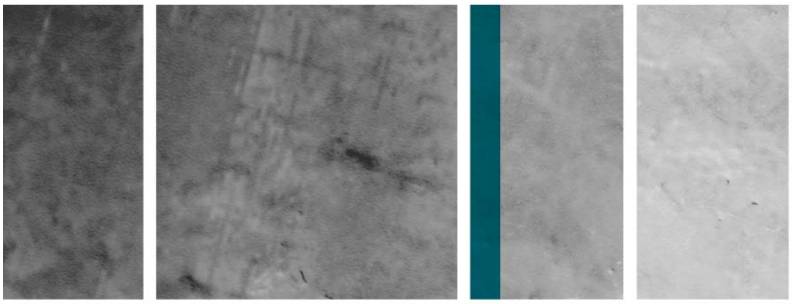
- Ground shooting
- Aerial shooting
- Fencing
- Trapping
- Repellents (including scare devices)
- Guardian dogs
- Poison baiting
- Commercial use (via some of the above options)

Constraints on management of wild deer

- Lack of SOP/manual for estimating deer abundances.
- Lack of knowledge of the ecology of the six deer species, particularly:
    - movements;
    - reproduction;
    - rate of increase;
    - mortality/survival rates.
- Social acceptability of some control methods.
- Motivations of hunters as pest controllers – can hunter behavior change so that harvest increases and deer density decreases?
- Skill and capacity of aerial and ground shooters.
- Trapping efficiency, particularly:
    - lures/attractants;
    - designs;
    - welfare outcomes.
- Use of deer carcasses by wild dogs and foxes following culling.
- Interactions between predators and deer – does fewer wild dogs mean higher fawn survival?
- Can poison baiting be used for deer?
- How to best utilize data collected by drones, including in peri-urban settings where other monitoring methods cannot be used.

Management tools and systems: Knowledge gaps prioritised as high (H), medium (M), low (L) or not identified (?).

Knowledge gap	Priority	Cost	Feasibility	Appropriate to fill gap	Timeframe (years)	Social acceptance
Assess animal welfare outcomes of aerial shooting	H	L	H	H	1	H?
Assess efficiency of using suppressors during ground shooting to reduce community concern and improve management effectiveness	H	L	H	H	1	H
Improve understanding of lures and options for baiting deer (including feeders)	H	L	H	H (in peri-urban)	3	H
Build capacity and training of contractors to control deer with dogs and ground shooting	H	H	M	M	2–5	?
How cost effective are guardian dogs and fences at protecting assets (e.g. crops)?	H	M-H	H	M	2–5	H
*Understand motivations of recreational hunters to shoot more females / more deer (e.g. incentives, education on reducing impacts)	H	H	M	H	2–5	?
Determine how commercial use of deer products (e.g. hides,	H	?	?	H	2–5	H



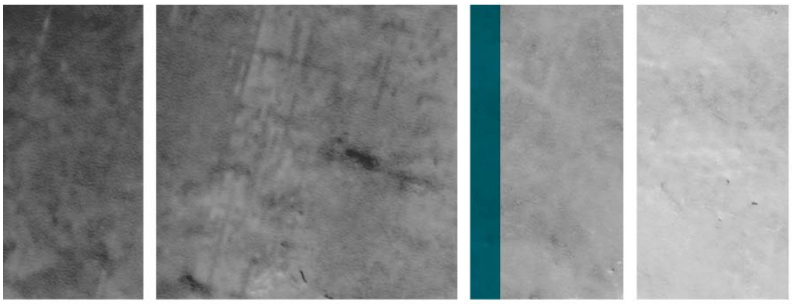
Knowledge gap	Priority	Cost	Feasibility	Appropriate to fill gap	Timeframe (years)	Social acceptance
meat, velvet, antlers) can be used to reduce impacts of deer						
**Best-practice management guide (online, regularly updated): • Review effectiveness of existing monitoring techniques for different scenarios, species, habitats, costs, sampling designs • For community – how to control deer • For managers – how to control and monitor deer and their impacts	H	L	H	H	1–2	H
Improve trapping techniques (jump-downs, gates, corral traps) and associated monitoring (e.g. SMS door closing)	M-H	M	H	H	2	H
***Develop a disease response strategy: • Determine diseases likely to be high risk? • Monitor disease prevalence (survey)	M	M	H	H	2–5	?

Knowledge gap	Priority	Cost	Feasibility	Appropriate to fill gap	Timeframe (years)	Social acceptance
• Contact rates between deer and livestock • Investigate using disease as biological control						
Develop fencing standards	L	L	H	H	3	H

** This knowledge gap was shared with the 'Community engagement, use and awareness' theme.*

*** This knowledge gap was shared with the 'Monitoring deer distribution and abundance' theme.*

**** This knowledge gap was shared with the 'Impacts' theme.*



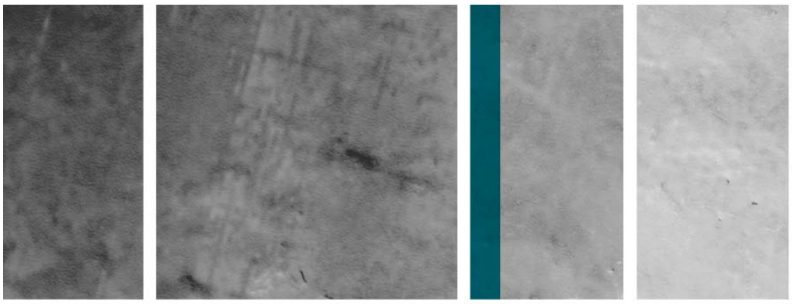
Theme 3: Monitoring deer distribution and abundance

Monitoring deer distribution and abundance: Knowledge gaps prioritised as high (H), medium (M) or low (L).

Knowledge gap	Priority	Cost	Feasibility	Appropriate to fill gap	Timeframe (years)
*Best-practice guide (online, regularly updated) • Review effectiveness of existing monitoring techniques for different scenarios, species, habitats, costs, sampling designs (desktop study) • For community – how to control deer • For managers – how to control and monitor deer and their impacts	H	L	H	H	1–2
Assess/validate emerging techniques (including thermal imaging, drones, automation of video/photographic image processing, species recognition algorithms, alert systems, citizen science platforms, integration with other systems, datasets)	M-H	M	H	H	2–3
Improved understanding of how fast and where deer will spread (e.g. using predictive models and habitat preferences)	M-H	M-H	H	H	2–5

Knowledge gap	Priority	Cost	Feasibility	Appropriate to fill gap	Timeframe (years)
Understand barriers to managers using monitoring data to inform control efforts (access, format, analyses, standardising, error detectability, processing issues, tailored to objectives)	M	H	M	M	1–5

** This knowledge gap was shared with the 'Management tools and systems' theme.*



Theme 4: Community engagement, use and awareness

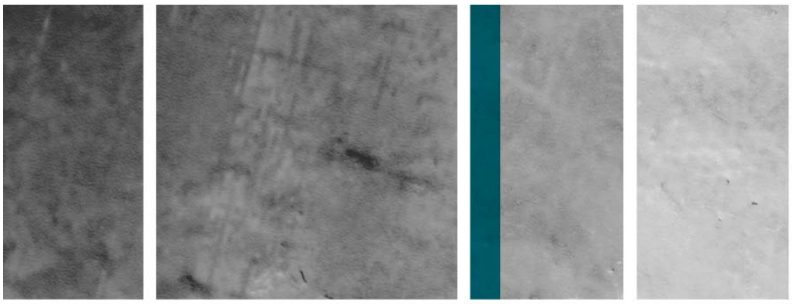
Community engagement, use and awareness: Knowledge gaps prioritised as high (H), medium (M) or low (L).

Knowledge gap	Priority	Cost	Feasibility	Appropriate to fill gap	Timeframe (years)
Develop a community engagement model: • Basic education on deer impacts • Trial sites • Up front, what is negotiable • Education on technology • Measure behaviour changes (survey) • Reporting back to community (two-way)	H	H	H	H	2–5
*Understand motivations of recreational hunters to shoot more females / more deer (e.g. incentives, education on reducing impacts)	H	H	M	H	2–5
Improved understanding of community attitudes at national scales, review existing surveys, determine thresholds for attitudinal change to support /implement management (repeat surveys through time)	M	L	H	L	1

** This knowledge gap was shared with the 'Management tools and systems' theme.*

Contact details for workshop attendees

Invasive Animals CRC		
Andreas Glanznig	Chief Executive	Andreas.Glanznig@invasiveanimals.com
John Tracey	Research Director	john.tracey@dpi.nsw.gov.au
Chris Lane	Projects Manager	chris.lane@dpi.nsw.gov.au
Federal Government		
Margaret Heath	Department of Agriculture and Water Resources	Margaret.Heath@agriculture.gov.au
ACT		
Ollie Orgill	ACT Parks and Conservation Service	oliver.orgill@act.gov.au
TAS		
Michael Driessen	Department of Primary Industries, Parks, Water and Environment	michael.driessen@dpipwe.tas.gov.au
Chris Johnson	University of Tasmania	c.n.johnson@utas.edu.au
SA		
Brad Page	Department of Primary Industries and Regions	bradley.page@sa.gov.au
Annelise Wiebkin	Department of Primary Industries and Regions	annelise.wiebkin@sa.gov.au
Grant Pelton	Department of Environment, Water and Natural Resources	grant.pelton@sa.gov.au
NSW		
Andrew Moriarty	Department of Primary Industries	andrew.moriarty@dpi.nsw.gov.au
Dave Forsyth	Department of Primary Industries	dave.forsyth@dpi.nsw.gov.au
Michelle Dawson	South East Local Land Services	michelle.dawson@lls.nsw.gov.au
Rob Hunt	Office of Environment and Heritage	rob.hunt@environment.nsw.gov.au
Grant Eccles	Office of Environment and Heritage	grant.eccles@environment.nsw.gov.au
Graham Hall	University of New England / Game & Pest Board	ghall20@une.edu.au
Tarnya Cox	Department of Primary Industries	tarnya.cox@dpi.nsw.gov.au



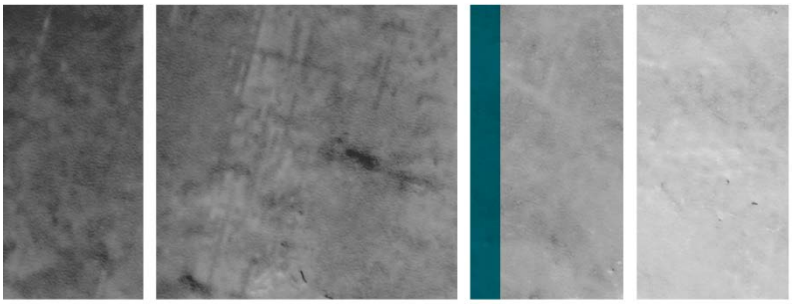
VIC		
Ben Fahey	Parks Victoria	ben.fahey@parks.vic.gov.au
Dan Brown	Parks Victoria	Daniel.Brown@parks.vic.gov.au
Naomi Davis	University of Melbourne	ndavis@unimelb.edu.au
Simon Toop	Game Management Authority	simon.toop@gma.vic.gov.au
David Ramsey	Arthur Rylah Institute	david.ramsey@delwp.vic.gov.au
QLD		
Tony Pople	Biosecurity Queensland / Invasive Animals CRC	tony.pople@daf.qld.gov.au
Matt Amos	Biosecurity Queensland	matt.amos@daf.qld.gov.au
Neal Finch	Department of Environment and Heritage Protection	neal.finch@ehp.qld.gov.au
Anthony Cathcart	Sunshine Coast Council	anthony.cathcart@sunshinecoast.qld.gov.au
Robert Cobon	Biosecurity Queensland North Regions	robert.cobon@daf.qld.gov.au
WA		
Malcom Kennedy	Department of Agriculture and Food	malcolm.kennedy@agric.wa.gov.au
New Zealand		
John Parkes	Kurahaupo Consulting	john.parkes1080@gmail.com

Background information. I. Current status of wild deer in Australian states and territories.

State/territory	Key legislation	Status
Australian Capital Territory	*Pest Plants and Animals Act 2005*	Pest
New South Wales	*Game and Feral Animal Control Act 2002*	Game
Northern Territory	*Territory Parks and Wildlife Conservation Act 2006*	Pest
Queensland	*Land Protection (Pest and Stock Route Management) Act 2002*	Pest
South Australia	*Natural Resources Management Act 2004*	Pest
Tasmania	*Nature Conservation Act 2002*	Game
Victoria	*Wildlife Act 1975*	Game
Western Australia	*Biosecurity and Agriculture Management Act 2007*	Pest

Australian Capital Territory

- Under the *Pest Plants and Animals Act 2005*, the Pest Plants and Animals (Pest Animals) Declaration 2005 lists *Cervus* spp. and *Dama* spp. as pests.
- *Axis* species and *Rusa* species are proposed to also be declared pending ministerial approval.
- There is no obligation for land managers to undertake control programs for declared pest species.
- Any deer species cannot be kept as livestock in the ACT without a licence under the *Nature Conservation Act 2014.*



New South Wales

- 'Deer (Family Cervidae)' classified as Game under the *Game and Feral Animal Control Act 2002* and *Game and Feral Animal Control Regulation 2012*.
- Deer may be hunted under a licence (with some exemptions for landholders and Government Officers executing their duties). Written permission required for hunting on specified public lands (obtained via online booking system).
- Year-long hunting season for sambar, chital and rusa deer; restricted hunting season for fallow deer and red deer (8 months) and hog deer (1 month).
- New Biosecurity legislation due to commence in early 2017 will likely provide several mechanisms to assist in the management of wild deer, where they cause unacceptable impacts.

Northern Territory

- Classified as a pest (feral – prohibited entrant) under the *Territory Parks and Wildlife Conservation Act 2006*.

Queensland

- The *Biosecurity Act 2014* imposes a *General Biosecurity Obligation* on individuals involved with deer, requiring them to take all reasonable and practical measures to prevent or minimise a biosecurity risk that they should know about.
- Wild or feral chital, rusa, red and fallow deer (all established in the wild in Queensland) are 'restricted' invasive animals under the *Biosecurity Act 2014*. They must not be moved, fed, given away, sold or released into the environment without a permit. Wild sambar and hog deer (not established in the wild in Queensland) are also restricted invasive animals under the *Biosecurity Act 2014*. In addition to the restrictions for the other four established species, they must not be kept without a permit and their presence must be reported to an authorised officer (usually from Biosecurity Queensland or local government).
- Where chital, rusa, red and fallow deer are contained within a deer-proof fence (e.g. on farms or in game parks), they are not declared pests. Any deer not within a deer-proof fence are considered feral or wild and subject to control.

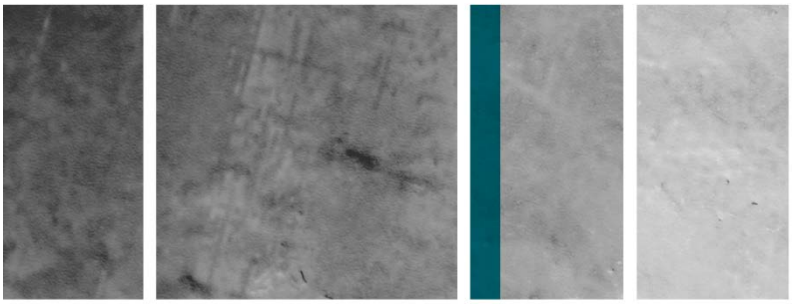
- All other species of deer in the wild are 'prohibited' invasive animals and may be subject to an eradication program if they are considered a significant biosecurity threat.

South Australia

- Deer are declared pest animals under the *Natural Resources Management Act 2004*.
- Under the *Natural Resources Management Act 2004*, it is an offence to release deer.
- Under the *Natural Resources Management Act 2004*, deer cannot be on a property unless they are adequately fenced.
- Under the *Natural Resources Management Act 2004*, deer that are not adequately fenced are declared pest animals, which must be controlled.
- Under the *Natural Resources Management Act 2004*, all land owners (public and private) are required to control deer (either capture or destroy) that are not adequately fenced.
- The *Natural Resources Management Act 2004* imposes additional requirements on the keeping of deer on Kangaroo Island.
- The *deer advisory note on controlling feral deer in South Australia* indicates that methods for controlling deer are limited to shooting (including with a spotlight) or trapping.
- Under the *National Parks and Wildlife Act 1972*, a basic hunting permit is required to hunt deer (the land owner is exempt).

Tasmania

- Classified as Wildlife under the *Nature Conservation Act 2002* and Partly protected wildlife under the *Wildlife (General) Regulations 2010*.
- Fallow deer may be hunted under a licence during an annual hunting season (1 month antlered males, 2 months antlerless deer). Bag limit of 1 male and 2 antlerless deer or 3 antlerless deer. First-year males may not be taken. Only rifle hunting permitted.
- Crop protection permit (CPP) required for controlling problem deer. Permits are available to take all sex and age classes. CPP are generally not issued for antlerless deer during November–March when females are pregnant/have dependent young.



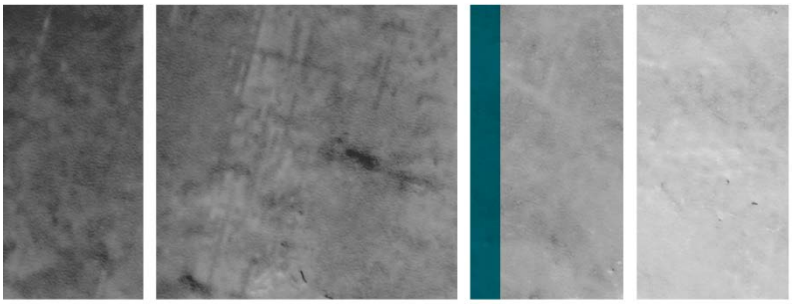
Victoria

- Under the *Wildlife Act 1975* all deer are protected as wildlife. Six species (chital, rusa deer, hog deer, fallow deer, sambar and red deer) are further declared game species for the purpose of the *Wildlife Act 1975* and the Wildlife (Game) Regulations 2012. These species can be hunted under a game licence where the harvest method is specified (e.g. firearms, hounds). Year-long hunting season and unrestricted bag limit for all game deer species, except hog deer (one month season, limit of one male and one female). Hunting Sambar deer with hounds is permitted between April-November, inclusive. The recreational hunting of deer at night is prohibited.
- Deer causing damage on public land can be destroyed under an Authority to Control Wildlife Permit.
- Game deer species (excluding hog deer), wapiti, sika deer and sika-red deer hybrids causing damage on private property are subject to an 'unprotection order' and can be destroyed without permit in accordance with specified conditions, which includes the use of spotlights at night.
- Under the *Catchment and Land Protection Act 1994*, all deer except chital, hog, red, wapiti, sika, sika–red hybrids, fallow, rusa and sambar, are listed as prohibited pest animals.
- Under the Wildlife Regulations 2013, deer may be kept without a permit for the purposes of farming. Under the *Wildlife Act 1975*, it is illegal to release captive deer to the wild.
- Under the *Flora and Fauna Guarantee Act 1988*, Sambar are listed as a Potentially Threatening Process for the reduction in biodiversity of native vegetation.
- Under the *National Parks Act 1975*, exotic (which includes deer) fauna must be controlled or eradicated in areas managed under that Act.

Western Australia

- Under the *Biosecurity and Agriculture Management Act 2007*, fallow and red deer/wapiti/elk are declared pests (s22(2)) and classified as C3 Management, Restricted Keeping) and are the responsibility of landholders to control.
- Under the *Biosecurity and Agriculture Management Act 2007*, rusa deer are declared pests (s22(2)) and classified as C1 Exclusion, Prohibited Keeping)
- Under the *Biosecurity and Agriculture Management Act 2007*, chital, hog, sika and sambar deer are prohibited species (s12 and classified as C1 Exclusion).

- Fallow deer and red deer/wapiti/elk may be kept with a permit. All other species are prohibited from being kept.
- A recent review of the declaration status of all vertebrate pests declared under section 22(2), recommended that it is appropriate for rusa deer to be declared a prohibited organism under section 12 of *Biosecurity and Agriculture Management Act 2007*. The recommended change in declaration status is currently (September 2016) before the Minister for approval.



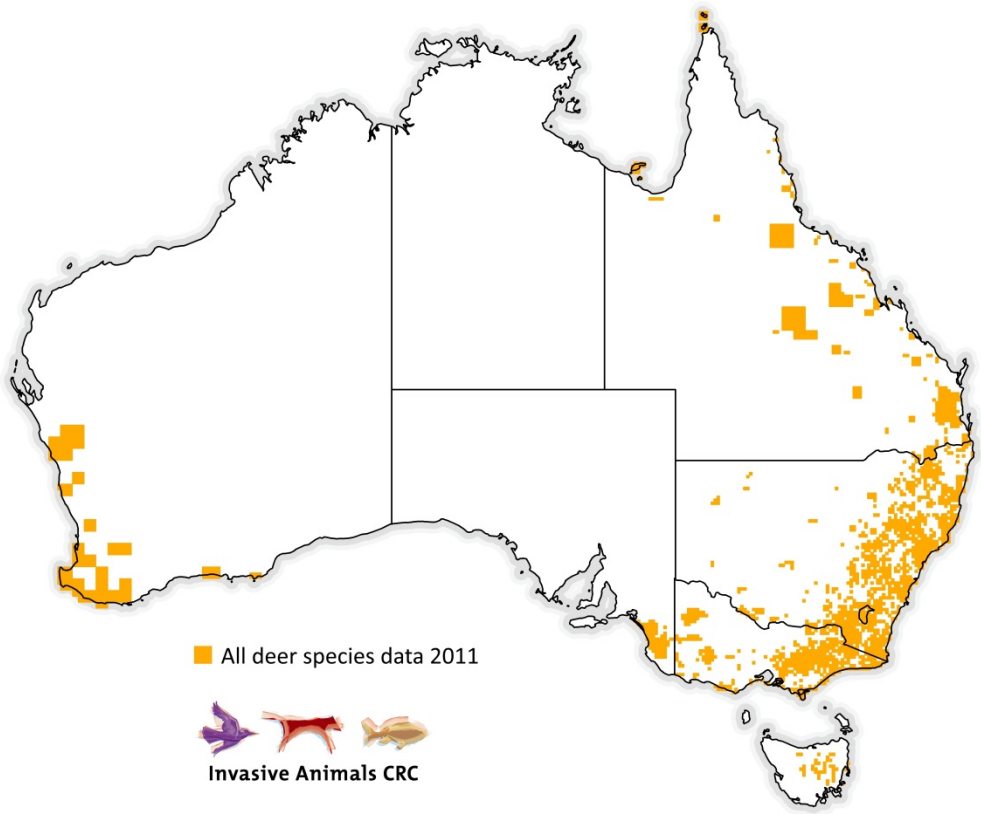
Background information. II. Wild deer distributions in 2011.

The following maps were produced based on information collated from a multitude of sources by Peter West (Invasive Animals CRC) in 2011. Although these maps are the most recent national assessments, the distributions of some species are believed to have changed since 2011. For further information on how the maps were created, see West (2011). These maps must not be reproduced without the permission of Peter West/Invasive Animals CRC.

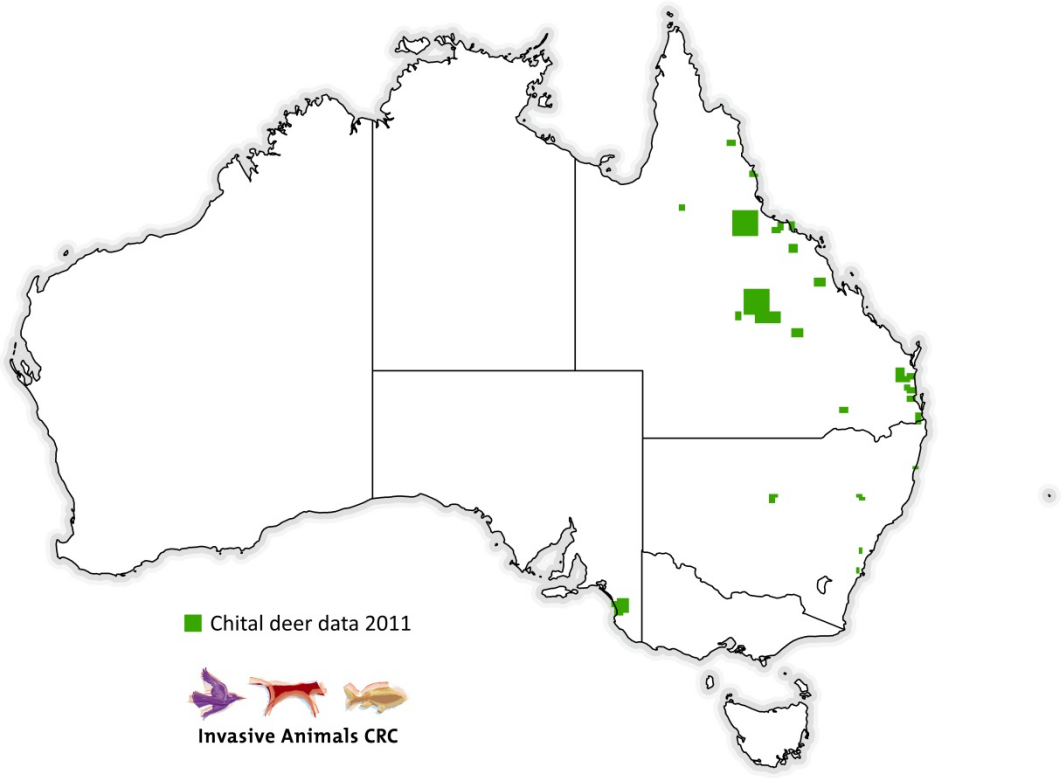
Reference

West, P. (2011) *National mapping of the abundance of established, new and emerging pest animals to improve decision-making and the assessment of Government investment programs. Stage 1: pest animals report to the Australian Bureau of Agricultural and Resource Economics and Sciences, Department of Agriculture, Fisheries and Forestry*. NSW Department of Primary Industries and the Invasive Animals Cooperative Research Centre, Orange.

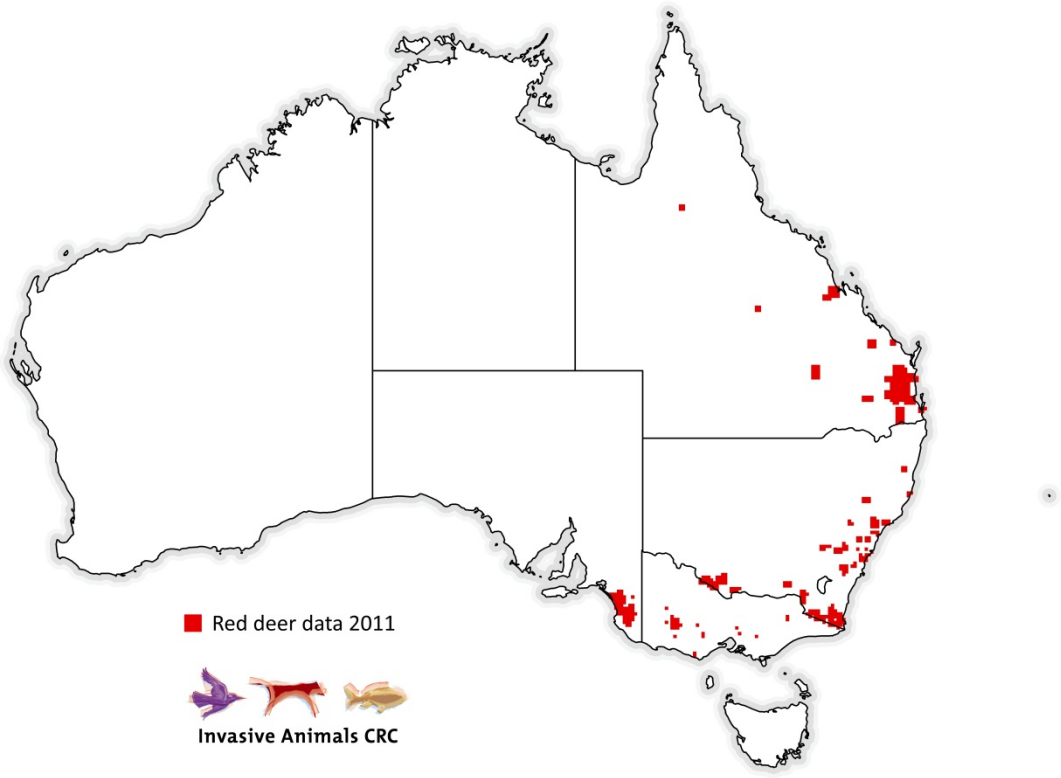
All deer species 2011



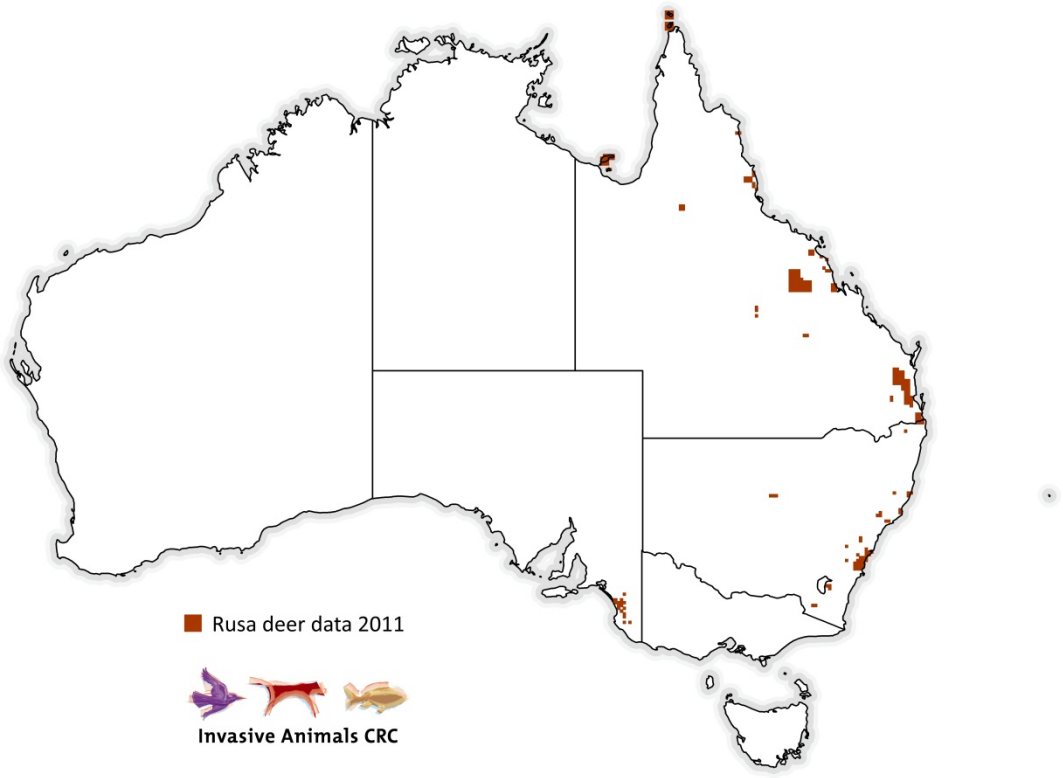
Chital deer 2011



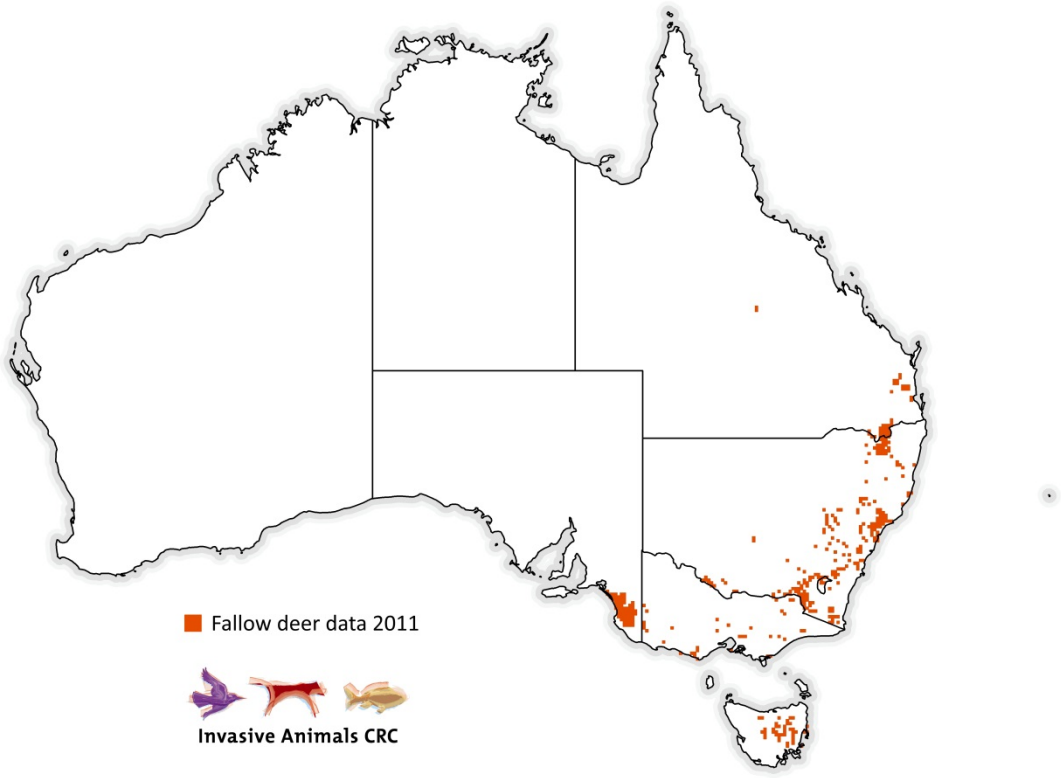
Red deer 2011



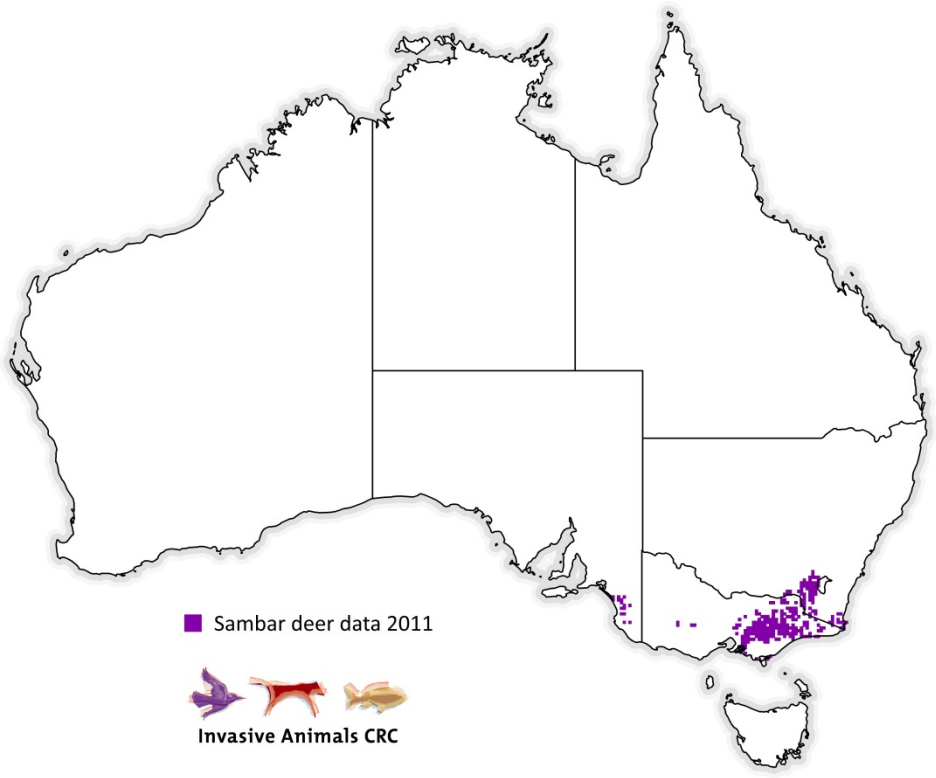
Rusa deer 2011



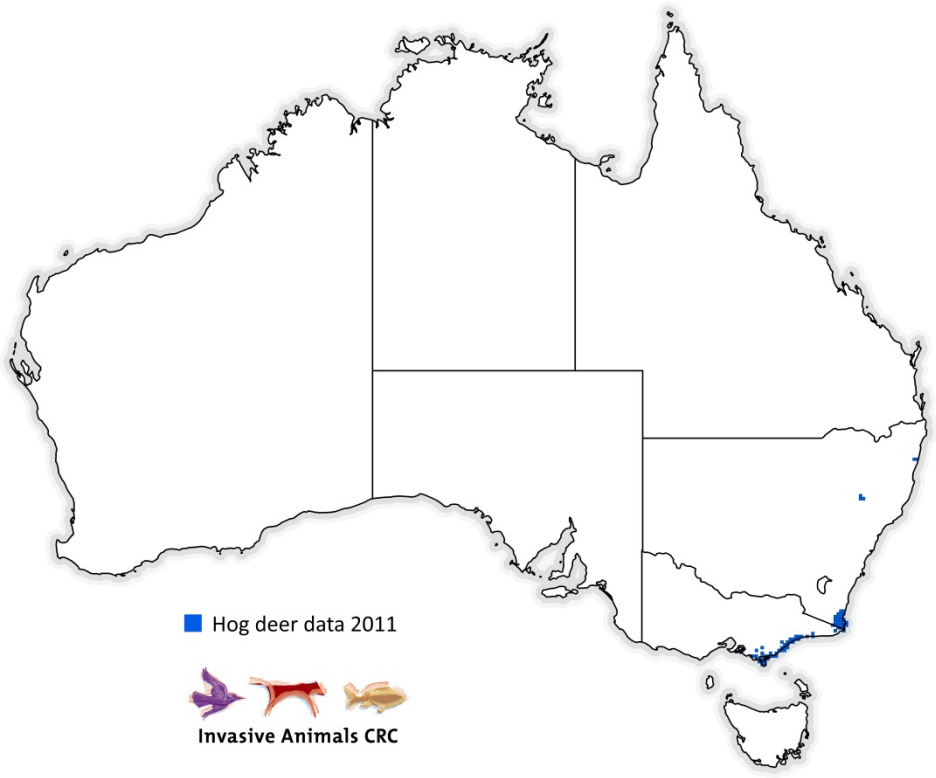
Fallow deer 2011

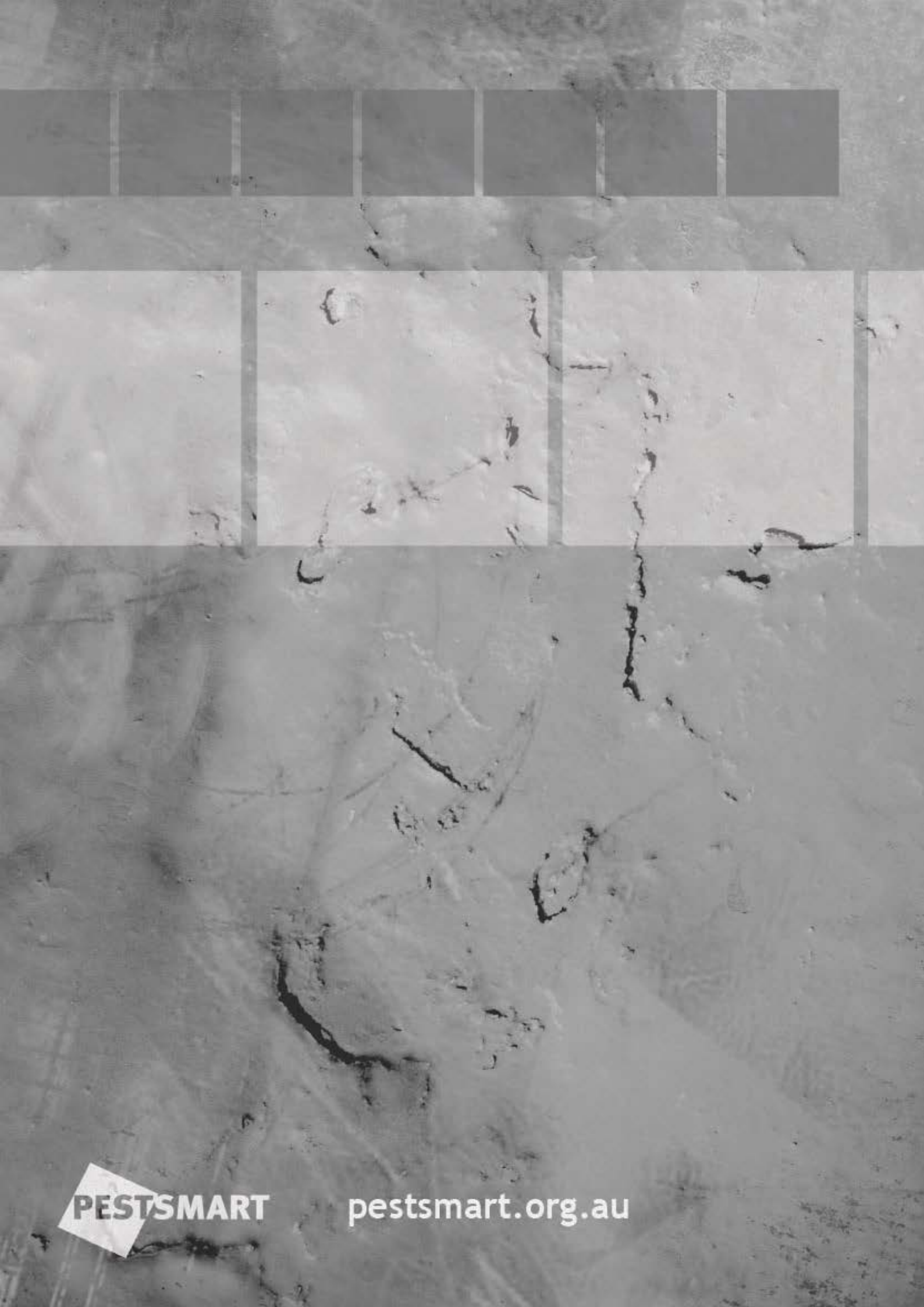


Sambar deer 2011



Hog deer 2011

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