



Natural
Resources
Commission

Shared Problem, Shared Solutions

Pest Animal Management Review

Draft Report March 2016



Enquiries

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List of acronyms

1080	Sodium fluoroacetate
ABARES	Australian Bureau of Agricultural and Resource Economics and Science
ABS	Australian Bureau of Statistics
APVMA	Australian Pesticides and Veterinary Medicines Authority
BIS	Biosecurity Information System
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Cwlth	Commonwealth
CyHV-3	Cyprinid Herpesvirus 3
NSW DPI	NSW Department of Primary Industries
GDP	Gross Domestic Product
Invasive Animals CRC	Invasive Animals Cooperative Research Centre
IPART	Independent Pricing and Regulatory Tribunal
LLS	Local Land Services
NPWS	National Parks and Wildlife Services
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PAPP	para-aminopropiophenone
RHD	Rabbit Haemorrhagic Disease
RSPCA	Royal Society for the Prevention of Cruelty to Animals
SSAA	Sporting Shooters Association of Australia
VET	Vocational Education and Training
VPRU	Vertebrate Pest Research Unit

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How you can have your say

The Commission invites submissions regarding this draft report from members of the community and stakeholders. Feedback received will be used to inform our final recommendations to the Premier in June 2016.

The Commission is specifically seeking feedback on the draft recommendations discussed in this report. We encourage you in your submission to identify your reasons for support or non-support of the recommendations, as well as any issues or opportunities for improvement.

There is no standard format for submissions. Submissions may range from a short letter outlining your views on a recommendation, or to a more comprehensive document discussing a large range of the draft recommendations. Where possible, you should specify which recommendation(s) you are referring to, and provide evidence, such as relevant data and documentation to support your views.

Submissions close **5pm 18 May 2016**.

We prefer to receive submissions through our **online form** at www.nrc.nsw.gov.au/pest-animal-management

Alternatively, submissions can be made via email, fax or mail:

Email: nrc@nrc.nsw.gov.au

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We treat all submissions as public and make them available on our website, unless marked confidential or it contains material that is offensive or in breach of any law. Details of our privacy policy can be found at the Commission's website at www.nrc.nsw.gov.au/making-a-submission.

Table of Contents

Executive Summary	1
Recommendations	5
1 Background of pest animal management	13
1.1 Scope of the review	13
1.2 Guiding principles and pest definition	14
1.3 Framework for pest management in NSW	15
2 Pest animals, impacts and risk	20
2.1 How it began	20
2.2 Managing the problem	20
2.3 Impact of pest animals in NSW today	23
3 The value of strengthened governance and planning	32
3.1 State planning and governance to set the agenda	32
3.2 Regional planning and governance guides on-ground management	37
4 Better risk management	46
4.1 New and future risks	46
4.2 Prioritisation and risk assessment	48
4.3 Assessing the risk of new incursions	49
4.4 Managing incursions and preventing infestations	52
4.5 Institutional complexity a barrier to effectiveness	54
4.6 Preventing new incursions of freshwater pests	57
5 People are fundamental for successful pest management	61
5.1 Coordination as a driver of local success	61
5.2 Enabling practice change	64
5.3 People and freshwater pest management	68
6 Recommended changes to legislation and regulation	71
6.1 Declaration of pests in NSW	71
6.2 Management of deer in NSW must change	72
6.3 Reducing the risks from cats	77
6.4 Wild dogs – Schedule 2 lands	83
7 Improved management	85
7.1 Biocontrol for carp	85
7.2 Valuing science and heritage – feral horses	87
7.3 Greater consistency in managing introduced birds in NSW	92
7.4 Recreational hunting as a management tool	94
7.5 Market mechanisms - wild boar and deer management	97
7.6 Non-commercial use of kangaroo meat for baits	98
7.7 Conservation and pest management collaboration	99

8	Improved knowledge base	100
8.1	Long-term research capacity	100
8.2	Setting effective research priorities	101
8.3	Sharing research	103
8.4	Pest mapping and citizen science	104
8.5	Standardising data protocols	105
8.6	Research and development in freshwater pest management	106
9	Targeted funding	107
9.1	Current investment in pest management	107
9.2	Current investment weightings and suggested future priorities	108
9.3	Public funding drives widespread public benefits	111
9.4	Recommendations to increase funding streams	112
9.5	Funding freshwater pest management	115

Attachment 1: Terms of reference

Attachment 2: Stakeholder report

Attachment 3: Supplementary Information: Regulatory framework

Executive Summary

The Premier of NSW has requested the Natural Resources Commission (the Commission) undertake an independent, state-wide review of pest animal management in NSW. The Premier's terms of reference request the Commission identify opportunities to improve the management of introduced terrestrial and freshwater vertebrate species in NSW, across all land tenures, for environmental, economic and social benefits. This report sets out the Commission's preliminary findings and 27 interlinked draft recommendations for pest animal management. The Commission welcomes community and industry feedback on the draft findings and recommendations to inform its final report to government in June 2016.

Our Principal Findings

Introduced pest animals are pervasive across NSW. No one is immune from their impacts. Conservative estimates place the annual economic impact of all invasive pest animals at \$720 million to \$1 billion dollars nationally, or \$170 million in NSW from wild rabbits, carp, pigs, foxes, dogs, goats and introduced birds. Invasive species and habitat loss are the greatest threats to biodiversity, with cats alone threatening 36 mammal species nationally. Much positive progress has been made in pest management. However, the risks from future incursions and diseases remain extreme. As the problem of pest animals is a shared one, the solutions demand shared responsibility, investment, action and accountability across all tenures.

The NSW *Biosecurity Act 2015*, with its general biosecurity obligation, provides a strong platform for securing the future of NSW agricultural markets, wellbeing and biodiversity. The challenge facing government is to effectively implement this obligation using contemporary education and engagement practices, backed by enforceable and enforced sanctions. Government must also address new and emerging pest risks, place a stronger focus on high-risk pathways and ensure administrators can rapidly access funds to enable future rapid response.

For many widespread species, such as dogs, pigs, rabbits and foxes, a number of sound practices have been developed out of extensive research and on-ground knowledge built to date. For these established pests, the ongoing challenge is mostly about sustaining landholder effort and funding across seasons, while maintaining research to identify the next game-changing control method, such as biocontrols.

Importantly, the Commission's draft recommendations are not limited to legislative or regulatory frameworks alone. They recognise that people will be integral to program success. Drawing on extensive research and consultation, the report outlines how, by engaging and involving people at all levels, government can drive higher returns on investment, improve on-ground results, and prevent damaging future incursions.

Building a more future-proof approach to pest management

Much opportunity lies firstly in strengthening governance at the state level. The leadership set by NSW's key bodies, led by the NSW Department of Primary Industries, should successfully guide and support pest management actions at the regional level, led in turn by Local Land Services. Agency and landholder efforts need to be better prioritised and guided by expert committees, which include community and industry representation. Joint landscape planning provides for robust and transparent governance, allowing a strategic and adaptive approach.

Further, state-wide strategies and regional plans need to be consistent with the new *Biosecurity Act 2015*, while making all stakeholders more accountable and aligned better with emerging risks and priorities.

With the new legislation, the government has the opportunity to introduce consistent regulations to address the risks and impacts from all major invasive species, namely to treat feral deer and cats as pests just like feral pigs and dogs. This will enable greater prioritisation of these species and better management of risk pathways while still valuing and encouraging recreational hunting and responsible pet ownership.

People are a cornerstone of successful pest management

While the State's key agencies are crucial to setting strong regulatory frameworks, communities will be instrumental in getting better on-ground results. This makes it essential to empower all landholders to own the problem of pest animals and work together, sharing the responsibility to manage it effectively and prevent new incursions.

This approach will draw on what we know to mean best practice in pest management: collective action across tenures, because pests affect everyone and can best be combatted through joint efforts. When individual landholders, managers or other parties do not uphold their responsibilities, the whole system weakens. It is critical that public and private landholders are not only engaged, but are also held to account for controlling pests on their land.

This report details successful community-led programs that are managing wild dogs, pigs, goats and rabbits collaboratively across tenures, and which set a valuable precedent for NSW to build on. Establishing a network of professional coordinators to build greater community capacity to participate in pest management and better align efforts across the wider landscape is essential.

Rural, urban and peri-urban communities must be educated on the potential incursion pathways represented by global trade movements, legal and illegal pet markets, and urbanisation as factors contributing to the deliberate or accidental release of pests into the environment. The role of citizen science and data mapping of new incursions can also be strengthened.

Strategic investments for high-value outcomes

To date, research has netted some high-value methods for those grappling first-hand with pest management. Foremost among them are biocontrols, which in the case of rabbits have delivered an estimated \$70 billion in returns over the past six decades. However, growing genetic resistance in many species means that current efforts need to be maintained and strategically extended, and new efforts need to be initiated.

NSW must continue to invest in research, and prioritise ongoing risk prevention to drive potential investment returns of up to 100 times greater than instances of pest infestations. The Commission urges the upkeep and expansion of research efforts, particularly in a climate where the major research body, the Invasive Animals CRC, nears the end of its tenure and has no confirmed successor. For example, the Centre's recently refined cyprinid herpesvirus (CyHV-3) for carp has the potential to reduce populations of this pest by up to 90 percent, a once-in-a-generation opportunity to restore the aquatic and environmental health of the Murray-Darling Basin river systems.

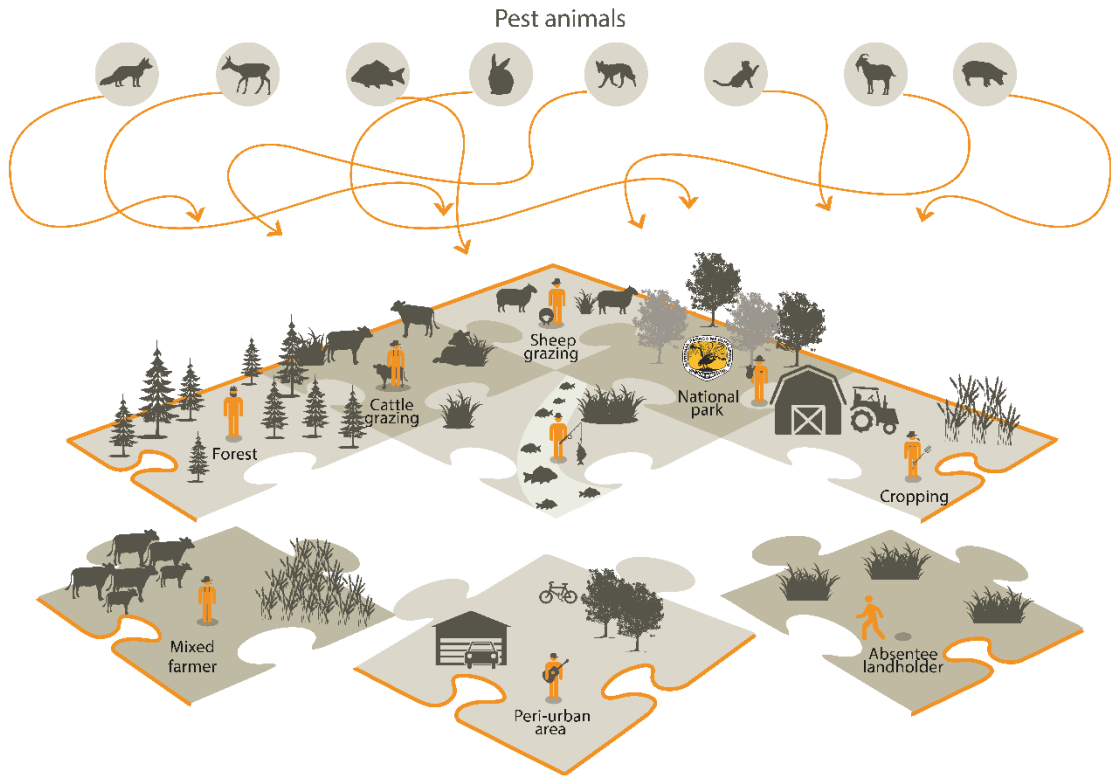
In addition to prioritising research and maintaining joint funding, the report also recommends that NSW initiate three new funding streams. The first of these would reflect the biosecurity risks created by smaller landholders, by reducing the minimum rateable area down to two hectares. The second would provide joint funding for the new Local Land Services coordinator positions. The final stream would provide for rapid response to new risks or opportunities at the local level, through a ratepayer fund similar to the Locust Levy.

Draft recommendations

The draft recommendations presented in this report have been developed to address pest management in the context of a more urbanised and more globally connected NSW than in the past. The Commission urges NSW to adopt a more strategic, shared and people-centric approach to securing NSW's biosecurity future as it enters the next phase of managing pests, through the implementation of the NSW *Biosecurity Act 2015* and draft *Invasive Species Plan 2015-2022*. Recognising that there is no silver bullet, the Commission has proposed the following interrelated suite of actions to reduce the risks and impacts from pests for the benefit of all residents of NSW.

Shared problem

Pests don't respect boundaries and land managers don't always work together



Shared solutions



Local groups supported by Local Land Services coordinators



Recommendations

Recommendations – Pest animals

Value of Strengthened governance and planning

1 **Recommendation:** Adoption of core components for state planning.

NSW Government should adopt the following as core components of its NSW *Invasive Species Plan 2015-2022*:

- i. government resources are prioritised based upon greater return on investment from prevention and eradication of new incursions
- ii. private and public land managers are best placed to jointly manage infestations and widespread pests as part of a cross tenure regional approach
- iii. improved management of risk pathways and extreme risk species
- iv. people are fundamental to making solutions work and need to be supported to ensure they are fully engaged
- v. reduce red tape to improve control of pests
- vi. biosecurity obligations are supported by enforceable and enforced sanctions for all risk creators regardless of tenure and industry
- vii. on-going research and development is prioritised
- viii. existing funding is maintained and new shared funding initiatives are developed to address targeted needs.

2 **Recommendation:** Provide transparent state level leadership and accountability.

The NSW Government should:

- i. update the NSW *Invasive Species Plan 2015-2022* to:
 - a. specify that the lead agency for new terrestrial and freshwater *incursions* is the NSW Department of Primary Industries.
 - b. specify that the lead agency for managing *established* terrestrial pest animals is Local Land Services and the lead agency for managing *established* freshwater pest animals is Department of Primary Industries.
 - c. specify that the Biosecurity Advisory Committee is responsible for deciding when a pest animal transitions from being a new incursion to an established pest animal
 - d. include clear objectives and priorities, measurable targets, roles and responsibilities and timeframes for delivering prevention and control of pest animals
 - e. commission an independent mid-term and final review of the NSW *Invasive Species Plan 2015-2022*, including risk assessments and surveillance activities.
- ii. confirm the ongoing status of the recently created Biosecurity Advisory Committee as responsible for both terrestrial and freshwater weed and pest animal management in NSW. An aquatic biosecurity representative should be appointed to the Biosecurity Advisory Committee.
- iii. make the Biosecurity Advisory Committee responsible for endorsing and monitoring the NSW *Invasive Species Plan 2015-2022*, providing oversight of pest animal risk assessments and approving the prioritisation framework

Recommendations – Pest animals

- iv. include in the terms of reference for the Biosecurity Advisory Committee obligations to consult with regional pest animal management committees (including freshwater representatives) on development and implementation of regional plans
- v. include the functions of the Pest Animal Council in to the Biosecurity Advisory Committee.

3 **Recommendation:** Provide regional leadership and local delivery of pest management.

The NSW Government should:

- i. establish regional pest animal management committees (akin to the regional weed committees) under Section 33 of the *Local Land Services Act 2013*. The scope of the Committee's work will include terrestrial pest animals and should include a representative from organisations representing landholders /producers, community, environment, recreational users, local government, and relevant agencies
- ii. establish an accountability hierarchy with the regional pest animal management committees reporting to Local Land Services Regional Boards and ultimately to the Minister based on the NSW *Invasive Species Plan 2015-2022*
- iii. establish a staged approach to integrate pest plant and animal management: parallel committees and planning to merge over a three-year period to realise opportunities of efficiencies
- iv. task the regional pest animal management committees with developing regional priorities and targets for widespread terrestrial pest animal management and standardised systems for surveillance and reporting. The regional plans will complement the mandatory measures for pest management to be stipulated in the biosecurity regulations
- v. ensure the regional plans establish and promote an integrated management approach that incorporates the control of multiple pest animals to improve landscape health and productivity
- vi. require Local Land Services to consult the Biosecurity Advisory Committee prior to seeking endorsement from the Minister for Primary Industries to release the regional plans
- vii. ensure the actions in regional pest management plans are enforceable across tenures and binding on agencies by seeking Ministerial endorsement of plans
- viii. request that Local Land Services and local governments define areas of responsibility at the urban rural interface with the aim of maximising pest animal control program effectiveness
- ix. require the Local Land Services, as part of the regional planning process, to develop standards and templates for local programs and reporting. Standards will ensure alignment with the regional plan and across programs.

4 **Recommendation:** Clarify freshwater roles.

The NSW Government should:

- i. clarify the role of fisheries compliance officers and conservation officers as authorised officers under the NSW *Biosecurity Act 2015*. This includes undertaking surveillance and monitoring of freshwater pest animal issues.

Recommendations – Pest animals

Better risk management

- 5 **Recommendation:** That the regulation of non-indigenous species is commensurate with the risks that they pose.

The NSW Government should:

- i. ensure the regulations supporting the NSW *Biosecurity Act 2015* are consistent with Invasive Plants and Animals Committee threat assessments. If for any reason there is a State variation, this should be publically reported and justified.
- ii. amend the NSW *Game and Feral Animal Control Act 2002* to remove non-indigenous game birds that have been assessed by the Invasive Plants and Animals Committee as posing an extreme threat.

- 6 **Recommendation:** Establish the capacity for a timely and coordinated response to pest animal incursions.

The NSW Government should:

- i. formalise the roles and responsibilities of NSW government agencies in response to pest animal incursions in the NSW *Invasive Species Plan 2015-2022*.

- 7 **Recommendation:** Implement cost effective surveillance for the timely detection of new pest animal incursions.

The NSW Government should:

- i. include active and passive biosecurity surveillance activities in regional pest animal management plans and the *Invasive Species Plan 2015-2022* including detail on roles and responsibilities at the state, regional and local scales and the surveillance of online and illegal trade in invasive species.

- 8 **Recommendation:** Ensure pest animal management is informed by the best available information.

The NSW Government should:

- i. prioritise the improvement of the Biosecurity Information System integration with pest animal surveillance programs both active and passive.

- 9 **Recommendation:** That timely resources are made available to address the risks posed by new incursions.

The NSW Government should:

- i. clarify and formalise the arrangements for accessing NSW government agency funding for eradicating new incursions.

- 10 **Recommendation:** Expedite action on critical freshwater pest animal issues.

The NSW Government should:

- i. seek to work with other jurisdictions including the Australian Government to finalise the 2006 *Ornamental Fish Strategy* by focusing resources on assessing the risks of pathways, rather than species

Recommendations – Pest animals

- ii. review and revise as necessary the obligations of the aquarium trade in relation to preventing new incursions of invasive fish. This could mean that aquariums and pet shops selling potential aquatic pests are registered biosecurity entities under the new NSW *Biosecurity Act 2015*
- iii. advocate to the Australian Government and other jurisdictions the use of environmental flows and environmental water to favour native fish and disadvantage freshwater pest animals.

Improved engagement and education

11 **Recommendation:** Support and coordinate local on-ground action.

The NSW Government should:

- i. establish one regional pest management coordinator in each Local Land Services region to work with local groups and set up new groups to:
 - a. coordinate collective control action on-ground across tenure
 - b. build capacity and awareness
- ii. establish a staged approach over three years for coordinators to have a broader invasive species role.

12 **Recommendation:** Promote shared responsibility for pest management across the community, industry and government.

The NSW Government should:

- i. build community-wide shared responsibility for pest animal management through improved education and capacity building programs. Community engagement should cover both established pests and risks from new incursions, be based on best practice and be delivered by Local Land Services regional pest management coordinators and other government agencies.

13 **Recommendation:** Provide state-wide community education programs about freshwater pest animals.

The NSW Government should:

- i. work with industry to develop a community engagement strategy to proactively engage with existing freshwater fishing groups and community networks to educate the community on freshwater pest animal management and the new general biosecurity obligation
- ii. appropriately resource and work with industry to develop education products for businesses selling aquarium and pond fish, ensuring they display signs warning against the disposal of fish, snails and plants in waterways, and suggesting safe alternatives.

14 **Recommendation:** Promote vocational education and training.

The NSW Government should:

- i. encourage the development and implementation of training courses based on the new Vocational Education Training qualifications

Recommendations – Pest animals

- ii. encourage pest management agencies to train their officers under the new qualifications to the appropriate level.

Changes to legislation and regulations

- 15 **Recommendation:** Improve enforcement and compliance for pest animals through consistent and streamlined regulation.

The NSW Government should:

- i. develop a regulation addressing pest animals under the NSW *Biosecurity Act 2015* framework. The regulation should:
 - a. list all currently declared pest animal species, including freshwater pests
 - b. include mandatory measures for pest control across tenures, as required.

- 16 **Recommendation:** Manage deer as a pest animal.

The NSW Government should:

- i. exclude all species of deer from the NSW *Game and Feral Animal Control Act 2002*
- ii. include all species of feral deer in a regulation addressing pest animals under the NSW *Biosecurity Act 2015*.

- 17 **Recommendation:** Manage feral cats as a pest animal.

The NSW Government should:

- i. declare feral cats as a pest by including them in the pest animal regulation being prepared for the NSW *Biosecurity Act 2015*
- ii. Ensure any mandatory measures are consistent with the model code of practice for the humane control of feral cats
- iii. prioritise within the NSW *Invasive Species Plan 2015-2022* the management of feral cats in areas of high biodiversity value
- iv. support continued research into the scale, efficiency, cost-effectiveness, sustainability and risk of cat control methods
- v. align the Draft NSW *Invasive Species Plan 2015-2022* with the Federal *Feral Cat Threat Abatement Plan*
- vi. amend the NSW *Companion Animals Act 1998* to provide for:
 - a. the compulsory desexing of all cats by the age of four months if not exempted
 - b. requiring all owners of entire cats older than four months to be registered as a breeder
 - c. requiring all entire cats to be registered annually
 - d. local governments to declare and enforce cat confinement areas
- vii. partner with the RSPCA and other relevant organisations to deliver a targeted education campaign raising the awareness of the risks posed by stray and feral cats and promoting responsible pet ownership.

Recommendations – Pest animals

18 **Recommendation 18(i):** Maintain the outcomes delivered through Schedule 2 lands.

The NSW Government should:

- i. capture Schedule 2 lands in the NSW *Biosecurity Act 2015* framework. This should include provisions for the management of wild dogs on the perimeter of national parks where they have negative impacts and allow for dingo conservation inside national parks.

Improved management

19 **Recommendation:** Prioritise the implementation of biocontrol options for carp.

The NSW Government should:

- i. acknowledge that carp are a significant pest animal and prioritise their removal from freshwater environments
- ii. appropriately resource research into the clean-up process for the carp CyHV-3 virus (should it be introduced), including implementation issues, cost recovery options and follow-up control
- iii. appropriately resource carp clean-up and seek shared funding arrangements and transitional arrangements where possible
- iv. acknowledge that biocontrol viruses have an effective span of control of about 15 years, based on the experience with terrestrial myxoma and RHD and that research capacity in this area should not be diminished.

20 **Recommendation:** Reduce the impact of feral horses.

The NSW Government should:

- i. finalise the work of the technical reference group and respond to its findings
- ii. remove feral horses in ecologically sensitive areas using best practice management techniques after consideration of the recommendations of the independent technical panel
- iii. recognise the heritage value of feral horses within its management program and maintain an acceptable population level across the landscape.

21 **Recommendation:** Adopt and resource a strategic risk based approach to managing urban and peri-urban pest animals.

The NSW Government should:

- i. work with Local Government to provide cost recovery and practical techniques to manage urban pests such as Indian myna birds.

22 **Recommendation:** Actively engage recreational hunting groups in regional pest animal management.

The NSW Government should:

- i. engage recreational hunters in the preparation of regional pest management plans and include recreational hunting resources in management programs.

Recommendations – Pest animals

23 **Recommendation:** Reduce red tape surrounding recreational hunting on private land.

The NSW Government should:

- i. remove the requirement for hunters to be licensed to target non-indigenous species on private land.
- ii. promote the use of approved hunting organisation membership and programs to link hunters with landholders

24 **Recommendation:** Maintain access to markets for pest animals.

The NSW Government should:

- i. work with the Australian Government to allow the development of markets, both export and domestic, for pest animals while minimising regulatory impediments.

25 **Recommendation:** Increase non-commercial use of kangaroo carcasses.

The NSW Government should:

- i. revise the current policy to include a risk-based approach to the non-commercial use of kangaroo carcasses to allow for the use of carcass for approved baiting programs.

Improved knowledge base

26 **Recommendation:** Expand research capabilities.

The NSW Government should:

- i. lead advocacy for and invest in the creation of Centre for Invasive Species Solutions, the proposed successor to the Invasive Animals Cooperative Research Centre (Invasive Animals CRC)
- ii. collaborate with the Commonwealth Government and other states and territories to enhance research opportunities and outcomes
- iii. support the Centre for Invasive Species Solutions maintaining a foresighting capacity, or in the absence of a national approach, establish a unit to build foresight capability, monitor pest trends, risks and invasion pathways
- iv. commit long-term funding to maintain pest animal research capacity to develop and evaluate cost-effective and humane control techniques prioritising:
 - a. biological control of rabbits
 - b. improving early detection mechanisms
 - c. feral cat control
 - d. deer control.
- v. support and expand the PestSmart portal as a centralised, accessible, web-based portal for collating research outcomes, data, information and results.
- vi. conduct five yearly surveys of invasive species incursions, distribution, abundance and impacts
- vii. transparently share results and analysis of these surveys with the community.

Recommendations – Pest animals

27 **Recommendation:** Adopt standardised data collection.

The NSW Government should:

- i. adopt standard data protocols and record keeping requirements, which are mandatory for anybody receiving funding for pest animal management
- ii. establish a metadata standard for collection of pest animal information
- iii. develop and maintain a state-wide data sharing system for tracking pest animal distribution, density and impacts, that has current data from all Local Land Services
- iv. ensure data is readily available to stakeholders and regional managers for use in adapting management plans and actions.

28 **Recommendation:** Support for aquatic pest research and development.

The NSW Government should:

- i. appropriately resource the Department of Primary Industries for research funding. In particular:
 - a. biological and genetic control of tilapia and other freshwater pest animals
 - b. complimentary measures for carp biocontrol and removal
- ii. fast track use of tools such as Environmental DNA and NextGen (for monitoring and surveillance).

Targeted funding

29 **Recommendation:** Ensure that timely resources are made available to address the risks posed by new incursions.

The NSW Government should:

- i. clarify and formalise the arrangements for accessing NSW government agency funding to manage the economic, social and environmental risks posed by new incursions.
- ii. maintain funding for emergency response to stop new incursions.

30 **Recommendation:** Provide adequate resources to deliver effective pest animal management.

The NSW Government should:

- i. implement the Independent Pricing and Regulatory Tribunal recommendation to decrease the Local Land Services minimum rateable area size from 10 hectares to 2 hectares to increase the rate base
- ii. provide ongoing funding for regional coordinators. Coordinators to be funded by the NSW Government and the establishment of a new Local Land Services rate specifically for pest management coordinators
- iii. establish a rapid response fund in each Local Land Services region to be funded by a new pest management rate specifically for strategic activities. The fund would be solely funded from this rate (no public investment) and be used by Local Land Services Boards to fund emerging risks and opportunities in pest animal management
- iv. expand the Farm Innovation Fund program for landholders for infrastructure associated with pest management such as cluster fencing.

1 Background of pest animal management

1.1 Scope of the review

The Premier of NSW has requested the Natural Resources Commission (the Commission) undertake an independent, state-wide review of pest animal management in NSW. The Premier's terms of reference (see Attachment 1) request that the Commission identify opportunities to improve the management of pest animals in NSW across all land tenures for environmental, economic and social benefits. As part of the terms of reference, the scope of the review was limited to introduced terrestrial and freshwater vertebrate species. Animals in the marine environment and native animals are excluded.

In particular, the Commission was asked to investigate and identify:

- opportunities to better coordinate, redirect or grow investment and management across tenures and across different pest species and maximise benefit per dollar invested
- ways to promote community understanding of, and involvement in pest animal management
- any policy, regulatory or organisational barriers that restrict effective pest animal management
- priority pest animal issues in NSW and emerging risks
- quality of the evidence base and processes supporting prioritisation decisions
- examples of current good practice, including those from other jurisdictions
- priority research needs.

An Advisory Committee has been formed to ensure the terms of reference are met and stakeholder input is appropriately considered. The Advisory Committee comprises:

- Dr John Keniry AM – Chair of the Advisory Committee and Commissioner of the Natural Resources Commission
- Dr Bruce Christie – NSW Department of Primary Industries
- Mr Tom Gavel – Local Land Services
- Mr Terry Korn (Public Service Medal) – Independent Expert
- Mr Robert Quirk – NSW Office of Environment and Heritage.

1.1.1 Review approach and consultation

In conducting this review, the Commission has used best available evidence, noting there are data gaps in some important areas. Consultation is critical for this review and the Commission has consulted relevant community, industry and environmental groups, as well as Australian, state, regional and local government organisations. The Commission also examined approaches in other jurisdictions to inform recommendations.

The process being followed is provided in Figure 1.1 and includes a collaborative issues workshop, an issues paper, a draft recommendations report and a final recommendations report to the Premier. Consultation on the issues paper and draft report is an integral part of the process.

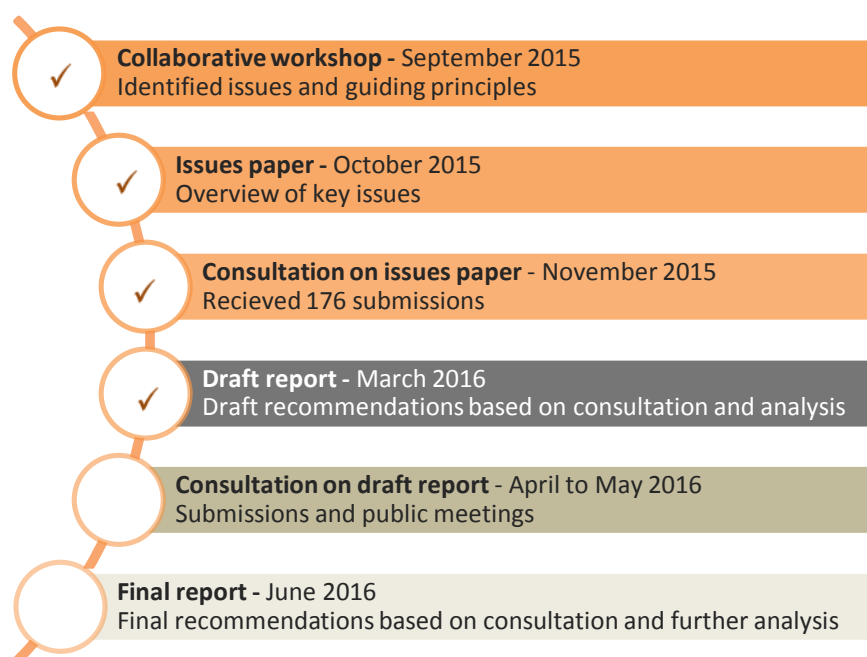


Figure 1.1: Process for the state-wide review of pest animal management

During the six-week consultation period on the issues paper, the Commission undertook five regional tours involving local stakeholders, six focus group meetings and telephone and face-to-face interviews with key stakeholders. In total 176 submissions to the paper were received from a range of stakeholders including landholders, recreational and special interest associations, community groups and government departments. A summary of the consultation can be found in Attachment 2.

The draft report will be available for public comment for six weeks. The Commission will undertake additional targeted consultation during this period, including holding a number of public meetings across NSW. The Commission will use this feedback and further analysis to inform the final report to the Premier in June 2016.

1.2 Guiding principles and pest definition

For the purposes of this review, the Commission adopts the pest definitions provided by the National Biosecurity Committee (2015):

- a pest animal is any animal with the potential to have a negative effect
- an established pest animal is a pest animal that has self-sustaining populations in Australia and is not considered eradicable. It may be distributed widely across NSW or only regionally. A regionally-distributed established pest may be the subject of containment measures to mitigate further spread.

The report focuses on those pests currently causing the greatest economic, social and environmental impacts, namely rabbits, wild dogs, feral pigs, foxes, feral cats and carp. It also discusses pest species that are having an increasing impact: deer, horses and birds.

In so doing, the report focuses on:

- risk pathways for new and emerging pests, such as the illegal trade in pets
- the need to update legislation concerning widespread pests which have the greatest impact, such as rabbits, wild dogs, feral pigs, foxes, feral cats and carp

- the need for effective management around pest species that are having an increasing impact: deer, horses and birds.

The terms of reference identified six principles as necessary for an effective pest animal management system, summarised in Table 1.1 below. These were based on stakeholder feedback received at the collaborative workshop, an analysis of principles in the NSW *Invasive Species Plan 2008-2015* and planning developed in other jurisdictions¹.

The six principles have guided the Commission in conducting the review and further detail is provided in Table 1.1.

Table 1.1: Principles for effective pest management

Principle	
Outcomes-focused	Pest management is one part of a whole-of-system approach to achieve triple bottom line outcomes (i.e. economic, environmental and social). Management arrangements should aim for best outcomes on the ground.
Shared responsibility	Pest animal management should be coordinated, involve collective action and ownership of the pest problem and should be underpinned by a clear understanding of roles and responsibilities. In addition to this, effective pest management should encompass clear leadership to provide direction for stakeholders, resource allocation and for effective cooperation across tenures and jurisdictions.
Evidence-based	Pest animal management should be designed using prioritised, risk-based programs based on best available science and research. Additionally, it is imperative to carry-out effective evaluation and reporting of outcomes.
Adaptive	Management must be adaptive and responsive to prevent and control new incursions and emerging threats. Additionally, management must be adaptable to new knowledge and skills, and emerging issues while enabling continuous improvement in program deliverables.
Cost effective	Effective pest management should ensure that action is appropriate and proportional to the problem. There should be clear deliverables to measure benefits and management should deliver desired results efficiently.
Accountable	Pest management should encompass practical and enforceable compliance arrangements where organisations and public and private landholders at all scales are held accountable for achieving results. Additionally, effective pest management should consider the appropriate accountability of risk creators.

1.3 Framework for pest management in NSW

Federal, state and regional bodies have different responsibilities and implement different actions, depending on how widespread any pest species is and over what period of time. The invasion curve is used to determine the most appropriate response depending on this spatial and temporal context.

¹ Plans include: *Invasive Plants and Animals Policy Framework* (Victorian Government), the *Queensland Pest Animal Strategy* (Queensland Government) and the *Pest Animals Management Strategy* (ACT Government).

1.3.1 The invasion curve

The invasion curve (Figure 1.2) articulates the relationship between the extent of a pest animal invasion process, over a period of time. It prescribes a discrete management objective for each increment along the curve: prevention, eradication, containment and asset protection. As a pest animal invasion occurs it progresses from one end of a management spectrum to the other. At each stage of the invasion, the area increases, and the implied impact and required resources for management (in most invasion cases²) also increases.

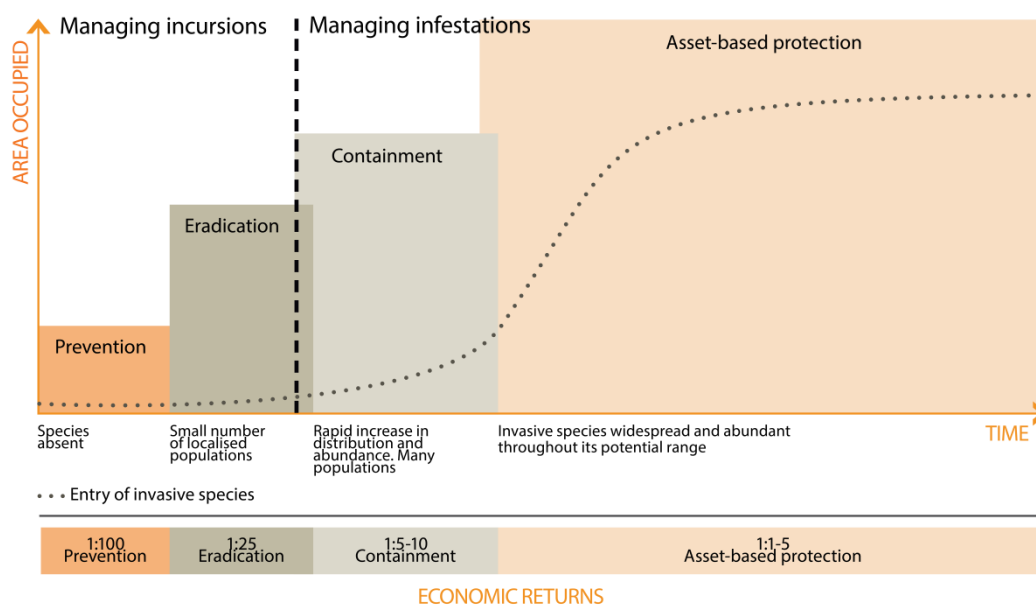


Figure 1.2: The invasion curve

The Australian Government's pest animal activities are primarily focused on prevention, through the regulation of border and pre-border activities (quarantine, customs etc.). Post border responsibilities for pest animal management responsibilities generally fall to state and territory jurisdictions (Beale 2008).

There are clear differences in the post border management requirements for invasive species that can be characterised as the management of:

- incursions (eradication)
- infestations (containment, asset protection)³.

The eradication of new incursions is resource intensive and time limited; containing the spread of established populations and protecting assets from their impacts are tasks that will be ongoing. The different management requirements for incursions and infestations demand different regulatory and institutional arrangements to be effective. Governments are best placed to lead the management of incursions, whereas the community, enabled and supported through regional structures, are best placed to manage infestations in the long term.

² Depending on the invasive species and its impact across the landscape, resources may not be prioritised to their management. For example, widespread pest animals, such as feral goats are considered by many in Western NSW as an important commodity and their management is not prioritised.

³ Containment is also a legitimate strategy in eradication programs.

1.3.2 Legislation, plans, governance roles

A range of national and state government agreements, strategies, legislation, plans and programs influence the regulatory arrangements for pest animal management in NSW (see Figure 1.3).



*Some of the acts due to be repealed when the Biosecurity Act commences are not shown in this figure

Figure 1.3: Regulatory landscape in NSW

On-ground pest management is primarily the responsibility of landholders (both private and public) and supported by state and territory governments. However, several Australian Government institutions play a role in coordinating strategic pest animal management.

Australian Government

The Department of Agriculture and Water Resources leads coordination and management of invasive species including vertebrate pests, weed, and diseases of plants, and terrestrial and freshwater animals at the national level. The key piece of legislation is the *Biosecurity Act 2015* (Cwlth), which is replacing the *Quarantine Act 1908* (Cwlth). This Act comes into force in 2016 and regulates management of biosecurity risks and emergencies through pre-border management and establishment of regulatory early-response systems.

The Department of Environment administers the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth). This Act provides a national framework to 'protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places' (Department of the Environment Australian Government 2016). Threat abatement plans for key threatening processes are in place for goats, rabbits, cats, foxes, cane toads and pigs. The importation of exotic fish is also regulated under this Act.

The department also leads application of three umbrella strategies important for biodiversity and pest management in Australia, namely Australia's *Biodiversity Conservation Strategy 2010-2030*, the *Australian Pest Animal Strategy* and the *Threatened Species Strategy*.

The Australian Pesticides and Veterinary Medicines Authority is an Australian Government statutory authority responsible for registration and regulation of all agricultural and veterinary chemical products under the *Agricultural and Veterinary Chemicals Code Act 1994* (Cwlth).

In addition to the above legislation, NSW is a signatory to a number of national agreements including:

- Intergovernmental Agreement on Biosecurity
- National Environmental Biosecurity Response Agreement.

These agreements outline the roles and responsibilities of government and industry in responding to emergency animal, plant pest and disease incidents and detail how those responses will be funded. NSW operates within the national biosecurity framework outlined in the intergovernmental agreement on biosecurity and the supporting agreements.

NSW

While all the stakeholders, legislation and strategies shown in Figure 1.3 influence pest animal management in NSW, for the purposes of this review, the following are seen as particularly important:

- The NSW Department of Primary Industries (NSW DPI) has state-level lead responsibility for pest management under various Acts, including the *NSW Biosecurity Act 2015*, the *NSW Game and Feral Animal Control Act 2002* and the *NSW Fisheries Management Act 1994*. It administers the licencing systems for recreational hunting on public land and for keeping certain non-indigenous animals. The department leads the coordination of invasive species management activities in NSW generally – both terrestrial and aquatic (NSW Department of Primary Industries 2015e) and is responsible for the *NSW Biosecurity Strategy 2013-2021* and the *Invasive Species Plan* (currently being updated 2015-2022).
- The Local Land Services (LLS) has an important role in the delivery of pest management in NSW. It currently regulates pest animal management on private and agricultural land under the *NSW Local Land Services Act 2013*. Another function of the LLS is as sole distributor for Pindone and 1080 (sodium fluoroacetate), and the provision of 1080 training for landholders. It also has responsibilities for the care, control and maintenance of almost 500,000 hectares of travelling stock reserves in NSW, which includes pest animal management.

- The NSW Office of Environment and Heritage (OEH) has responsibility for protecting NSW's environment and heritage. It also has responsibilities for pest management as a public land manager (national parks). The office also administers the NSW *Threatened Species Conservation Act 1995*. The Act establishes a procedure to identify key threatening processes that may threaten the survival of endangered or vulnerable species, populations and ecological communities. A number of pest animals have been identified as key threatening processes. Under the NSW *National Parks and Wildlife Act 1974*, the Office of Environment and Heritage regulates the keeping and licencing of both native and exotic reptiles. However, under section 2 of the NSW *Non-Indigenous Animals Regulation 1987*, NSW DPI regulates high risk non-indigenous animals, including reptiles and amphibians, and is responsible for licencing the keeping of these animals under the NSW *Exhibited Animals Protection Act 1986* or the NSW *Animal Research Act 1986*.

The challenges posed by aspects of the current arrangements are discussed further in Chapters 5, 6 and 7.

2 Pest animals, impacts and risk

A wide range of factors has contributed to the establishment of many pest species in Australia, and an equally wide range of communities, stakeholders, land managers and administrators are impacted by their feeding, predatory or nesting habits. Even as effective control measures are delivering notable successes for some species, new risks continue to emerge.

2.1 How it began

Non-native animals were introduced in NSW in 1788 when the First Fleet carried a consignment of livestock including pigs, cattle, rabbits and horses. Rodents, such as the house mouse and black rat are also thought to have arrived during European settlement (Caughley et al. 1998) (see Figure 2.4).

By the 1900s rabbits had spread to Western Australia after being released for hunting on a property near Geelong in 1859 (Williams et al. 1995). The spread of other pest animals followed: the fox was first released in southern Victoria in the 1870s and quickly established, becoming common in NSW in the early 1900s (Saunders et al. 1995). Domestic dogs arrived with the first settlers and quickly started to hybridise with dingoes and become feral (Fleming et al. 2001).

Established colonies of feral pigs existed in NSW prior to the 1870s due to the practice of allowing domestic pigs to free range (Pullar 1950). Feral goats probably established in the same way and were often released as a future source of food (Parkes et al. 1996). Feral cats may have arrived earlier via Dutch shipwrecks in the 17th century (Burbidge & McKenzie 1989). Deer were introduced in Australia in the early 19th century for hunting (Rolls 1969). Carp were first introduced in the 1860s but remained relatively confined until a major flooding event in the Murray-Darling Basin during the 1970s saw their numbers explode (Koehn et al. 2000).

In Australia, of the 79 (mammal) species introduced, 49 became established (some only locally or for limited duration) (Long 2003). Although mammals predominate as introduced pests, 20 bird species, four reptiles, 23 freshwater fish and one amphibian have also established on the mainland (Bomford & Hart, 2002).

2.2 Managing the problem

Over the history of pest animal management in NSW, a body of knowledge around what constitutes good practice has been built, which has morphed into best practice approaches. However it is clear that actions do not always reflect best available knowledge. History shows that commercial approaches are not effective; rather approaches based on facilitating voluntary action within local groups backed by strong research have the best results. The challenge is to sustain voluntary and government efforts over time.

2.2.1 Legislation

The first Australian legislation introduced to manage pest animals was the NSW *Rabbit Destruction Act 1875* in South Australia, and eight years later, the NSW *Rabbit Nuisance Act 1883* (Rolls 1969). These Acts introduced the concepts of imposing rates to pay for control (mainly bounties) and to fix penalties for failing to destroy pests. Pastures Protection Boards (now Local Land Services (LLS)) were formed in NSW under the NSW *Pastures Protection Act 1912* to manage rabbits and other pests (Rolls 1969).

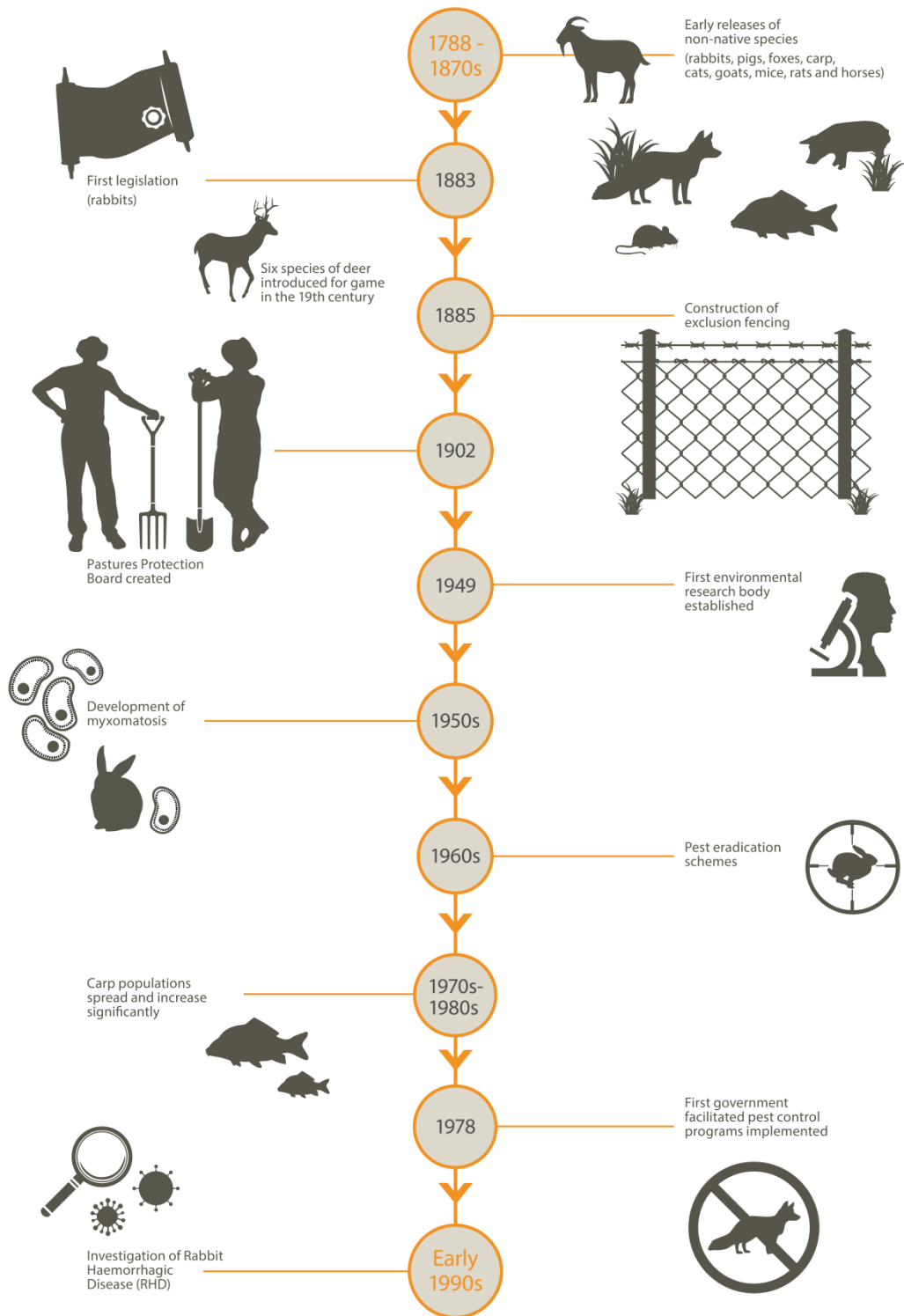


Figure 2.4: A history of pest animal management in Australia from the time of introduction (European settlement) to the early 1990s

2.2.2 Control methods

Many early approaches to pest animal control focused primarily on lethality to the pest and cost-effectiveness (humaneness had a relatively low priority). With the development of biological controls in the early 1950s, pest management for some pests, notably rabbits, shifted from single, localised rabbit control to landscape-scale control. For many other pests, such as foxes, pigs and wild dogs, baiting and shooting continued to remain the primary control methods.

With the shift to best practice approaches, animal welfare has become a growing concern in the pest animal control sector (Braysher, 1993; Olsen, 1998). Hence, over the years there have been many advances resulting in the publication of comprehensive Codes of Practice and Standard Operating Procedures for all of the key pest animal species and control methods (Sharp & Saunders 2005).

2.2.3 Land manager participation

Pest animal controls became increasingly regulated. With the creation of the Pasture Protection Boards in 1912, came the first pest control inspectors (rabbit inspectors) (Rolls 1969). These inspectors were employed throughout NSW to persuade landholders to implement controls for rabbits as well as other declared pests (Rolls 1969). However, the success of inspectors was varied with many landholders choosing to ignore the requirements of the law.

Research from the 1950s outlines similar observations and is still relevant today. It cited factors that contributed to the failure of pest animal control (Officer 1959) as the:

- inability of State authorities to deal with pests on public lands
- failure of these authorities to enforce the law on private landholders.

However, there were some later successes of broad scale landholder participation such as the Bathurst Rabbit Eradication Scheme, which commenced in the early 1960s (Coman 1999). The concepts of this scheme mirror what was later described as best practice (Braysher, 1993) - landholders worked in groups, property boundaries were ignored, plant and labour were pooled, and the Pastures Protection Board provided technical and on-ground support.

2.2.4 Strategic management, best practice and community programs

The first review of Pastures Protection Boards concluded that using inspectors coupled with improved advisory services was achieving good results for rabbits and wild dogs on private land (Bull 1975). The only criticisms appeared to be the lack of pest control on Crown lands and the lack of attention to feral pigs, which were a growing concern.

Government sponsored and facilitated pest control programs started in NSW in the 1970s with programs such as the North-West Feral Pig Control Pilot Scheme (Bryant et al. 1984). This scheme combined two key features of best practice, facilitation and evaluation. Control combined 1080 baiting with helicopter shooting (Bryant et al. 1984).

The scheme was closed by the Government in 1981 when a severe drought decimated what remained of the feral pig population (Bryant et al. 1984). While the scheme was considered a success in increasing landholder participation it fell short on the level of commitment by landholders with only 739 properties involved out of a potential 6,000. One recommendation arising out of the evaluation was that the officers employed to coordinate control programs needed to be more highly trained and skilled in advisory services for landholders (Bryant et al. 1984).

2.2.5 Research and development

Under the leadership of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the 1950s to 1980s saw a period of enormous progress in scientific knowledge and administration for pest animal control (Coman 1999). Myxomatosis (a biological control in the form of a virus for rabbits) is an outstanding example in terms of controlling rabbits in the early 1950s (Fenner & Ratcliffe 1965).

In the early 1990s, CSIRO led the investigation of Rabbit Haemorrhagic Disease (RHD) for the control of rabbits. In NSW the use of 1080 bait – a good indicator of the level of effort needed to control rabbits – declined by 83 percent in the three years after the spread of RHD (Cox et al. 2013). As occurred with myxomatosis, the effectiveness of RHD is declining (Mr G Saunders 2016, pers. comm.). Current initiatives underway in the Invasive Animals CRC rabbit research program are aimed at addressing this decline (Cox et al. 2013).

2.3 Impact of pest animals in NSW today

Today, pest animals are still imposing significant economic, social and environmental costs on NSW. They adversely affect agricultural productivity, access to export markets, public health and amenity, tourism, the conservation of biodiversity and resilience of socio-ecological systems (National Biosecurity Committee 2015).

Our understanding of pest animal introductions and spread has improved with modern science and research. Nonetheless, increasing demands placed on the environment by a growing population, climate change, increasing competition for agricultural production and commodities and changing land uses (such as peri-urbanisation, decline of full time farming and increase in lifestyle blocks or absentee landholders) will test the adaptiveness and resilience of the landscape and the responsiveness of NSW biosecurity measures.

2.3.1 Economic impacts

The Commission's updated analysis indicates that rabbits, carp, pigs, foxes, wild dogs, goats and introduced birds in NSW are conservatively estimated to impose an average annual cost of \$170 million (see Table 2.2). The national economic impact of pests is between \$720 million and \$1 billion.

It should be noted that the Commission's economic estimates take a conservative stance, and that a number of other estimates have been published to date. See Box 2.1.

**Table 2.2: Average economic impact of pest animals in NSW
(McLeod, 2016)**

Average economic impact of pest animals in NSW, 2013-14*		Source
Production losses	\$109 million	McLeod (2016)
Landholder management costs	\$22 million	McLeod (2016)
Government expenditure (including landholder rates and industry levies)	\$39 million	McLeod (2016); Commission analysis of government spending
Total	\$170 million	

*Note: Production loss figures have been derived using the 'economic surplus' method which was adopted by Gong et al (2009). Production losses are valued using fixed price and economic surplus methods. Pest animals included were rabbits, goats, pigs, foxes, dogs, introduced birds and carp. Average farm pest expenditure outlined in Gong et al (2009) included "fixed costs of management" which has been updated and is reflected in the landholder management costs. Government expenditures are derived from interviews of public pest managers conducted on behalf of the Commission. Local Land Services expenditures including rates are also included as part of government costs. There is a high degree of uncertainty in estimating production losses and management costs of pest animals. The figures depicted above are intentionally conservative given this high degree of uncertainty and should be viewed as indicative only.

Box 2.1: A note on data and conservative estimates

There is limited data available to assess the impacts of pest animals. Best available information has been sourced where possible, however significant limitations remain.

Many studies have attempted to value the costs and benefits of individual pest animals nationally and in individual regions. McLeod (2004) and Gong et al. (2009) are the two most recent and comprehensive national studies.

This review has drawn heavily on these two seminal studies. The Commission engaged McLeod to update these two studies to demonstrate changes in NSW for a select number of species. Analysis has been updated for: rabbits, goats, pigs, fox, dogs, introduced birds and carp, but does not include estimates for other species such as mice, rats or deer, for example. Figures have been presented at the national and state scale.

Given the high degree of uncertainty around current data and limited recent information on pest impacts and distribution, the Commission's estimates are conservative compared to real time information. Further, given the small sample of pests assessed and the data uncertainty it is likely that state-wide economic impacts are significantly greater than those reported here.

For example, while the methodology is robust, Gong et al. (2009) estimates wild dogs cost the economy \$48.5 million nationally each year. A more state specific methodology, based on state-wide surveys, calculated the 2009 cost of wild dogs in Queensland alone to be significantly higher at \$67 million.

When this cost is adjusted to 2016 dollars and for beef prices (which are significantly higher than 2009), the cost in Queensland is estimated to be about \$100 million per year – this means the national impact of wild dogs would be significantly higher than the very conservative methodology used by Gong et al. (2009).

Production impacts

The long term trend for the economic cost of pest animals is increasing. The Commission's updated analysis suggests that production losses have increased by 20 percent since the Gong et al. study in 2009 (for a selection of pest species including rabbits, pigs, foxes and wild dogs). This result is primarily driven by increased prices for key agricultural commodities and by increased rabbit and pig numbers. The increases in rabbit and pig numbers have been driven by a reduced efficacy of the (Rabbit haemorrhagic disease) RHD virus, favourable seasonal conditions and increased habitat from environmental water flows favouring feral pigs.

Production losses from pest animal impacts include⁴:

- up to \$83 million in lost wool, sheep-meat and beef production due to rabbits, dogs, goats, pigs and foxes
- around \$12 million per year lost in viticulture production due to introduced birds
- \$9 million per year in lost recreational fishing
- \$6 million per year in lost broad acre cropping production.

Whilst rabbits and birds have the greatest production impacts, wild dogs, foxes and pigs also cause moderate economic impacts.

Impacts from deer in NSW are less well researched, however evidence from other states indicates that they cause financial losses. Surveys of landholders in Victoria indicated that the impacts of deer on agricultural production ranged from \$200 to \$20,000 and averaged \$4,600 per landholder (Lindeman & Forsyth 2008). Deer are further discussed in Chapter 6.

Very few studies have estimated the economic costs of pest freshwater fish, largely due to difficulties in quantifying their impacts on public and private assets. However, the impact of carp in the Murray-Darling Basin is conservatively estimated at \$22 million per year (\$9 million in NSW) (McLeod 2016). This is attributed to carp competition and predation on native fish stocks and reduced fishing amenity, impacting on the \$1.3 billion recreational fishing industry in the Murray-Darling Basin (Ernst and Young 2011; Lintermans 2007). Other economic costs result from environmental management to improve river health, as well as prevention and community education (McLeod 2004).

Landholder management costs

In addition to lost production, landholders face increased costs of production due to pest management activities. Recent studies by the Australian Bureau of Agriculture and Resource Economics and Science (ABARES) have found wild dogs are costing individual farmers up to approximately \$7,200 annually in management (Binks et al. 2015).

The Australian Bureau of Statistics (2008) survey of broad acre (cereal cropping and livestock) farm expenditure on natural resource management found that some \$768 million was spent by 150,403 Australian farms in 2006–07 on pest management. Gong et al (2009) disaggregated this cost as it included management of native animals and birds, feral and domestic animals, and insects; along with fixed and variable components.

⁴ Estimates are conservative due to the high degree of uncertainty around current data and limited recent information on pest impacts and distribution (see Box 1 above).

Adjusted for inflation in 2013-14 dollar terms, the Commission’s updated analysis conservatively estimates that NSW farmers spend around \$22 million on pest management annually (McLeod 2016).

In addition, NSW farmers contribute \$3.4 million in rates to LLS, which are directed toward pest management and a further \$1.6 million collected from Western region landholders by the NSW Department of Primary Industries (NSW DPI) for the maintenance of the wild dog barrier fence.⁵

Government management spending

The NSW Government spends \$39 million on pest management, including contributions from landholder rates and industry levies.

The Office of Environment and Heritage (OEH) including the National Parks and Wildlife Service (NPWS) accounts for around 37 percent of spending on pest management, and LLS account for around 27 percent. The remaining expenses are allocated to different state, regional and local bodies as shown in Figure 2.5 (McLeod 2016).

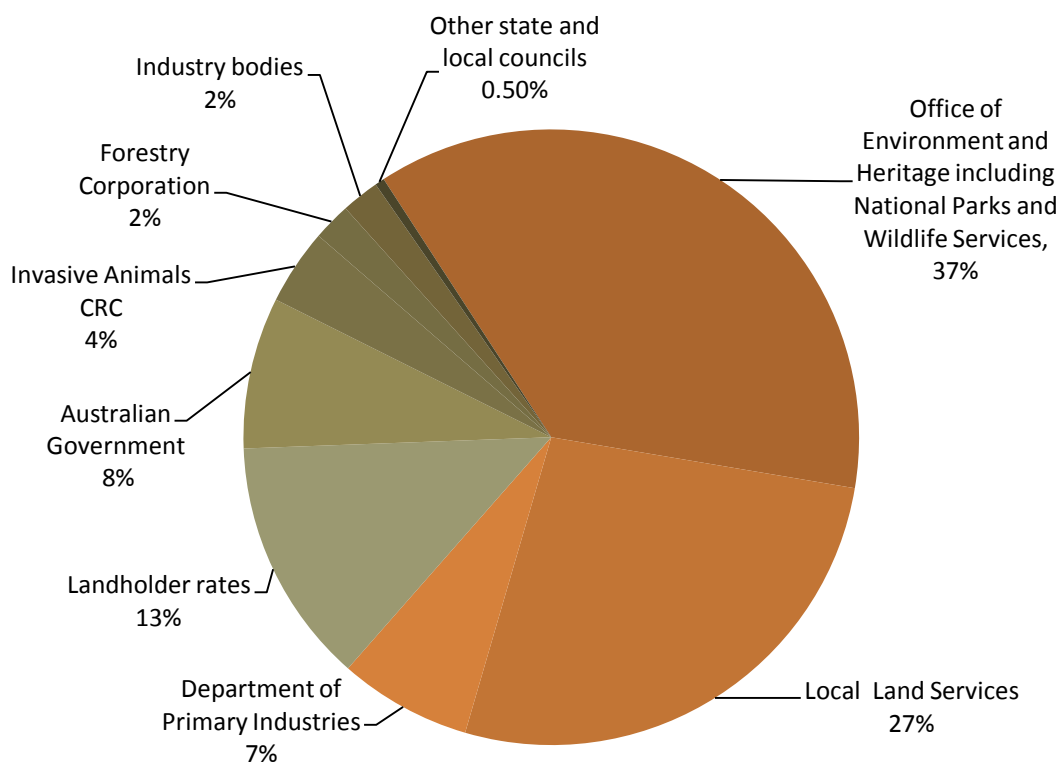


Figure 2.5: Spending on pest management by organisation (percentage of total spent)

In 2014-15 almost half of total pest management spending is estimated to have been allocated to activities based around control measures, followed by advisory and facilitation services with a focus on asset protection and containment. This applies equally to terrestrial and freshwater pests.

⁵ Estimates of landholder management costs are conservative as they have been developed using models that are based on national data. Consultation undertaken for the review indicates that localised impacts can be significantly higher.

Data on species specific pest management is difficult to obtain for all government agencies. Nonetheless, data from interviews with the OEH indicates that in 2014-15 it alone allocated 43 percent (\$6.5 million) of its pest management budget on wild dog control, which equates to 16 percent of all public expenditure on pest management in NSW. Expenditure on wild dogs is likely to be much higher when funding from LLS, NSW DPI and landholders is taken into account.

Decreased agricultural output due to pest animals also has an impact on government revenue. It has the potential to compromise the resilience, health and prosperity of communities which can require increased financial support by government.

It is also important to note the significant voluntary, un-costed input towards pest animal management from landholders and volunteer pest managers when considering public expenditure. Chapter 9 contains a more detailed discussion of public funding.

2.3.2 Social impacts

The wide distribution of many pest animals and the growing urbanisation of the landscape means that more people and communities are impacted in various ways, including mental health, quality of life, family succession planning, community services and cultural traditions (Thompson et al. 2013; Fitzgerald 2009).

In particular, consultation indicates emotional and psychological impacts associated with wild dog and fox attacks. Landholders also experience social impacts relating to illegal hunting of pest animals, with many raising concerns during the review about illegal hunters' trespassing and anti-social behaviour.

Evidence from research, submissions and regional tours indicate that the social impact of rabbits and birds remain widespread across the state. In contrast, negative social impacts from deer, pigs and wild dogs are most acutely felt in specific regions of the state and appear to be increasing.

The link between social and economic impacts is significant. As the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) 2015 report indicates, social impacts, such as emotional stress following dog attacks on livestock, were frequently associated with a contraction of the sheep industry which had flow-on social and economic impacts for individuals and communities (Ecker et al. 2015).

The ABARES national survey of farmers in areas affected by wild dogs found that 50 percent of those surveyed had their calving or lambing birth rate reduced which in some instances strained the mental health of some farmers (Binks et al. 2015). This was reinforced by evidence presented to the Commission which reported that mortality rates of new born lambs in some areas has increased by up to 50 percent through wild dog predation.

2.3.3 Environmental impacts

Invasive animals such as rabbits, goats, deer, pigs, horses and carp out-compete native species for habitat and resources. They also damage the environment by altering vegetation, soil and water systems, thereby changing the habitat of native species or causing large scale land degradation (Coutts-Smith et al. 2007). Introduced predators, such as foxes and feral cats can also decimate prey populations and have caused the extinction of many native fauna species in NSW (Environment Protection Authority 2012).

Despite management efforts over the past 100 years, pest impacts are growing. Contributing factors include land use change, urbanisation and climate change. Other pressures such as altered fire regimes and changed hydrology patterns can all favour pest species. Managing pest animals to improve biodiversity requires strategies that also address these interacting pressures across the landscape (Department of the Environment Australian Government 2011; Potschin & Haines-Young 2013).

Impacts on threatened species

In NSW 40 percent of listed threatened species are affected by pest animals (NSW Department of Primary Industries 2013). Nationally rabbits are listed as having the largest impact, threatening 304 listed species, which is a 100 percent increase in impact since research was released in 2008 (see Figure 2.6) (Coutts-Smith et al. 2007; Department of the Environment Australian Government 2015b).

In the *Australian State of Environment Report 2011*, the Australian Government (2011) states that “invasive species, especially foxes and feral cats, and habitat loss are the two major threats to vertebrate fauna”.

Introduced herbivores cause extensive damage to native vegetation and soils through grazing, trampling and digging and contributing to total grazing pressure (Coutts-Smith et al. 2007). They may also compete with native herbivores for food and further degrade the environment by providing an abundant food source for other pests. For example, rabbits can support high densities of feral cats and foxes, which in turn suppress small native prey species (McLeod 2004).

In addition, freshwater pest fish are predominately an environmental pest, and have been recognised as one of eight key threats to native fish in the Murray-Darling Basin (Murray-Darling Basin Ministerial Council 2003). They negatively impact the environment through competition with native species for food and habitat, altering and degrading aquatic habitats and reducing genetic diversity (Ayres & Clunie 2010a; Hall & Fulton 2012; McLeod 2004). The impacts of pest fish can also indirectly influence other ecological aspects of inland river systems, such as riverbank erosion and changes to river health.

Pest fish such as carp are also predators, consuming native fish eggs, invertebrates and tadpoles. Redfin perch prey on small native fish, threatening nine species listed under the NSW *Threatened Species Conservation Act 1995* (Coutts-Smith et al. 2007). Pest fish, such as eastern gambusia also demonstrate aggressive behaviour towards native fish, threatening 19 NSW listed species (Coutts-Smith et al. 2007). Freshwater pests often carry pathogens and disease, such as epizootic haematopoietic necrosis virus, which is a key threat to native fish in the Murray-Darling Basin (Murray-Darling Basin Ministerial Council 2003).

Whilst difficult to value, research on the financial costs of pest animals on the environment was conducted at a national scale for a selection of pest animals in 2004, estimating that the environmental impacts of the fox, cat and carp was around \$345 million (McLeod 2004). Since this time an extensive analysis of environmental costs has not been completed due to limited confidence in data and its application in environmental cost models.

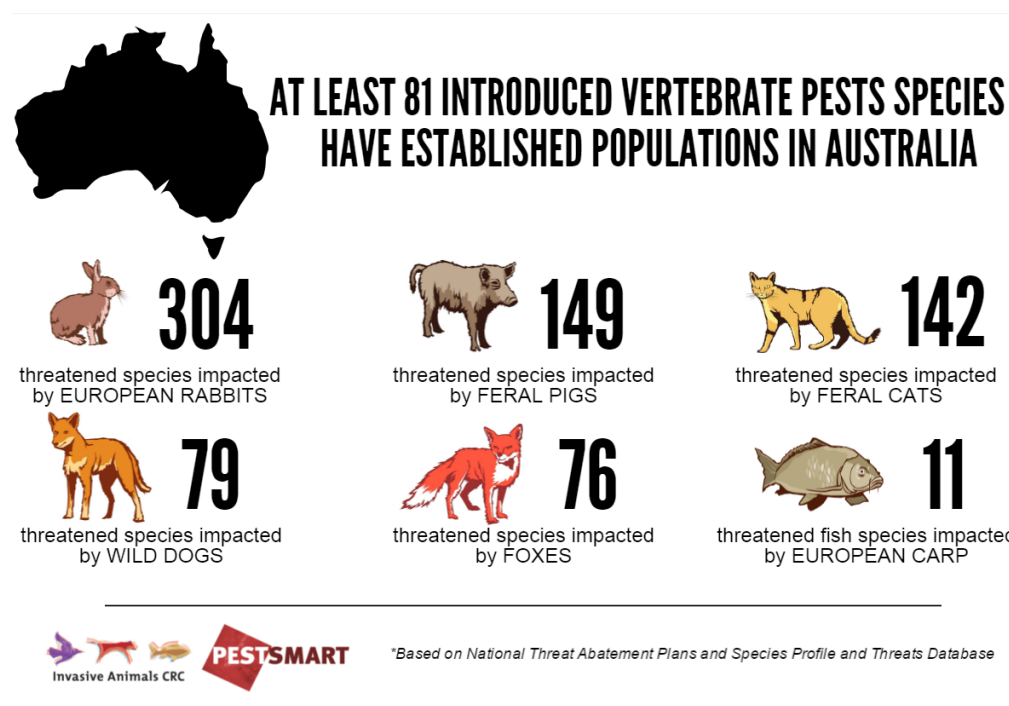


Figure 2.6: Impact of pest animals on threatened species (Source: Invasive Animals CRC)

Maintaining biodiversity

Collectively, invasive species (pest animals and weeds) pose the second greatest threat to biodiversity in NSW (Coutts-Smith et al. 2007). Pest animals contribute significantly to biodiversity decline, especially small to medium-sized ground-dwelling mammal species (Environment Protection Authority 2012). The impact of pest animals also ranks highly when compared with other threatening processes such as the destruction and modification of native vegetation (Coutts-Smith et al. 2007).

Because of these threats, effectively managing invasive species is essential to maintain biodiversity. Reserves of genetic diversity also contribute to the capacity of landscapes to adapt to change and support their resilience to shocks (Department of the Environment Australian Government 2011; Environment Protection Authority 2012).

2.3.4 Balancing economic, social and environmental impacts

There are strong linkages between economic, social and environmental impacts. For example, the goat industry relies heavily on feral goat populations and was worth \$73 million at the farm gate in 2014 (McLeod 2016).⁶ This creates the potential for competitive tension between economic benefit and environmental damage. Conversely, the economic impact of the goat industry on drought affected western graziers has had a positive social impact.

Wild dogs have devastating economic and social impacts on sheep and cattle producers. However, they are believed to have ecological value in some parts of the state, similar to the role of dingoes in the landscape. This creates a tension between the environmental benefit and the social and economic damage caused by dogs.

⁶ Note this figure is for farm gate prices only. The ABS (2015) has estimated that the export value of Australian processed goat meat is around \$242 million. All estimates of pest animal impacts in this report have been assessed at the farm production level and not at the industry level. This approach for assessing pest animal impacts on agricultural production has been used by Gong et al. (2009) and McLeod (2016).

Social, economic and environmental tensions also exist in freshwater ecosystems. Pest fish, such as redfin perch are valued by many in the recreational fishing community. However, through their predatory behaviour, redfin perch impact on native fish biodiversity as well as the recreational fishing industry by predation on other favoured species.

It is essential that pest animal managers consider the economic, social and environmental interdependencies of pest animal impacts in any management decision.

2.3.5 Distribution and abundance

Pest animals inhabit a broad variety of habitats including agricultural regions, arid environments and urban areas. Some pest animals, such as deer, goats and wild dogs, are currently located in specific hotspots across the state while other pests, such as rabbits, cats, foxes and carp are more widespread (West & Saunders 2007).

Pest abundance and distribution can vary from year to year with climatic variation, prey availability, fires, flooding, changes in land use, agricultural production and management activities. Accidental or deliberate introduction of pest species into the landscape or freshwater environments can also influence populations of pest animals and fish. Attributing changes in distribution and abundance to any one cause is difficult.

The ability of the state to eradicate all pest animals is impossible. However, through well-coordinated and regular management, public and private land managers can work to minimise the economic, social and environmental impacts of pest animals.

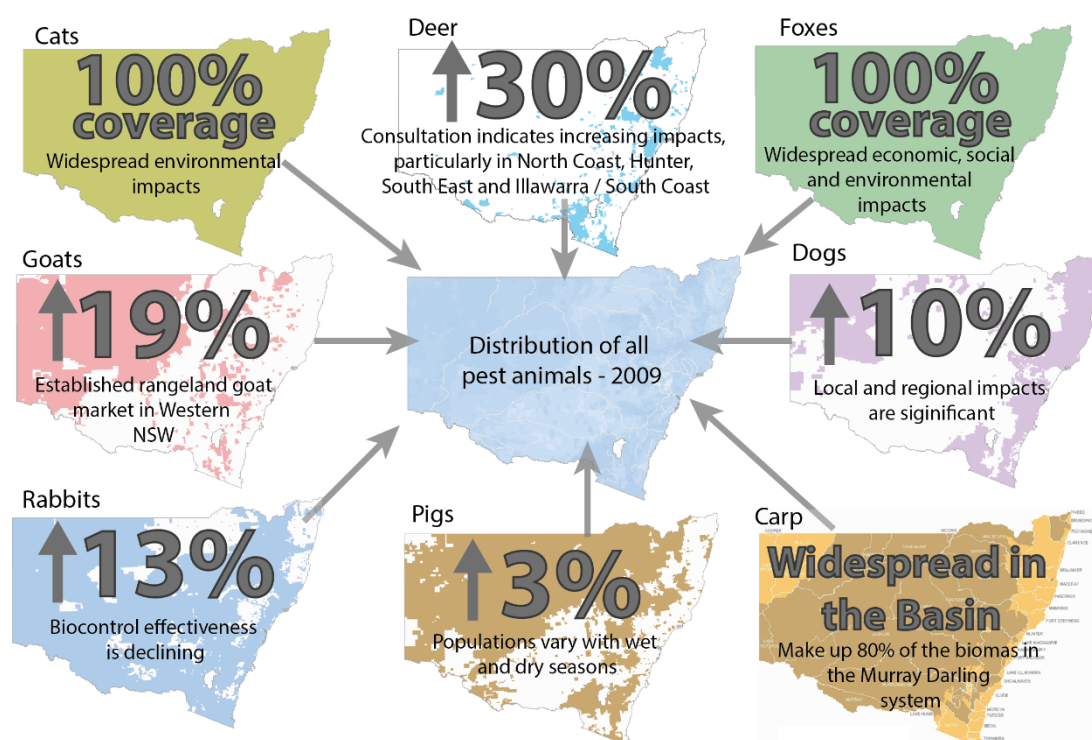


Figure 2.7: Pest animal distribution and increase from 2005 to 2009

Accurate data regarding the distribution and abundance of pest animal species is difficult and expensive to obtain, particularly in freshwater environments. However, the distribution and abundance figures do reveal problems that are supported by on-ground evidence (Figure 2.7).

For example, deer and wild dogs have increased in recent years, along with pig numbers in some areas. Deer (comprising six different species) increased in distribution by around 30 percent over a five-year period to 2010 and anecdotal evidence suggest an even greater increase since this time (NSW Department of Primary Industries 2015d). Similarly, wild dogs have increased by around 10 percent over the same period and now inhabit many areas along the Great Dividing Range and far north-west of the state (NSW Department of Primary Industries 2015d). Recently, the effort to control pests is not achieving any state-wide population scale reductions.

3 The value of strengthened governance and planning

On-ground actions by people need to be guided and supported by risk-based strategies and plans across tenure. These plans need to be jointly developed at the local, regional and state scales to best harness collective action and to prioritise efforts based on risk and evidence.

3.1 State planning and governance to set the agenda

The NSW Government has recently strengthened the legislative framework in relation to biosecurity, including pest management, with the creation of the NSW *Biosecurity Act 2015* and is currently developing the regulations underpinning the Act. The legislative framework is complemented by a number of strategies and plans relevant to pest animal management (see Table 3.3).

Table 3.3: Plans for pest animal management in NSW

Organisations	Plans
Australian Government	Australia's Biodiversity Conservation Strategy 2010-2030 Australian Pest Animal Strategy Threatened Species Strategy
NSW Government – Department of Primary Industries	NSW Biosecurity Strategy 2013-2021 Draft Invasive Species Plan 2015-2022 Wild Dog Management Strategy 2012-2015
Local Land Services	Strategic plans Regional wild dog plans
NSW Government – Office of Environment and Heritage	Managing Pests in NSW National Parks 14 Regional Pest Management Strategies (National Parks and Wildlife Service)
Forestry Corporation NSW	11 Ecologically Sustainable Forest Management Plans (incorporating pest management)
Various	Species specific local management plans prepared by community groups or industry bodies include but are not limited to: wild dog management plans (at least 25 across NSW), rabbit management plans; fox management plans, feral pig management plans etc

These plans demonstrate the positive steps being taken at all levels, from government to landholders, to manage pest animals in NSW. However, inconsistencies across the state reveal that roles and responsibilities are ready for further clarification. If goals are not shared or functional links established between state, regional and local planning, pest control efforts risk being hampered by:

- 1 inconsistent approaches across the state
- 2 lack of coordination and cooperation across groups
- 3 overlapping and duplicative planning processes and control programs
- 4 lack of accountability for outcomes.

During the consultation phase for this report, stakeholders expressed a need for a specific planning hierarchy within pest management. A tiered approach will help to establish clear objectives, accountabilities and increased participation prior to any action, along with more

integrated planning, collaboration and reporting throughout the pest management process. When combined with strengthened compliance requirements (see Section 3.2.2), such an approach would create a well-rounded framework to improve pest animal management in NSW. This approach would also support and enable on-ground action.

3.1.1 State planning

NSW has already taken significant steps in addressing pest animal-related risks, for example through the *NSW Biosecurity Strategy 2013-2021* and the *NSW Biosecurity Act 2015*.

As the name implies, the *NSW Biosecurity Strategy 2013-2021* sets an overarching direction for NSW, addressing not only animal pests but also weeds and diseases. It is an umbrella strategy, which states that biosecurity:

- is a shared responsibility
- contributes to sustainable economic growth
- protects the environment and community
- is underpinned by a responsive and consistent legislative framework.

The introduction of these policy and legislative frameworks provided the opportunity for the NSW Department of Primary Industries (NSW DPI) to reassess the planning processes underpinning them both to ensure the goals of the Strategy are achieved.

Supporting these overarching frameworks is the draft *Invasive Species Plan 2015-2022*. This plan, promoted as the state plan for pest animal management in NSW, should align with the *Biosecurity Strategy 2013-2021*. The overall objective of the draft *Invasive Species Plan 2015-2022* is 'to foster and support a cooperative culture where everyone contributes to minimising the impacts of invasive species in NSW'. The plan has four strategic goals aimed at preventing new incursions, containing existing populations, adaptively managing widespread invasive species and building capacity. The draft plan is the product of a collaborative process involving key public landholders.

The Commission acknowledges the positive steps that NSW DPI has taken to provide a comprehensive overarching legislative framework for managing invasive species in NSW that embeds the principle of shared responsibility.

However, one notable area not addressed by the draft *Invasive Species Plan 2015-2022* is whether or not the previous 2008-2015 plan (on which it is based) was effective in achieving its objectives. The actions and outcomes in the draft 2015-2022 plan are more or less identical to the goals and objectives of the previous one, with no explanation as to why these actions have been extended for another seven years.

The NSW *Invasive Species Plan 2015-2022* should also link the *NSW Biosecurity Strategy 2013-2021* and pest management plans developed at the regional scale. However, the current draft 2015-2022 plan falls short on several areas:

- it does not clearly align with the *Biosecurity Strategy 2013-2021*
- actions and accountabilities are unclear
- timeframes for implementation and the framework for monitoring and reporting outcomes are unclear.

This misalignment between strategy and plan complicates accountability, making it difficult to explain how regional and local action is contributing to state-wide goals. For example:

- While the NSW *Biosecurity Strategy 2013-2021* proposes specific strategies designed to improve the early detection of invasive species⁷, the actions within the draft 2015-2022 plan focus on maintaining the current capacity, primarily through educational material and hotlines.
- While the NSW *Biosecurity Strategy 2013-2021* proposes the development and adoption of a risk weighted framework to prioritise investment⁸, the draft 2015-2022 plan reiterates the need to assess risks, rather than setting state-wide priorities (identified as part of a risk-based process).

The state plan for pest animal management should also be revised to better integrate pest weed and freshwater pest management, given the various successes achieved to date with such integrated efforts. This includes developing state-wide targets and actions specific to managing freshwater pest animals, and ensuring targets are prioritised and risk-based. The state plan should also consider cross-jurisdictional or basin-wide freshwater pest issues.

Recommendation 1: Adoption of core components for State planning.

The NSW Government should adopt the following as core components of its NSW *Invasive Species Plan*:

- i. government resources are prioritised based upon greater return on investment from prevention and eradication of new incursions
- ii. private and public land managers are best placed to jointly manage infestations and widespread pests as part of a cross tenure regional approach
- iii. improved management of risk pathways and extreme risk species
- iv. people are fundamental to making solutions work and need to be supported to ensure they are fully engaged
- v. reduce red tape to improve control of pests
- vi. biosecurity obligations are supported by enforceable and enforced sanctions for all risk creators regardless of tenure and industry
- vii. on-going research and development is prioritised
- viii. existing funding is maintained and new shared funding initiatives are developed to address targeted needs.

Before it is finalised, the draft 2015-2022 plan should be updated to clearly articulate the priorities, approach, roles and responsibilities that must be implemented if regional and local plans are to contribute to state objectives and priorities.

It should be guided by a risk-based management approach that identifies gaps and opportunities in terms of resources (human and financial), as well as prioritising the management of pest species (new and existing) (Australian Capital Territory Government 2012). This is discussed further in Chapter 4.

⁷ Outcome 3: Improved identification, diagnostic, surveillance, reporting and tracing systems for pests, diseases and weeds

⁸ Strategy 5.1

Based on research and best practice approaches, the key elements of a strategic plan should:

- set state-wide priorities for pest management that support common national objectives
- promote a coordinated and strategic state-wide approach to pest animal and freshwater pest management by setting consistent key performance indicators for pest management
- set a clear process for early response to identified future risks
- clarify the roles of government, including clear triggers for the transfer of responsibility from state to regional – thereby improving engagement and cooperation at all scales
- specify measurable targets and clear lines of accountability.

An important element, understated in the current draft and previous iterations of the Invasive Species Plan, is the requirement for evaluating the effectiveness of the plan. But the plan does not provide guidance on what monitoring, evaluation and reporting will be undertaken to determine whether the goals are being achieved and if not, why not. The Commission recommends an independent body undertakes a mid and end-term evaluation of the plan's implementation.

Recommendation 2 (i): Provide transparent state level leadership and accountability.

The NSW Government should:

- i. update the NSW *Invasive Species Plan 2015-2022* to:
 - a. specify that the lead agency for new terrestrial and freshwater *incursions* is the NSW Department of Primary Industries.
 - b. specify that the lead agency for managing *established* terrestrial pest animals is Local Land Services and the lead agency for managing *established* freshwater pest animals is Department of Primary Industries.
 - c. specify that the Biosecurity Advisory Committee is responsible for deciding when a pest animal transitions from being a new incursion to an established pest animal
 - d. include clear objectives and priorities, measurable targets, roles and responsibilities and timeframes for delivering prevention and control of pest animals
 - e. commission an independent mid-term and final review of the NSW *Invasive Species Plan 2015-2022*, including risk assessments and surveillance activities.

3.1.2 State committee

The Pest Animal Council is seen as the state-level committee advising government on pest management in NSW. While the Council's objectives reflect that of an advisory committee, it is a non-statutory body, with limited accountability for its outputs. The Council is chaired by NSW DPI and includes both government and non-government representation. Members also perceive the Pest Animal Council as having a technical advisory and guidance role, not a decision-making one.

Stakeholder feedback gathered during the Commission's review indicate that the current arrangements are inadequate, and emphasise the need for more formalised processes that support local action such as state and regional pest committees (see Attachment 2 – Stakeholder consultation).

With an overarching (albeit temporary) Biosecurity Advisory Committee already established to oversee implementation of the NSW *Biosecurity Act 2015*, there is opportunity to reconsider the governance arrangements for pest animal management in NSW. The Biosecurity Advisory Committee is a non-statutory committee with an independent chair comprising representatives from Local Land Services (LLS), NSW DPI, the Nature Conservation Council of NSW, NSW Farmers Association, NSW Office of Environment and Heritage (OEHL) and the Pest Management Advisory Board.

This committee should be made accountable for state-level advice and governance around pest animal management. This may involve subsuming the functions of the Pest Animal Council, and amending the terms of reference accordingly. Committee membership would need to be revised and broadened to reflect the expanded responsibilities. Membership could include representation from the Local Government NSW, Invasive Animals Cooperative Research Centre (Invasive Animals CRC), NSW Royal Society for the Prevention of Cruelty to Animals (RSPCA), and representation from a freshwater expert is recommended. The committee should also report to and guide NSW DPI on developing a state-wide pest management plan, and provide state-level guidance to the regional pest animal committees. These are discussed in Section 3.2.

Recommendation 2(ii-v): Provide transparent state level leadership and accountability.

The NSW Government should:

- ii. confirm the ongoing status of the recently created Biosecurity Advisory Committee as responsible for both terrestrial and freshwater weed and pest animal management in NSW. An aquatic biosecurity representative should be appointed to the Biosecurity Advisory Committee.
- iii. make the Biosecurity Advisory Committee responsible for endorsing and monitoring the *Invasive Species Plan 2015-2022*, providing oversight of pest animal risk assessments and approving the prioritisation framework
- iv. include in the terms of reference for the Biosecurity Advisory Committee obligations to consult with regional pest animal management committees (including freshwater representatives) on development and implementation of regional plans
- v. include the functions of the Pest Animal Council in to the Biosecurity Advisory Committee.

3.2 Regional planning and governance guides on-ground management

3.2.1 Regional committees

Regional committees are valuable because they provide public and private land manager representation to work together to set regional priorities. They are an effective means of engagement, participatory decision-making, knowledge-sharing and collaborative planning. They also serve as an accountability mechanism.

There is currently one regional animal advisory committee in the state, which has been in operation for 16 years. Much like the Pest Animal Council, this informal committee in northeast NSW depends on voluntary agency membership. LLS regional office provides secretarial support. During its time, the committee has developed numerous cooperative control programs and strategic initiatives, such as the *North Coast Wild Dog Management Plan* and previously a deer management plan (no longer active).

Provisions already exist under the NSW *Local Land Services Act 2013* to establish local community advisory groups (section 33). These groups should “consist of persons that the local board considers to be suitably qualified to serve on the group and to be suitably representative of the interests of the local community and stakeholders in the region”.

Each LLS Board has established one or more local community advisory groups for its region. A regional committee for pest animal management could be established under this provision to set strategic priorities. The provision of secretarial support is also vital and must be appropriately resourced.

Regional weed committees have recently been established. The Commission’s review of weed management in 2014 highlighted the benefits of integrating pest plant and animal management, and shown that the institutional structure proposed for weeds would also be effective for the management of pest animals. Such a governance arrangement is supported by NSW Farmers, who expressed support in their submission for integrating ‘pest plant and pest animal management using advisory committees that feed into LLS Boards across NSW, and a state-wide advisory committee.’

Recommendation 3 (i-iii): Provide regional leadership and local delivery of pest management.

The NSW Government should:

- i. establish regional pest animal management committees (akin to the regional weed committees) under Section 33 of the *NSW Local Land Services Act 2013*. The scope of the Committee’s work will include terrestrial pest animals and should include a representative from organisations representing landholders / producers, community, environment, recreational users, local government, and relevant agencies
- ii. establish an accountability hierarchy with the regional pest animal management committees reporting to Local Land Services Regional Boards and ultimately to the Minister based on the *NSW Invasive Species Plan 2015-2022*
- iii. establish a staged approach to integrate pest plant and animal management: parallel committees and planning to merge over a three-year period to realise opportunities of efficiencies.

3.2.2 Regional planning

Regional plans are an important link between state and local planning. They enable alignment with state-wide priorities and consistency of approach while addressing regional and local variances (refer Figure 3.8) and guiding on-ground action.



Figure 3.8: Relationship between local, regional and state planning

Currently there is no framework for regional pest animal planning. While LLS has draft regional strategic plans, these are for their whole business and not designed to guide and direct pest operations across tenures. Some regional LLS also have an ‘operational’ pest plan to support their strategic plans.

Plans reviewed by the Commission to date cover several area-specific pest animal programs, including:

- regional wild dog management programs (noting this is a requirement of both the *National Wild Dog Action Plan* and *NSW Wild Dog Strategy*)
- fox control programs
- wild rabbit programs
- strategic feral pig programs.

The plans clarify the work to be completed but do not provide further detail in relation to how programs will be delivered, monitored or evaluated, to assess whether the objectives have been achieved.

The Commission sees much scope for improvement in regional pest management planning, which can be tailored to the unique characteristics of the landscape, and be relevant across tenures and organisational boundaries. At this scale pest animal management can be usefully integrated with pest plant and other biosecurity production and conservation considerations, as well as broader governance arrangements such as strategic planning and accountability frameworks.

Landscape-scale approach

A landscape systems approach to management focuses on increasing capacity and preparedness to respond to continuous change, for example, fluctuations in pest animal impacts. It accommodates the interdependent impacts of factors such as climate change, fire, drought, weeds, production and social aspects as well as providing the opportunity to reduce unexpected outcomes from perhaps, a single target approach to pest animal management.

An overwhelming majority of submissions received by the Commission expressed support for a landscape-scale approach to pest management, including NSW Farmers who support 'a landscape approach to pest animal management and [we] believe that the holistic approach to natural resource management embodies this approach.'

The regional pest management plans should be based on an adaptive, landscape scale approach. Stakeholders have recognised the importance of adopting a management approach that addresses a 'multi-faceted issue that requires local ownership, community participation, coordinated action and continual review and adaptation of programs'⁹.

Such an approach allows pest animal management to be prioritised based on factors such as risk, timing, sequencing of actions, control techniques, capacity and resources, and in the context of the economic, social, environmental and institutional characteristics of any landscape. In terms of control, tools vary in their effectiveness depending on a range of factors and the *NSW Vertebrate Pest Control Manual* recommends instigating integrated programs that employ a number of different approaches (NSW Department of Primary Industries 2012b). A multiple species approach can also be implemented by sequencing programs around the differing species in a particular locality.

An integrated adaptive approach requires coordination and collaboration, as it provides a suite of actions to choose from, with flexibility as to where these actions are carried out and in which

⁹ Landcare NSW submission to the State-wide review of NSW pest animal management Issues paper

combination. This approach also demands trialling and monitoring the effectiveness of different interventions, with the aim of learning how to better manage the landscape over time.

The regional plans need to incorporate more guidance around monitoring, evaluation and reporting at the regional level, to determine whether the goals are being achieved and if not, why not. As regional service providers, LLS are best placed to collaboratively prepare regional pest management plans, as officers know both the local people and issues, can plan accordingly and most importantly, involve communities and public land managers in the planning.

Participation in strategic pest management programs

As seen from some examples of rabbit, pig and dog management programs described in Chapter 5, it is difficult to achieve 100 percent participation in coordinated programs. There will always be someone with differing motivations or perspectives. During consultation stakeholders provided a range of examples including landholders intentionally keeping pest animals on their property and providing accommodation for hunters (quasi game-parks), ethical concerns regarding the control technique (i.e. poison) and absentee landholders.

However LLS can encourage participation through:

- involvement in the planning process
- providing a sense of shared responsibility and
- empowering the local community to own the problem of pest management and work together across tenures.

If landholders still fail to take action the NSW *Biosecurity Act 2015* provides a strong compliance framework to allow LLS to ensure pest management is carried out. Creating a robust and transparent governance framework to complement the legislative framework should reduce the likelihood of non-participation as much as possible.

Regional plans, prepared by LLS and guided by an advisory committee with community representatives, will set the priorities for the region, including large scale pest management programs such as aerial baiting across both public and private land. As well as encouraging communities to meet their biosecurity duty, such strategic pest management programs will adhere to relevant Standard Operating Procedures and Codes of Practice to ensure the control techniques employed consider the humanness of the technique and cost-effectiveness.

Locally driven and rigorous systems that seek to involve the whole community in the planning and setting of priorities for regional pest management will encourage the community to have ownership of the plan and its subsequent implementation. Such a process will mean public land managers are also aware and engaged.

The regional plans, when approved by the NSW Government, will become the minimum requirement for everyone in that region to meet their general biosecurity duty. The aim is for the whole community to consent to the actions in the plan.

If a landholder does not want to comply with the actions in the regional plan (for example, they choose to opt out of aerial baiting, which impacts on the overall effectiveness of the program on neighbours), they need to demonstrate how they will meet their general biosecurity duty by means of an alternative approach. This alternative approach has to be accepted by LLS (as an authorised officer). If LLS finds the outcome inadequate to meet the general biosecurity duty

under the Act, a biosecurity direction can be issued seeking the landholder to take action. If no action is taken, penalties can be issued (see Figure 3.9).

Ultimately, LLS should not have to allocate valuable time and resources on those that choose not to take action and the NSW *Biosecurity Act 2015* provides a legislative basis for its officers to undertake pest management on a landholder’s property and recover the cost of the work. As a last resort authorised officers can undertake pest control on that property. This could be in the form of trapping, baiting, ripping or in extreme cases where people are intentionally keeping pest animals (such as quasi-game parks for hunting), it could involve a fence being put around that property. Under section 133 of the NSW *Biosecurity Act 2015*, the cost for carrying out this work will be charged to the landholder.

General Biosecurity Duty – compliance

If the General Biosecurity Duty is not discharged the Act includes compliance measures:

Pest animal management plans should specify the pest animal control obligations. This includes the pest control required and monitoring work required to be done, where the control work and monitoring will be conducted, who is responsible for the work, who will report and what the timelines are for each activity. Private land managers, the community and government agencies will be made aware of their obligation to implement the strategies contained in a pest animal management plan.

Regional Pest Animal Management Plans

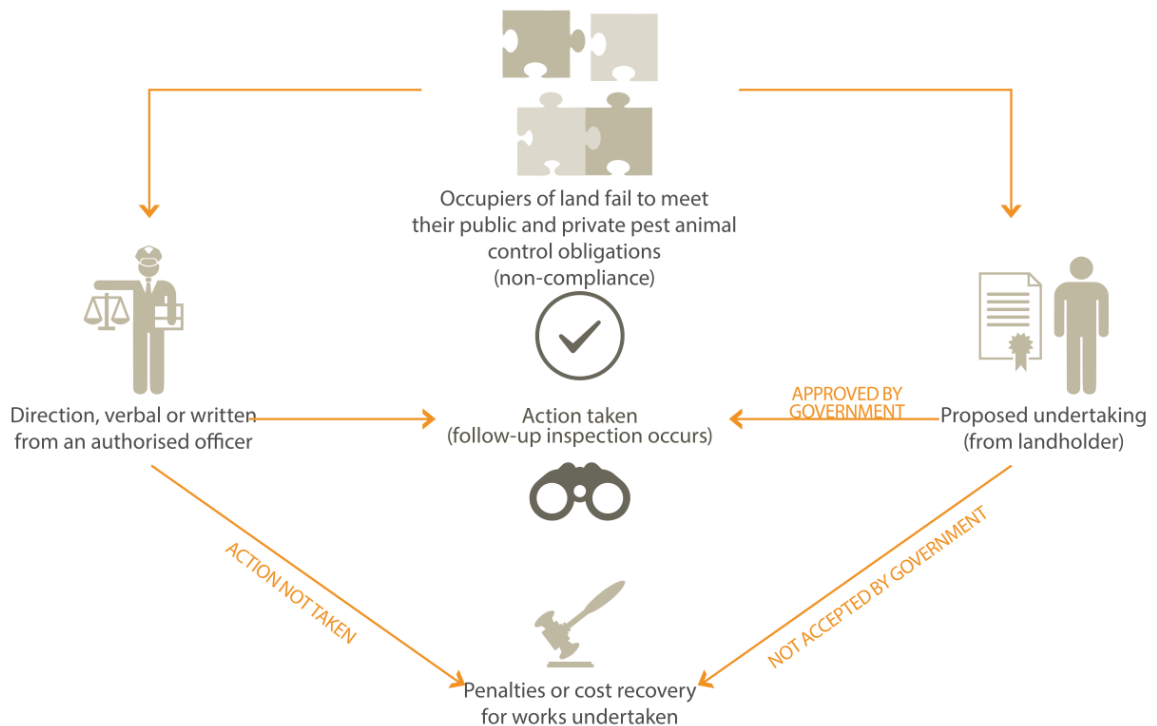


Figure 3.9: Compliance framework for failure to discharge the general biosecurity duty

Box 3.2: Compliance and enforcement through the Biosecurity Act

The NSW *Biosecurity Act 2015* includes a general biosecurity duty approach to provide flexibility around managing biosecurity risks such as pest animals. This approach is supported by specific enforcement measures. If a person fails to discharge their general biosecurity duty, section 23 of the Act provides for two tiers of offences:

- i. Category 1: applies where the failure to discharge the general biosecurity duty was intentional or reckless and the failure caused or had potential to cause a significant biosecurity threat. This is the most serious offence.
- ii. Category 2: applies to any other failure to discharge the general biosecurity duty and carries much lower penalties. This category also applies to a failure to comply with a mandatory measure (section 25 of the Act) or a biosecurity direction.

If a landholder fails to discharge their general biosecurity duty, he or she will not automatically be prosecuted. The Act provides for an interim measure in the form of a biosecurity direction, which is issued by an authorised officer under the Act. The landholder can either accept the terms of the biosecurity direction or propose an alternative undertaking, which needs to be accepted by the authorised officer, in order to meet his or her general biosecurity duty. Failure to comply may result in prosecution or other enforcement action.

Example - baiting program for wild dogs and foxes:

To meet their general biosecurity duty in relation to wild dogs and foxes, landholders can participate in a regional baiting program as per their regional pest animal management plan.

If an organic farmer does not want to participate in the program due to the use of chemicals they can adopt an alternative approach such as trapping on their property. An authorised officer would follow up with the landholder to check that action has been taken that achieves an equivalent outcome to the baiting program. If inadequate or ineffective then LLS would seek an alternative proposal from the landholder, or direct the landholder to undertake specific actions.

Or if an absentee landholder does not respond to requests for participation in the baiting program and wild dogs and foxes have been sighted on their property; LLS would attempt to contact the landholder seeking that he/she meet their general biosecurity duty. If the landholder fails to take action, LLS would enter the property to carry out pest management. The cost of which is charged to the landholder and/or they would be prosecuted.

Recommendation 3(iv-viii): Provide regional leadership and local delivery of pest management.

The NSW Government should:

- iv. task the regional pest animal management committees with developing regional priorities and targets for widespread terrestrial pest animal management and standardised systems for surveillance and reporting. The regional plans will complement the mandatory measures for pest management to be stipulated in the biosecurity regulations
- v. ensure the regional plans establish and promote an integrated management approach that incorporates the control of multiple pest animals to improve landscape health and productivity
- vi. require Local Land Services to consult the Biosecurity Advisory Committee prior to seeking endorsement from the Minister for Primary Industries to release the regional plans
- vii. ensure the actions in regional pest management plans are enforceable across tenures and binding on agencies by seeking Ministerial endorsement of plans
- viii. request that Local Land Services and local governments define areas of responsibility at the urban rural interface with the aim of maximising pest animal control program effectiveness.

3.2.3 Local delivery to manage finer variances

Local action is critical for effective pest management and is often guided by local plans. So while regional plans are an effective bridging tool for integrated strategic pest animal management, subregional plans (or local plans and programs) are equally, if not more, important to manage pest animals on the ground taking account of local variances. Plans can be simple or complex, but need to promote active participation as it is at the local scale where impacts are felt and control occurs (i.e. on-ground activity).

To increase the success of arrangements at the local scale, strong support from the regional and state scales is needed. These plans should establish clear rules and procedures for devolving decision making to the smallest capable scale, to create a system of co-responsibility and ownership and the foundation for meaningful landholder participation.

Many in the community are prepared to take ownership of pest management issues on their own property, and have stated an awareness of the role they play. However, absentee owners or landholders with differing enterprises and land uses do not always recognise or commit to shared ownership of the pest animal problem, often making decisions individually and for short-term benefit. This is known as a collective action problem. If efforts are to be effective, local landholders need to work together to implement actions that are coordinated, planned, prioritised and informed by risk.

The importance of coordinators to support community led programs at the local scale is discussed in Chapter 5. To further assist the local community, LLS should develop a standard template for local programs. This would provide guidance around program design and alignment with the regional plan and other programs within the region. Coordinators could also assist with this task by supporting community groups in capacity building, knowledge transfer and motivation.

Recommendation 3(ix): Provide regional leadership and local delivery of pest management.

The NSW Government should:

- ix. require the Local Land Services, as part of the regional planning process, to develop standards and templates for local programs and reporting. Standards will ensure alignment with the regional plan and across programs.

Freshwater pest governance

NSW Department of Primary Industries

In addition to its state-wide roles and responsibilities, NSW DPI currently leads freshwater pest fish management at the regional scale. Management includes research, control, community education and awareness and conservation activities. The Commission recommends NSW DPI (specifically, Fisheries NSW) maintains its role to lead on all aspects of freshwater pest fish management at the regional scale.

Fisheries NSW also has a significant role in inland recreational fisheries licencing and compliance, and native or salmonoid fish stocking (NSW Department of Primary Industries 2016). This is carried out by approximately 20 inland fisheries officers across the state. These officers are partly resourced by the NSW Recreational Freshwater Fishing Trust, with funds totalling approximately \$4 million each year. They have general fishery duties which include licence compliance checks and managing illegal activities but not biosecurity (specifically surveillance).

A small number of conservation staff (partly funded by the Trust), who manage threatened species, habitat rehabilitation and community education, also have some responsibility in pest fish management. To improve surveillance opportunities and compliance under the NSW *Biosecurity Act 2015*, the Commission recommends the NSW Government expand and clarify the role of fisheries officers and conservation officers to¹⁰:

- include surveillance of freshwater biosecurity
- become authorised officers under the Act.

Recommendation 4(i): Clarify freshwater roles.

The NSW Government should:

- i. clarify the role of fisheries compliance officers and conservation officers as authorised officers under the NSW *Biosecurity Act 2015*. This includes undertaking surveillance and monitoring of freshwater pest animal issues.

¹⁰ Some conservation officers would require compliance and enforcement training to be sufficiently qualified to become authorised officers under the NSW *Biosecurity Act 2015*.

Local Land Services

LLS is the lead agency for the management of terrestrial pest animals at regional scales. However, there is no current role for LLS in freshwater pest management.

The Commission encourages collaboration between LLS and NSW DPI in managing whole-of-landscape pest animal issues including freshwater pests. For example, pending approval of CyHV-3 for carp biocontrol, LLS and NSW DPI will need to collaboratively plan for strategic release of the virus and the clean-up of dead carp biomass. Collaboration can create opportunities to improve community education and awareness, and help build community capacity to participate in carp clean-up issues.

4 Better risk management

One of the difficulties in managing pest animals is that the appropriate management approach varies depending on where the species is positioned on the invasion curve (see Figure 1.2). However, where a pest species is positioned on the invasion curve can also vary from region to region. For example, deer are widespread in some regions and absent from others.

The Australian Government's pest animal activities are primarily focused on prevention, through the regulation of border and pre-border activities such as quarantine and customs. Post-border responsibilities for pest animal management generally fall to state and territory jurisdictions.

4.1 New and future risks

Future threats to agricultural production from pests have the potential to far outweigh the annual economic impacts that pests currently have. Many pest animals are potential carriers of exotic diseases, and should these become established in pest animal populations they could be difficult to detect and eradicate (Olsen 1998). Emerging pest-related risks to the productivity of Australia and NSW include worsening of environmental conditions due to climate change and negative impacts to the country's valuable agricultural trade.

Prevention and preparedness can pay enormous dividends when done well. This was demonstrated by an Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) review of locust controls in 2010. Such control were estimated to have avoided potential losses of \$963 million with total expenditure by all parties estimated to be \$50 million, with an estimated ratio of benefits to costs of around 19:1 (Millist & Abdalla 2011).

Disease

Australia is free of the world's worst animal diseases, such as foot-and-mouth disease and (classical) swine fever. However, the risk of these diseases remains a threat to the Australian environment, economy and community. The growing rate of global trade, closer proximity of livestock, people and wildlife and other human interventions such as animal translocations for conservation or recreation purposes continue to increase the risk of a serious disease outbreak (Henderson 2008).

For example, the threat from deer or pigs of an outbreak of foot and mouth disease or the spread of Johns disease pose direct threats to Australia's agricultural production. ABARES estimates that national losses from a foot and mouth outbreak could range from \$7.1 billion for a small three-month outbreak, to \$16 billion for a large 12-month outbreak – equal to around 30 percent of the gross value of agricultural production (Matthews 2011; Australian Bureau of Statistics 2015). Pest animals can also spread weeds, which can impact productivity and biodiversity.

Studies of feral pig populations show that pigs are particularly likely to play a role in spreading endemic or exotic disease, particularly around major river catchments (Hampton et al. 2004). Similarly, pest fish harbour diseases and pathogens that can devastate native freshwater species. For example, redfin perch are the main carrier of epizootic haematopoietic necrosis virus, which is one of eight key threats to native fish in the Murray-Darling Basin (Murray-Darling Basin Ministerial Council 2003).

The risks of feral herbivores (deer, donkeys, horses, buffalo, goats, camels and cattle) spreading disease is also of concern. They are difficult to survey and contain, and are potentially a highly mobile, widespread and long-term host of infection (Hampton et al. 2004).

Globalisation

Exotic vertebrate species that establish in the wild can become predators and competitors, and provide vectors for the introduction of novel diseases and parasites. This has the potential to harm both native and domestic animals and plants (Henderson et al. 2011).

There are many examples of exotic pest animal species that have become naturalised in Australia following localised incursions. Once established, pest animals can change the function of landscape systems by becoming predators and competitors of valued species. (Henderson et al. 2011).

NSW is on the doorstep of some of the world's largest and fastest growing economies with rapid growth in trade, tourism and in passenger and cargo movements (NSW Department of Primary Industries 2014). The risk of new pest animal incursions is projected to rise with this increase in the movement of people and goods and faster transport systems that enable more species to survive transit (Simberloff et al. 2013).

Population growth and urbanisation is also projected to increase the number of domestic pets and animal collections. This drives the legal and illegal trade of animals as well as releases, both accidental and deliberate (Simberloff et al. 2013). NSW is the most populous Australian state and has numerous large urban centres.

Climate change

Climate change is likely to produce increasingly favourable conditions for pest animals and weeds. Recent research indicates that climate change can result in simplified ecosystems and place stress on native species, creating ideal conditions for pest animals to expand and colonise new regions (Dunlop et al. 2012). By modifying temperature and rainfall environments, climate change could also enable some pest animal species to become more numerous within their current range; for example, cane toads are expected to expand southwards in NSW (Eco Logical Australia 2015).

Maintaining global competitiveness

Agriculture is one of the few sectors of the Australian economy which is a truly internationally competitive sector when relative productivity and input costs are accounted for (McKinsey Australia 2014). Australia's proximity to Asia, the fastest growing region in the world, provides important opportunities which could be put at risk by pest animals if not managed appropriately.

Australia's clean and green food production reputation provides another competitive advantage and point of difference in a globally competitive marketplace that must be sustained. However, increased demand in overseas markets does not necessarily translate into realised benefits in Australia unless the nation's agriculture remains profitable, sustainable and judicious in its risk management (Grafton et al. 2015).

The risks to Australian agricultural production are many and varied. Prices and incomes are extremely volatile in comparison to other countries. Australian taxpayers also pay the lowest level of subsidies to their agriculture sector (as a proportion of GDP) of any taxpayers

worldwide (Grafton et al. 2015). Maintenance of this high level of productivity is critical to the future prosperity of the sector and a strong biosecurity management framework is imperative to this.

4.2 Prioritisation and risk assessment

With increasing risks of new incursions, along with growing distribution and impacts of established species, pest animal investments must be prioritised, transparent and defensible. Prioritisation leads to more efficient resource allocation and a better conceptualisation of the issue, highlighting opportunities to explore and resolve conflicts and leading to more coordinated control efforts across landscapes.

The prioritisation process should ideally maximise social wellbeing through investments that produce maximum net benefits. Unfortunately, in practice, pest animal prioritisation is rarely based on a systematic assessment of risk (Heikkilä 2011). For example, species are prioritised for control for different reasons in different areas by different stakeholders. These reasons include histories of control, substantial visibility, political pressure, suspected impacts and current knowledge (Virtue et al. n.d.). Wild dog control is a critical issue, yet its rating as a national and then state priority would have been more sound if based on a transparent risk assessment process. A risk-based prioritisation process will provide for more rational pest management planning at the regional and local scales.

Risk assessment is almost always based on imprecise or inadequate information. Despite this limitation, prioritisation models do better than unstructured individual opinions. To make risk-based prioritisation more objective, a number of preferred characteristics have been proposed including:

- components have a scientific basis that is mathematically simple but logical
- the scheme is fully transparent
- the questions are clear and generic enough to suit a range of circumstances
- the evaluation process minimises the impact of subjective views and is repeatable such that two persons evaluating the same organism reach a similar outcome
- there are as few questions as possible but the comparison is robust
- there is potential to use all available data
- the scheme is easy to apply (Heikkilä 2011).

The last point, ease of application, generally means using qualitative and semi-quantitative models that are faster to apply and require less accurate or complete data than fully quantitative models. The disadvantage is that the scores and aggregations of such models are arbitrary, which may not be as transparent as a fully quantitative approach (McKenzie et al. 2007). On the other hand, where comprehensive models are used, their complexity is a barrier to adoption, particularly in an adaptive management context where prioritisation may need to be regularly reviewed.

NSW risk assessment process

The need for a risk assessment framework for invasive species specific to NSW was identified in the NSW *Invasive Species Plan 2008–2015* as well as the *draft Invasive Species Plan 2015–2022*. Developing such a framework should be a priority of the NSW Department of Primary Industries (NSW DPI) to provide a defensible, transparent and participatory approach to support consistent management across Local Land Service (LLS) regions.

Australia and New Zealand have used a successful prioritisation tool for pest risk assessment since the late 1990s (Virtue et al., 2006). Originally developed by the South Australian Government to manage pest weed risks, this tool is being applied by all states in Australia. South Australia has adapted the approach to establish an equivalent risk assessment process for pest animals (Williams, 2010) and it now supports an integration of pest plant and animal management. The process is used by Natural Resource Management Boards to prepare integrated pest management plans that prioritise the risks posed by pest animals and rank control programs.

Operating at both state and regional scales, the South Australian model has been credited with dramatically improving pest management, and initiating a cultural shift in attitudes towards early intervention and triple bottom line outcomes (Virtue et al., n.d.).

Limitations of the model

A downside to simple models like that of South Australia is their sensitivity to judgements regarding risk and the feasibility of control. As the outcomes of the risk assessment process can have significant impacts on investment and regulatory impact, there is a strong need to ensure transparency, independence and oversight of process.

4.3 Assessing the risk of new incursions

Assessing the risks posed by new incursions involves an analysis of both the risk a species will establish and the risk that it will have an adverse impact (Bomford 2008).

Risk of establishment

There are four key success factors (Bomford 2008) for the establishment of a pest animal population:

- **propagule pressure** – the release of large numbers of animals at different times and places enhances the chance of successful establishment
- **climate match** – exotic species have a greater chance of establishing if they are introduced to an area with a climate that closely matches that of their original range
- **history of establishment elsewhere** – a history of previous successful establishment is a strong predictor for all vertebrate taxa
- **taxonomic group** – species that belong to families and genera that have high establishment success are more likely to be successful than other species.

Of the vertebrate pest animals, exotic freshwater fish, followed by reptiles, currently pose the highest risk of establishment (Henderson & Bomford 2011). Reptiles are a popular pet species and the most common vertebrate stowaways intercepted. They pose a greater risk of establishment in the wild than birds, mammals or amphibians (Cassey & Henderson 2012).

Risk of impact

The adverse impacts of exotic species can be broadly classified as economic, environmental and social. Reliable information regarding the potential impacts of species is difficult to obtain particularly for fish, reptiles and amphibians, which are the taxa most likely to establish (Bomford 2008).

The following factors (Bomford 2008) indicate the potential of an exotic species having an adverse impact:

- have close relatives with similar behavioural and ecological strategies that cause adverse impacts elsewhere
- are generalist feeders
- are predatory
- destroy or modify vegetation or otherwise cause major habitat changes
- have the potential to cause physical injury
- harbour or transmit harmful diseases or parasites
- have potential to hybridise with close relatives among native species
- are known to spread rapidly following their release into new environments.

It is argued that the difficulties in responding to ecological uncertainties has resulted in lower priority being assigned to the environmental impacts of pest animals, compared to the economic or agricultural impacts (Invasive Species Council 2014).

National consistency in the import, movement and keeping of non-indigenous vertebrate animals in Australia is a priority for the Invasive Plants and Animals Committee¹¹. All Australian jurisdictions have agreed on a nationally consistent approach to the risks posed by non-indigenous vertebrates (National Biosecurity Committee 2015). The national Invasive Plants and Animals Committee assesses and categorises the threats posed by non-indigenous vertebrate mammals, birds, amphibians and reptiles held in Australia under state and territory legislation. Meanwhile its sub-committee, the National Freshwater Fish Expert Group, assesses risks associated with alien fish species.

The national Invasive Plants and Animals Committee assigns four threat categories which specify the regulatory approach that should be adopted for each species (for example, regulation of movement or keeping) by state and territory jurisdictions:

- extreme - species should be prohibited
- serious - species should be registered and kept under licensed collections (for example, zoos and research only)
- moderate - species should be registered and kept under licensed collections
- low - regulation optional.

In NSW the *Non-Indigenous Animals Act 1987* classifies terrestrial non-indigenous animals according to risk and imposes controls. Generally, animals assessed as having an extreme pest potential are not permitted in NSW whilst animals assessed as having a significant biosecurity risk are managed through a system of licences, permits and regulations to regulate their

¹¹ Activity 11 2015-16 Priorities for the Invasive Plants and Animals Committee.

control, importation, keeping, movement and release (NSW Department of Primary Industries 2015c). The *Non-indigenous Animals Act 1987* (NSW) does not regulate economically important animals, domestic animals, widespread pests (such as foxes, feral goats) and animals that do not pose significant risks.

However, the NSW risk assessment and classification process has been criticised by some stakeholders (Invasive Species Council et al. n.d.) for being subjective, duplicating the effort at the national scale and for not aligning with the threat assessments made by Invasive Plants and Animals Committee.

The NSW *Non-Indigenous Animals Act 1987* will be repealed by the NSW *Biosecurity Act 2015* when the appropriate regulations policies and procedures have been prepared. NSW DPI proposes to use the current species classification with the NSW *Biosecurity Act 2015* provisions.

Inconsistencies in pest animal threat assessment

As seen above, despite the commitment to a national approach there are considerable inconsistencies between the risk categorisation at the national scale and in NSW. The guidelines for the import, movement and keeping of non-indigenous vertebrates in Australia (Vertebrate Pests Committee 2014) provides for variation by state and territory jurisdictions. The guidelines allow State and Territory jurisdictions to apply more conservative strategies if considered necessary and may choose not to apply the guidelines to established pests or livestock, pet and farm animals (Vertebrate Pests Committee 2014).

For example the ferret (*Mustela putorius*) is listed in the International Union for Conservation of Nature's top 100 invasive species and have naturalised in many places including New Zealand, Morocco and the United States (DPIPWE 2011). Ferrets are associated with declines in native wildlife populations in New Zealand and are classified as an extreme threat by the Invasive Plants and Animals Committee. The response by the state and territory jurisdictions varies. They are illegal in two Australian jurisdictions, permissible under licence in another two, and not permitted to escape in one state. By contrast, there are no restrictions in NSW, Western Australia or South Australia (Department of Primary Industries Parks Water and Environment Tasmanian State Government 2011).

In NSW ferrets are placed in category 4 under the NSW *Non-Indigenous Animals Act 1987* with "animals that would be unlikely to present a threat to the environment, agriculture or persons, or greatly worsen an existing threat if they escaped into the wild, the importation and keeping of which are not restricted".

A similar situation arises with non-indigenous game birds; quails, pheasants and peafowl of the family *Phasianidae*. The current classification of these birds by the Invasive Plants and Animals Committee indicates a pest potential as they have established feral populations elsewhere in the world. In NSW they are placed in category 4 as unlikely to present a threat. NSW DPI indicate the reason for the low risk categorisation is that no wild populations have established in NSW despite being present for some time. This appears incongruous with the NSW *Game and Feral Animal Control Act 2002* which allows for licensed shooters to target these species if found in the wild, providing an incentive for their deliberate release.

The risks posed by pests, and incentives to release non-indigenous animals, support tighter regulation. Game bird species assessed by the Invasive Plants and Animals Committee as posing an extreme threat should be removed from the schedules of the NSW *Game and Feral Animal Control Act 2002*.

Other examples where threat categorisations at the national and state scales do not align include the Canada goose (*Branta canadensis*) and Indian ringneck parrot (*Psittacula krameri*). The trade in and keeping of some non-indigenous animals presents another high risk pathway to new incursions. Provisions within the NSW *Biosecurity Act 2015* could, where justified, promote stronger regulation of the sale, movement, disposal and breeding of high risk species. While risk assessment and risk management is central to this process, risk communication is also important. There should be an open exchange of information between risk assessors, risk managers and those who may be affected by decisions taken. As the regulations supporting the Biosecurity Act approach completion, NSW DPI should provide the Biosecurity Advisory Committee and make publically available the reasons for any inconsistencies with the approach in NSW and that recommended by Invasive Plants and Animals Committee.

Consistent with the recommendations of the Beale (2008) review, the Commission also recommends greater harmonisation of the risk assessments and regulation of non-indigenous animals across Australian jurisdictions.

Recommendation 5(i-ii): That the regulation of non-indigenous species is commensurate with the risks that they pose.

The NSW Government should:

- i. ensure the regulations supporting the NSW *Biosecurity Act 2015* are consistent with the Invasive Plants and Animals Committee threat assessments. If for any reason there is a State variation, this should be publically reported and justified.
- ii. amend the NSW *Game and Feral Animal Control Act 2002* to remove non-indigenous game birds that have been assessed by the Invasive Plants and Animals Committee as posing an extreme threat.

4.4 Managing incursions and preventing infestations

The post-border management requirements for invasive species can be grouped into two broad approaches:

- managing incursions (prevention, eradication)
- managing infestations (containment¹², asset protection).

A pest animal *incursion* is an isolated population (as opposed to an individual) not known to be established, but recently detected and expected to persist and establish naturalised, sustaining populations (Henderson et al. 2011). It may be a species not previously found in Australia or NSW, or the expansion of an already established pest species into a new area or region. Conversely, a pest animal *infestation* is a population that is established, self-sustaining that cannot be feasibly eradicated and requires management intervention to contain or protect assets from impact (Sydes 2014). The requirement for different management approaches demands different regulatory and institutional approaches as reflected in the governance and planning arrangements outlined in Chapter 3.

Once prevention efforts have failed the management options include doing nothing, or controlling or eradicating the incursion. Eradication is normally preferred as it removes rather than minimises impacts. However, this is rarely feasible at larger scales, reinforcing the importance of early detection and rapid response.

¹² Containment is a legitimate strategy in eradication programs.

The management of new pest animal incursions into NSW is a state government responsibility. NSW DPI takes the lead and coordinates preparedness, response and recovery programs to manage incursions of significant pests (NSW Department of Primary Industries 2015e). The infestation of an established pest animal population within new regions (either naturally or by relocation) is the responsibility of Local Land Services (LLS), and highlights the importance of coordination between LLS and other land managers in pest animal programs, such as building containment lines.

Box 4.3: Managing infestations of cane toads in NSW

Cane toads are not declared a pest under NSW legislation, but are listed as category 2 (a species of high pest potential) under the NSW *Non-Indigenous Animals Act 1987*. They also have key threatening process listing under the *Threatened Species Conservation Act 1995* (NSW) and the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth).

Cane toads are widespread in north-eastern NSW and eradication in these areas is not currently a possibility. Consistent with the national threat abatement plan for cane toads the NSW Office of Environment and Heritage has established a containment zone and identified outlier populations that are targeted for eradication (OEH 2012). The organisation has also produced best practice guidelines for eradicating outlining cane toad populations.

The management of cane toad infestation into NSW will require a whole of government and community response. The NSW *Invasive Species Plan* should indicate whether the management of cane toads is a priority. If so, the regional pest management plans of the affected Local Land Services region should include free programs designed to achieve agreed outcomes. These programs may include the vigilant surveillance of high risk pathways and community based passive surveillance programs.

Although communities have an important role in managing new incursions, particularly in surveillance, the NSW Government is best placed to lead. The current NSW biosecurity arrangements provide the resources and legislative authority required for government to do so. With new incursions, time is critical and a 'command and control' approach is required. However, the effectiveness of such an approach diminishes as eradication becomes less feasible when a pest animal population becomes established and widespread (Graham 2013).

NSW has a demonstrated capacity to respond effectively to biosecurity threats, for example equine influenza or Red Imported Fire Ants. Applying this capacity to provide an equivalent response to invasive plant and animal incursions should be the goal. As existing technologies are improved and new technologies developed, such as biological controls, eradication of larger pest animal incursions may become more feasible (Gregory et al. 2014).

The effective management of new pest animal incursions is based on preparedness. Preparedness requires surveillance systems, information management systems, the regulatory power to act decisively, and timely access to adequate resources. However, having this capacity does not in itself ensure effectiveness. Effectiveness also requires clearly defined roles and responsibilities, sufficient skills and knowledge of managers and communities, and accountability for the performance of key functions.

Box 4.4 describes the management approach adopted in other jurisdictions to manage incursions of a high risk species – the red-eared slider turtle.

Box 4.4: A high risk species – Red-eared slider turtle

Red-eared slider turtles are a serious threat to biodiversity. They have established in South-eastern Queensland, with additional confirmed reports throughout Australia, often near large urban areas. In NSW, a small breeding population was first identified in the late 1990s, and they have since been reported across the Sydney region (Robey et al. 2011).

In 2011 the Invasive Animals CRC concluded that the risk posed by the establishment of this species in Australia was unacceptably high. They recommended that adequate resources be committed to its eradication including efforts to better educate the community (Henderson & Bomford 2011).

Subsequent to this recommendation, Queensland undertook a risk assessment and invested almost \$1 million in efforts to eradicate the species (Csurhes & Hankamer 2012). Eradication efforts are being followed with passive and active surveillance, recording about one animal in the wild and three in captivity each year (Csurhes pers. comm. 2016). There has also been localised eradication success in Victoria and Western Australia.

In NSW there was a comparatively small response to the detection of the Sydney breeding population when control, including eradication, may have been feasible (Burgin pers. comm. 2016). Although the species is prohibited under the NSW *Non-Indigenous Animals Act 1987*, NSW still has no stated management objective for current incursions or any co-ordinated action to limit the red-eared slider's impact.

4.5 Institutional complexity a barrier to effectiveness

Clear roles and responsibilities are critical to the effective management of incursions. Institutional and regulatory complexity increases the risk of roles and responsibilities becoming confused. Although the NSW *Biosecurity Act 2015* and regulations will go a long way to reducing institutional complexity, there are still areas for improvement.

In NSW, the regulation of controlled categories of non-indigenous reptiles is currently shared by the NSW DPI and the NSW Office of Environment and Heritage (OEH). However, there is no formal mechanism to coordinate the activities of the two agencies, frequently resulting in ad hoc response to incursions.

The respective roles and responsibilities of the different agencies including access to the necessary resources should be agreed and formalised. Periodic testing and evaluation of the rapid response capacity should also be undertaken. Developing rapid response plans and cost sharing arrangements is identified as an action in both the 2008-15 and draft 2015-22 *Invasive Species Plans* and should be prioritised.

Recommendation 6(i): Establish the capacity for a timely and coordinated response to pest animal incursions.

The NSW Government should:

- i. formalise the roles and responsibilities of NSW government agencies in response to pest animal incursions in the *Invasive Species Plan 2015-2022*.

4.5.1 Pest animal surveillance

In the event of pre-border and post-border prevention activities failing, early detection through vigilant surveillance of high risk pathways is essential for effective eradication or containment of new incursions. Detection of any new species should trigger a rapid assessment of risks, determination of feasibility of eradication and the development and implementation of management strategies (Gregory et al. 2014).

However, surveillance is a resource-hungry activity and is a challenge for governments with limited budgets and personnel. Efficiencies can be generated through improved risk-based prioritisation, better use of technology, better utilisation of existing resources, and improved co-ordination and collaboration between organisations.

Improved identification, diagnostics, surveillance, reporting and tracing systems for pests, diseases and weeds is an outcome sought by the NSW *Biosecurity Strategy 2013-2023*. The strategy promotes the adoption of the latest technology and diagnostics, together with greater co-ordination of surveillance activities and accessibility to information.

The timely detection of new incursions was an objective of the NSW *Invasive Species Plan 2008-2015*, but the planned outputs of educational material and functioning hotlines were unlikely on their own to sufficiently support this objective. The 2015-2022 consultation draft of the plan builds on these outputs, and adds increasing stakeholder and community capacity as actions. However, the 2015-2022 draft plan does not provide the guidance needed to support coordinated passive and active surveillance activities at the state, regional and local scales. As new incursions remain a constant risk, the plan should also include digital surveillance systems such as automated web crawlers to monitor online activity (Sonricker Hansen et al. 2012).

Unfortunately, current biodiversity surveillance and diagnostic activity is often fragmented and applied differently across different prevention activities. For example, the State Government funds local government to actively monitor weed incursions through the NSW Weeds Action Program. However, there are no requirements or systems to support the concurrent recording of pest animal information (see Chapter 8). Similarly, NSW Fisheries Officers have no formally designated biosecurity surveillance responsibilities, despite their daily interface with freshwater ecosystems across the state.

Although public awareness programs, online reporting, and telephone hotlines exist, consultation indicates that their full potential is not being realised for important programs such as passive surveillance. An example is described in Box 4.5.

Box 4.5: Surveillance for widespread pests

Some widespread pests behave like new incursions and demand the same type of management response. For example, house mouse (*Mus domesticus*) populations can quickly erupt into plague proportions in NSW cropping regions with landholders recording up to 8,000 mice per hectare in 2011 (Hodgkinson 2011).

The community plays a major role in surveillance for early detection, and the Invasive Animals CRC has developed the MouseAlert website and phone app to encourage this. Another nation-wide program is Mouse Census Week, which encourages communities in Australian cropping regions to map mouse activity. Co-funded by several major bodies including Invasive Animals CRC, the first census was in April 2015, collecting 150 records. It is expected that the regional pest management plans for NSW cropping regions will continue to include surveillance programs and a rapid response capacity.

The NSW Weeds Action Program requires Regional Weeds Committees to prepare active and passive surveillance plans for their region. These plans identify high risk pathways for both terrestrial and aquatic weed species, and already include the pet shops and aquariums that pose pest plant and animal incursion risks. This review recommends that pest plant and animal functions be integrated, including the considerable efficiencies that can be found in the surveillance function.

Recommendation 7(i): Implement cost effective surveillance for the timely detection of new pest animal incursions

The NSW Government should:

- i. include active and passive biosecurity surveillance activities in regional pest animal management plans and the *Invasive Species Plan 2015-2022* including detail on roles and responsibilities at the state, regional and local scales and the surveillance of online and illegal trade in invasive species.

4.5.2 Information management

Effective management of new incursions depends on the collection and management of information. The importance of reporting and data management in a centralised pest animal portal has been recognised by both NSW DPI and LLS as they expand and develop electronic reporting mechanisms and digital platforms (see Chapter 8).

The Biosecurity Information System being developed by NSW DPI has the potential to provide the capacity required. Integrating the Biosecurity Information System with surveillance activities at the regional and local scale, including community based reporting systems such as FeralScan, should be prioritised.

Recommendation 8(i): Ensure pest animal management is informed by the best available information.

The NSW Government should:

- i. prioritise the improvement of the Biosecurity Information System integration with pest animal surveillance programs both active and passive.

4.5.3 Timely access to resources

Early detection must be supported by timely access to resources, including funding for research, information, planning, coordination and eradication or containment. NSW DPI uses funding from within its cluster to respond to new incursions. For example, NSW DPI funding was used to address the incursion of fire ants in Port Botany in 2014-2015 (NSW Department of Primary Industries 2015f), and for the protection of native turtles against disease in the Bellinger River in 2015 (NSW Department of Primary Industries 2015a). The rules governing access to this funding are currently uncertain and require clarification (see Chapter 9). In particular, it is unclear how environmental impacts are considered in the risk assessment process and whether other agencies should be required to contribute funding.

Recommendation 9(i): Timely resources are made available to address the risks posed by new incursions.

The NSW Government should:

- i. clarify and formalise the arrangements for accessing NSW government agency funding for eradicating new incursions.

4.6 Preventing new incursions of freshwater pests

Prevention of new aquatic biosecurity incursions remains the most feasible approach for freshwater pest management. This provides the greatest return on investment (see Figure 1.2), given the limited applicability of available control techniques. Preventative actions rely on managing trade, legislation, surveillance, quarantine and in particular community action (Ayres & Clunie 2010b).

4.6.1 Reducing incursion risk from the ornamental fish trade

In Australia, 65 percent of alien fish have been introduced through the loosely regulated aquarium or ornamental fish industry. Since the 1970s, 21 of the last 23 alien fish species to establish wild populations are attributed to aquarium trade (Lintermans 2004). With the ornamental fish industry in Australia valued at an estimated \$350 million, international and domestic trade is a large incursion pathway and should be managed appropriately.

Ornamental fish strategy

The ornamental fish trade needs to be controlled more soundly in three core areas. The first is clarity around species on the national noxious fish list, being developed by the National Freshwater Fish Expert Group under the 2006 *National Ornamental Fish Strategy*. As of August 2014, the noxious fish list contained 138 species that are not permissible for trade within or out of Australia, and which all states and territories have agreed to control through legislation (National Freshwater Fish Working Group 2014; National Freshwater Fish Working Group n.d.). A 'grey' list of 507 noxious species remain subject to unclear enforcement, along with hundreds of other potentially threatening unlisted species (National Freshwater Fish Working Group 2014).

To advance the process of refining this list, the Commission recommends the NSW Government advocates that the Australian Government and other states prioritise risk assessment of incursion pathways and carriers¹³, rather than fish species.

¹³ Risk pathways include the informal trade and keeping of domestic aquarium species.

Recommendation 10(i): Expedite action on critical freshwater pest animal issues

The NSW Government should:

- i. seek to work with other jurisdictions, including the Australian Government, to finalise the *National Ornamental Fish Strategy 2006* by focusing resources on assessing the risks of pathways, rather than species.

Current regulatory arrangements for aquarium trade in NSW

The second issue relating to problems around ornamental fish is licensing for producers of fish for the aquarium trade. These businesses currently require a permit under the *NSW Fisheries Management Act 1994* but it is unclear how potential risks will be managed under the *NSW Biosecurity Act 2015* regulatory framework.

The Commission encourages NSW DPI to work with stakeholders to review and revise the obligations of the aquarium trade in preventing new incursions. This may include requiring pet shops and aquaculture producers to become registered biosecurity entities under the Act, and to monitor and record freshwater species sales. This approach follows a successful precedent set in Tasmania, where it is illegal to import or sell freshwater fish without holding a registered dealer licence under section 62 of the *Inland Fisheries Act 1995* (Tasmania).

Finally, the controls around the movements of ornamental fish in Australia after their initial purchase are minimal, with no legislative requirement to keep records of ongoing movements or sales. The *National Ornamental Fish Strategy 2006* identified this as a key issue.

Reducing the risks from illegal trade requires a NSW Government-led system of incentives and penalties. These should be underpinned by better education campaigns that target unaware consumers and online dealers, informing them of the risks from freshwater ornamental or aquarium species.

Recommendation 10(ii): Expedite action on critical freshwater pest animal issues.

The NSW Government should:

- ii. review and revise as necessary the obligations of the aquarium trade in relation to preventing new incursions of invasive fish. This could mean that aquariums and pet shops selling potential aquatic pests are registered biosecurity entities under the new *NSW Biosecurity Act 2015*.

4.6.2 Surveillance for new incursions

Effective pre and post-border surveillance is difficult in the case of freshwater pests, as small populations are hard to detect (Britton et al. 2011). NSW DPI undertakes a range of surveys, sampling programs and research for this purpose. However, survey techniques such as traditional trapping or electrofishing are prohibitively expensive for monitoring across a large area such as NSW, especially over the long term.

Biotechnology tools such as Environmental DNA (eDNA) and NextGen genomic sequencing show promise as an emerging surveillance method, as they can detect the presence of freshwater species in waterways (Hall 2012).

Improving surveillance also includes expanding or clarifying the role of NSW DPI conservation or fisheries compliance officers as authorised officers under the NSW *Biosecurity Act 2015*. These on-ground officers are well placed to identify pest fish incursions within freshwater systems. They have direct relationships with the fishing community, which can also assist further in surveillance.

Current community surveillance programs, such as the FeralFishScan and FishCare, draw on community resources to fill knowledge gaps in the distribution and abundance of alien freshwater fish. They also promote education and awareness of freshwater biosecurity issues. The Commission encourages the NSW Government to increase opportunities for community surveillance involving recreational fishers, as they are familiar with freshwater environments and interested in river health.

4.6.3 Emergency response

Rapid response to any new biosecurity incursions in freshwater environments is critical, as freshwater pests are extremely difficult to eradicate once there is an incursion (Hall 2012).

A good example of rapid response is the emergency management program in early 2015 to reduce the spread of disease in Bellinger River snapping turtle populations. Led by NSW DPI and supported by other government agencies, organisations and the community (NSW Department of Primary Industries 2015a), the program achieved its objectives in just two months. Community education campaigns, agency and community surveillance programs, risk assessments and planning, and direct management played a large role (Moloney et al. 2015). Since April 2015, no new diseased turtles have been found.

The NSW Government should strengthen and maintain its capacity to respond to such biosecurity emergencies. Appropriate resourcing is critical, and should be supported through funding available to NSW DPI (see Chapter 9), and boosted through collaborative partnerships in response to incursion events.

4.6.4 Planning in the Murray-Darling Basin

The *Native Fish Strategy for the Murray Darling Basin 2003-13* was developed to address the long-term decline in native fish (Barrett et al. 2013) in the region. During consultation, this plan was praised as a well-developed document that gave strategic direction and clear accountabilities for the management of alien fish in the Murray-Darling Basin.

However, the Murray-Darling Basin Authority and state partners stopped funding the strategy in 2013 due to resource constraints. No further action has been taken since then by the Murray-Darling Basin Authority or any other agency, to implement a basin-wide strategy for managing freshwater pests.

In the absence of a basin-wide freshwater biosecurity plan, the NSW Government should clearly incorporate management objectives for freshwater pests into its state pest animal management plan, while continuing to advocate for cross-border initiatives.

4.6.5 Planning for environmental water in the landscape

A common goal of environmental flow regimes in the Murray-Darling Basin is to maintain or enhance native fish populations and river health (King et al. 2010). Over the past decade, this objective has delivered mixed results. For example, while increased river regulation has improved the health of wetlands and environmental flows, it has also benefited pest species more than native fish. Some problematic outcomes include:

- damming of water at weirs creating favourable, slow-flowing breeding grounds for carp
- flooding of wetlands providing increased habitat for feral pigs and allowing carp access to favourable breeding grounds
- top or bottom water release from dams, where bottom release (cold water) is not favourable to native fish, while top release (warm water) favours carp as well as native fish
- non-specificity of fish passageways, allowing alien fish to spread (Murray-Darling Basin Native Fish Working Group 2013; King et al. 2010; Hall & Fulton 2012).

Managing these issues is challenging for environmental water managers, as the priority is to benefit river health, natural processes and native species, rather than reduce the risk of pest animals. Management techniques for pest fish such as wetland drying, carp screens and cages on weirs (Hall & Fulton 2012) can be used to control populations at managed wetlands, but in large or unregulated systems, control options are limited.

To address this problem, water and land managers acknowledge the need for better communication and strategic coordination on environment flow regimes and control programs (Hall & Fulton 2012). The *Basin-wide environmental watering strategy 2014* states the importance of communication and coordination. The strategy recommends that environmental water managers collaborate with other natural resource management groups to achieve integrated outcomes and mitigate risks such as carp (Murray-Darling Basin Authority 2014). Groups and committees such as environmental water advisory groups are encouraged to consider the risks posed by environmental flows in prioritising watering strategies (Murray-Darling Basin Authority 2016, pers. comm., January).

However, in consultation, stakeholders raised concern about a potential lack of communication and coordination between water and land managers in managing the risks from environmental flows. Some also noted poor monitoring of the impact of environmental flows on pest fish activity.

Better collaboration and communication presents a significant opportunity to improve landscape-based planning, reducing the impacts of environmental flows on native fish and boosting river health. The Commission encourages the NSW Government to ensure:

- directions under the *Basin-wide environmental watering strategy 2014* are considered and acted upon
- the NSW Office of Water, OEHL, advisory groups and committees work with NSW DPI, LLS and community to manage pest animal risks from environmental water
- LLS considers incorporating environmental flow regimes into strategic feral pig management planning.

Recommendation 10(iii): Expedite action on critical freshwater pest animal issues.

The NSW Government should:

- iii. advocate to the Australian Government and other jurisdictions the use of environmental flows and environmental water to favour native fish and disadvantage freshwater pest animals.

5 People are fundamental for successful pest management

Governments and the broader public recognise local communities as best placed to manage widespread pest animals. They can apply local knowledge, organise their own resources, and implement programs tailored to local needs (Martin et al. n.d.; Sobels et al. 2001; Department of Agriculture Fisheries and Forestry Queensland State Government 2015). Enabling ownership and delivery through local education and engagement programs is also the most cost-effective approach to managing established terrestrial pest animals. Further, if programs are owned by the community, they can outlast institutional or other changes.

5.1 Coordination as a driver of local success

To address the known problem of non-participation in local pest management efforts, strong coordination at the local scale has emerged as a key objective (Ecker et al. 2015; Thompson et al. 2013), whether on a volunteer-led or professional basis.

5.1.1 Volunteer-led coordination efforts

In NSW, the majority of pest management groups are volunteer-led, made up of neighbouring landholders and focused on a particular species. For example, the South East Local Land Services area has 13 wild dog regional groups and Northern Tablelands Local Land Services area has 25 groups. Other community groups in the state focus on fox baiting, rabbit control and controlling myna birds in urban areas. Volunteer-led efforts are scattered across the state, with varying levels of investment, continuity and commitment (Ecker et al. 2015).

These groups are often supported by Local Land Services (LLS) biosecurity officers, who work with landholders to provide advice, assistance and coordination in pest animal control programs. However, because their roles are broader than facilitating pest animal management alone, they often have limited resources for pest animal control activities. The responsibilities of these biosecurity officers range from managing animal health and disease, to preparing pest baits and toxins, identifying and certifying livestock, and inspecting properties. In some regions, volunteer-led groups may also be supported by Landcare regional facilitators and local coordinators but their role is again broader than pest animal management.

During the consultation process for this review, many stakeholders expressed concern around the current arrangements for collective action through volunteer-led community groups, noting barriers such as:

- time, funding and resourcing constraints
- local leader burnout through over-reliance or lack of succession planning
- complexity of reporting, legal requirements and funding arrangements
- difficulty in agreeing and acting upon roles and responsibilities
- disagreement with the approach and priorities of management.

These barriers, along with changing rural demographics and land use and balancing the use of scientific and landholder knowledge, were also identified by Ecker et al. (2015) as hindering the success of volunteer-led community pest management groups.

5.1.2 A shift to professional coordinators

Evidence from a range of pest animal and natural resource management programs demonstrates the success of coordinators in helping local community groups develop more effective processes and initiatives. Such success is attributed to the coordinators' ability to overcome numerous barriers and provide tailored services for landholders, as outlined in Table 5.4 below (Thompson et al. 2013; Ecker et al. 2015; Sobels et al. 2001; NSW Natural Resources Commission 2015a).

Table 5.4 Services provided by professional coordinators

Services provided by professional coordinators
Education and community capacity-building – enabling groups to conduct best practice pest animal management and helping them become self-sustaining and self-learning.
Network-building – establishing communication networks among individual landholders, other groups and stakeholders to share and learn pest management practice.
Expanding reach – identifying new strategic areas for existing groups to expand into or promote development and support of new groups.
Facilitating co-development and implementation of plans and programs – coordinating group co-design, setting accountabilities and timeframes, providing user-friendly starter packs of information such as templates, establishing monitoring measures and building capacity in groups to report against these plans.
Promoting accountabilities – employing methods to prompt landholders to meet their regulatory and neighbourly responsibilities.
Facilitating relationships – facilitating trust, respect, transparency and flexibility and ensuring group tensions are managed for positive outcomes.
Two-way communication – sharing and disseminating targeted information to the group, and representing the groups' interests to key stakeholders and regional committees.
Supporting administration – providing assistance, advice and support for groups to administer grant applications, budgets and legal issues (such as corporatisation and insurance).
Liaison – liaising with researchers and end-users on research gaps, providing a forum to discuss issues and ideas, and assisting landholders to get the latest scientific knowledge.

The success of coordinated groups in achieving various on-ground outcomes has been recognised by governments and industry alike. Government programs, such as the Victorian Local Landcare Facilitators Initiative and the newly established NSW Local Landcare Coordinators Initiative, have directed investments of \$12 million and \$15 million respectively into establishing networks of local professional coordinators. The programs aim to build community capacity and achieve on-ground natural resource management outcomes (Department of Environment and Primary Industries Victorian State Government 2015).

On an industry level, Australian Wool Innovation and Invasive Animals CRC have additionally invested in a national network of wild dog coordinators. These coordinators have encouraged stakeholder groups to work together to reach agreed objectives for regional wild dog management as set forth in the *National Wild Dog Management Strategy*. There are currently two

coordinators in NSW. Economic effectiveness reviews of this program reveal a return on investment for the national facilitator of between 5:1 and 8:1 for every dollar invested over a 15-year period (Chudleigh et al. 2011).

The Commission recommends a network of coordinators be established, with one in each LLS region to improve geographic coverage, capacity building, knowledge transfer and motivation specifically for pest animal management in NSW. This would align with LLS' statutory role, which is to deliver a local coordination service that empower local communities through capacity building, delivering effective pest management programs within the context of a strategic regional plan (NSW *Local Land Services Act 2013*).

LLS pest management coordinators can also assist in integrating pest and weed management. They could transition after three years to coordinating community groups in delivering not just pest animal programs, but also invertebrate and weed management programs. The transition will require coordinators to work closely with already established community groups and other relevant stakeholders, such as local government and industry.

Adequate resourcing for these coordinators is essential for success. It is proposed that LLS pest management coordinators are resourced jointly through LLS rates and the NSW Government, reflecting the mix of industry and public benefits accrued. See Chapter 9 for details on the proposed funding model.

The role of the two Australian Wool Innovation wild dog coordinators in NSW would complement those of the proposed LLS pest management coordinators. LLS and industry will need to work together to utilise the skills and networks of established coordinators as new coordinators are established. A collaborative arrangement should include maintaining the two wild dog coordinators, with LLS focusing more on other pest species in those areas affected by wild dogs.

Recommendation 11(i, ii): Support and coordinate local on-ground action.

The NSW Government should:

- i. establish one regional pest management coordinator in each Local Land Services region to work with local groups and set up new groups to:
 - a. coordinate collective control action on-ground across tenure
 - b. build capacity and awareness
- ii. establish a staged approach over three years for coordinators to have a broader invasive species role.

5.2 Enabling practice change

The cooperation of well-informed people is fundamental to reducing the risks associated with pest animals. Educated and engaged people can help prevent new incursions, assist in surveillance activities and can minimise the impacts of established pest species.

Educated and engaged communities can provide a range of benefits to biosecurity. These benefits are outlined in the Australian Government's biosecurity community engagement guidelines, and in the ACT *Pest Animal Management Strategy 2012-2022* (Kruger et al. 2012; Australian Capital Territory Government 2012), and are summarised in Figure 5.10.

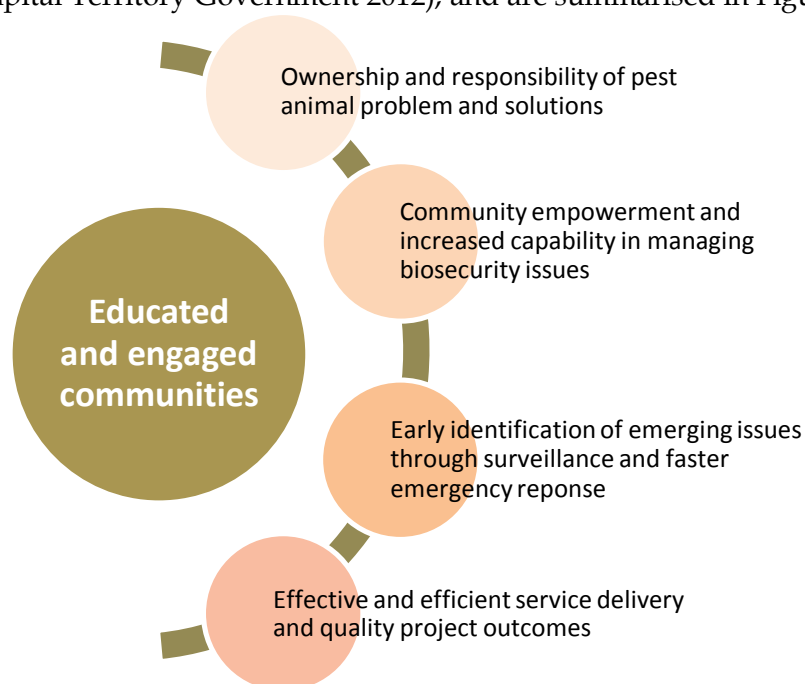


Figure 5.10: Outcomes of educated and engaged communities

In addition, engaged communities can also help mobilise local knowledge, skills and resources in pest animal management (Australian Capital Territory Government 2012). The *Performance Standard for Local Land Services* states that 'diversity of participation increases social capital, creates more resilient solutions to problems, divides responsibilities and labour, and gives smaller groups the capacity to negotiate solutions to complex problems' (NSW Natural Resources Commission 2015b). For governments, facilitating practice change through educated and engaged communities is a key step to achieving successful pest animal management.

5.2.1 Tailoring engagement to audience needs

Government needs to understand the varying needs and values of the diverse audiences it is seeking to engage (Kruger et al. 2012; Hine et al. 2015).

Landholders – Landholders are fundamental to managing widespread pest animals. Government, industry and researchers alike recognise that they are the most impacted by pest animals and are best placed to manage them (Standing Committee on Agriculture Fisheries and Forestry 2005; Martin et al. n.d.; Hine et al. 2015). Education and awareness campaigns for landholders aim directly at enabling them to solve the problem, putting pest animal management in their hands through communities of practice (ACT Governments).

Because landholders comprise not only resident farmers but also absentee landholders, small block owners, and public land managers, different engagement approaches will be necessary. These varying landholder groups have different land use, farming styles, industry or property type and size, with varying characteristics including demographics, farm and family history and lifestyle. They also display different levels of willingness to adopt new practices. Furthermore, landholders have varying training or accreditations, along with diverse values, beliefs, knowledge and behaviours. These all influence their approach to managing pest animals (Hine et al. 2015).

Understanding the individual audiences, values and motivators through segmentation analyses, such as landholder benchmarking and applying behavioural insights, is essential in developing better initiatives that drive widespread practice change (Hine et al., 2015; NSW Department of Premier and Cabinet, 2014). Equipped with such an understanding of the different audiences, governments can tailor and target engagement tools to help land owners reduce the impacts of pest animals on both their own and neighbours' land, especially through an improved understanding of management options and the need to act. These steps will also enable landholders to assist in surveillance activities for pest animals and help meet their obligations under the NSW *Biosecurity Act 2015* and regional pest management plans.

Studies have shown that the best method for educating and building capacity among landholders is face-to-face, but it is also the most time-consuming and expensive (McLeod et al. 2015; Aslin & Brown 2004; Chudleigh et al. 2011). In consultation undertaken for this review, many stakeholders noted their preference for such engagement. They highlighted its value particularly in regional communities with technology barriers, or with an older demographic more familiar with traditional forms of engagement.

In addition, working through groups, networks or key influencers such as community champions can greatly increase community ownership of pest animal management (Hine et al. 2015; NSW Natural Resources Commission 2015b). Government can foster groups and networks to enable collective action, provide mutual support and encourage certain pest management behaviours and practices, allowing these behaviours to spread organically between the group (Hine et al. 2015). Such groups and networks also use resources more efficiently, allowing government intervention and engagement activities to be resourced elsewhere (NSW Natural Resources Commission 2015b).

Stakeholders - The next group is stakeholders, who have some level of interest or concern about pest animals, the damage they cause, and what should be done about it. They can include industry organisations or representative bodies, research institutions, special interest groups such as recreational hunters or conservation managers, animal welfare groups, pet shops or exotic animal keepers and government agencies (National Wild Dog Action Plan Project Committee 2014).

Education and engagement campaigns aim to ensure that different stakeholders understand a particular pest animal issue and the actions that need to be taken (Roger Beale et al. 2008). The more involved stakeholders are in pest management, the more they need to understand the issue.

Stakeholders who are directly impacted by pest animals, or who play a role in decision making, must be willing to adopt and champion relevant practice. They will only do this if they find the information presented to them credible and acceptable (Australian Capital Territory Government 2012). For example, peak industry groups such as Australian Wool Innovation are

playing a crucial role in pest animal management by supporting sheep graziers to manage wild dogs. Similarly, the government must inform, engage and collaborate with such industry groups to gather industry support in adopting new policies, ensure best practice is supported by on-ground members and promote a clear understanding of roles and responsibilities among government, industry and partners.

Broader community - This includes rural, urban and peri-urban communities. Here, governments, biosecurity agencies and pest animal managers should aim for increased awareness around the pest animal issue, and for public or political acceptance for pest animal management (Australian Capital Territory Government 2012).

For example, the government may conduct awareness campaigns to increase the community's acceptance of new techniques and management approaches, some of which may have minor animal welfare concerns. These include the new rabbit RHD K5 virus. Other awareness campaigns may be aimed at gathering support for government expenditure to protect against new incursions, or to accept inconvenience due to quarantine restrictions (Roger Beale et al. 2008).

Broader community education and engagement may also aim to generate capacity and drive practice change. For example, the government may hold education programs to enable community to participate in surveillance activities; to demonstrate responsible pet ownership in peri-urban communities; or to discourage illegal practice, such as backyard or black market exotic animal trade to help reduce the risk of new incursions (Standing Committee on Agriculture Fisheries and Forestry 2005).

Current engagement approaches in NSW

Governments and industry have developed a number of engagement guidelines and education materials that aim to assist communities and other industries to effectively manage pest animals and prevent new incursions. For example, PESTPLAN products aim to build capacity of landholders and pest managers to develop local pest animal management plans (Braysher & Saunders 2003). The NSW Government and LLS should build on past education programs and products to improve service delivery and drive practice change.

In NSW, engagement on terrestrial pest management occurs at state, regional and local scales and is primarily the responsibility of NSW Department of Primary Industries (NSW DPI) and LLS. Other stakeholders, such as industry and research organisations, also play an essential role in engaging with and educating landholders and the broader community in pest animal management.

Engaging on general pest animal issues

In addition to targeted education about the NSW *Biosecurity Act 2015*, NSW DPI and LLS uses a range of tools to provide education and awareness on different components of pest animal management. Tools include websites, newsletters, face-to-face communication at field days and events, and manuals and media (see Figure 5.11).

The information currently provided is generally science-based and addresses the specific issue it is intended for. This could be improved by being more targeted to the needs and values of the people it is trying to influence. NSW DPI and LLS should consider refining their communication tools and partnering with industry or other organisations to drive ongoing improvements in education and engagement. These organisations have their own trust-based relationships, networks and engagement mechanisms.



Figure 5.11. A sample of the education brochures, websites and newsletters provided by NSW Department of Primary Industries, Local Land Services, the Office of Environment and Heritage and other bodies.

As with any pest animal management program, adequate resourcing is needed to ensure education outcomes can be achieved. The NSW Government should continue to invest in pest animal management education and awareness activities from its existing budget. Investment should be prioritised, allocated appropriately, include evaluation and consider opportunities for leveraging resources from other stakeholders (further discussion of funding in Chapter 9).

Engagement to support the NSW Biosecurity Act 2015

Putting into practice the NSW *Biosecurity Act 2015* and the supporting policy instruments presents a timely opportunity to improve people's awareness and capacity to address the pest animal problem. NSW DPI is responsible for educating landholders, stakeholders and the community on their responsibilities under the NSW *Biosecurity Act 2015*, and has recently begun a targeted community engagement process¹⁴. This process includes consultation with stakeholders and inviting public submissions, and is expected to raise public awareness of pest animals and the public's shared role in managing them. Other communication tools that could be used by the department to consult on the Act include online forums, websites, media and brochures, which are appropriate for general policy and program education campaigns that target the broader community (Aslin & Brown 2004).

Additionally, the Act stipulates that stakeholders and landholders are integral to surveillance and management. These groups will require targeted education campaigns to ensure they can capably discharge their legislative obligations.

As LLS is best placed to engage with local communities, the Commission encourages NSW DPI to work closely with them in developing and implementing education campaigns to inform the landholders about their responsibilities under the NSW *Biosecurity Act 2015* and its policy instruments. NSW DPI and LLS should also co-design region-specific and targeted education and engagement campaigns with local communities to develop their capacity to take ownership

¹⁴ Available online (accessed February 2016): <http://www.dpi.nsw.gov.au/biosecurity/biosecurity-act-2015/timeline-of-community-engagement>

of the pest animal problem (NSW Natural Resources Commission 2015b; International Association for Public Participation 2014).

The proposed pest animal management coordinator at each LLS should educate landholders on their responsibilities under the Act and under regional plans, particularly as NSW transitions to the new legislation. NSW DPI should maintain appropriate resourcing of the LLS' education program throughout this collaborative arrangement.

The NSW *Biosecurity Act 2015* also includes directions to prevent new incursions through management of risks, such as the exotic animal trade. NSW DPI should engage appropriately with risk creators, such as the pet or exotic animal trade industry, to educate on the risks posed by these animals, and how animal traders can share responsibility in reducing such risk. Education and engagement programs should also be co-designed with these stakeholders to ensure sophisticated and targeted education outcomes (Hine et al. 2015).

Recommendation 12(i): Promote shared responsibility for pest management across the community, industry and government.

The NSW Government should:

- i. build community-wide shared responsibility for pest animal management through improved education and capacity building programs. Community engagement should cover both established pests and risks from new incursions, be based on best practice and be delivered by Local Land Services regional pest management coordinators and other government agencies.

5.3 People and freshwater pest management

Since the mid-1990s, communities across the Murray-Darling Basin have shown an increasing interest in managing alien freshwater fish to improve native fish populations and habitats (Hall & Fulton 2012). Public participation in freshwater pest management should be guided by best practice, with each group engaged at a level appropriate to the capacity they need to make decisions or change behaviours (International Association for Public Participation 2014; Kruger et al. 2012).

For example, regarding the anticipated release of CyHV-3 into NSW waterways, the NSW Government will need to do more than inform the public. It should consult, involve and collaborate with the community in the decision-making process ahead of the virus' release.

NSW DPI currently leads community education for freshwater biosecurity in the state, including raising awareness of community and stakeholder obligations under the NSW *Biosecurity Act 2015*. The value of these freshwater education and engagement programs could be lifted even further if freshwater education and engagement programs were co-designed and co-implemented with industry, fishing groups and the community, rather than by government alone (Hine et al. 2015).

One successful practice identified in consultation are the "train the trainer" programs provided by NSW DPI and Murray-Darling Basin Authority, which include training representatives from a number of community groups and industries in pest fish awareness and surveillance. These representatives then share the knowledge and practice with their own networks.

The NSW Government should also expand education programs that target different cultures within recreational fishers to reduce the spread of pest fish between catchments. This could include developing multi-lingual education materials on pest fish, responsible fish stocking practices and the risks presented by the ornamental fish trade.

Educating the aquarium industry

A *Code of Practice for Animals in Pet Shops* has been developed by NSW DPI (Burton 2008). This encourages aquarium retailers to speak to customers about re-homing policies or using euthanasia agents in tanks, to reduce the likelihood of live disposal of aquarium vertebrates and plants. However, unlike terrestrial pets, pet shops are not required to monitor and record sales of pet fish, and any adoption of this code by retail outlets is unclear (NSW Department of Primary Industries 2016, pers. comm., February).

The NSW Government also engages with the aquarium industry through the NSW Ornamental Fish Reference Group on changes to NSW management of ornamental or noxious fish. New noxious fish listings, both national and NSW, are communicated to the aquarium industry and the general public through online and print publication materials¹⁵. NSW DPI also routinely circulates various advisory materials on the risks of freshwater aquarium species, such as fact sheets, to aquarium traders or NSW FishCare Volunteers (NSW Department of Primary Industries 2016, pers. comm., February).

To improve current education opportunities, the Commission supports a strengthened collaborative arrangement between NSW DPI and peak industry groups, such as the Pet Industry Association of Australia. Industry should increase its online content on freshwater biosecurity risks, including prohibited fish and reptile species. Both the NSW Government and industry should seek out strategies to increase membership of aquarium shop owners to these groups.

Recommendation 13(i, ii): Provide state-wide community education programs about freshwater pest animals.

The NSW Government should:

- i. work with industry to develop a community engagement strategy to proactively engage with existing freshwater fishing groups and community networks to educate the community on freshwater pest animal management and the new general biosecurity obligation
- ii. appropriately resource and work with industry to develop education products for businesses selling aquarium and pond fish, ensuring they display signs warning against the disposal of fish, snails and plants in waterways, and suggesting safe alternatives.

5.3.1 Education – pest managers

The complexity and importance of encouraging practice change demonstrates that government and commercial pest managers need to have the skills and training to assist with education, planning and on-ground pest management. Currently, training for pest managers focuses on tasks involved in control, such as the chemical handling certification required to prepare and use toxins like 1080 (sodium fluoroacetate), or the specialist training required to undertake

¹⁵ Example NSW Department of Primary Industries communication materials available online at: <http://www.dpi.nsw.gov.au/fisheries/pests-diseases/freshwater-pests/ornamental-fish#>

other pest management tasks such as aerial culling of pests (Feral Animal Aerial Shooting Team training) (Sharp and Saunders 2014).

While government and private training providers continue to deliver specialist training, the number of Registered Training Organisations delivering broader training, such as the Vertebrate Pest Management PROfarm course run by Tocal College have greatly declined (Koster et al. 2002). Those few organisations that continue to deliver training base it on out-of-date qualifications. Recently the Agrifood Skills Council updated the Certificate III level qualification in pest animal management under the Vocational Education and Training (VET) system to make them consistent with the Australian Pest Animal Strategy (Natural Resource Management Ministerial Council 2006). The training should be nationally endorsed in 2016. The Commission recommends that all pest management training materials be updated based on the new VET materials.

The Commission encourages government to train its officers under the new qualifications to gain a range of skills, including planning and communication. In addition to government officers the Commission encourages the ongoing formal training of commercial pest animal operators. Over time this has the potential to improve on ground management and potentially increase the pool of professionally trained individuals which the government can use should they wish to engage contractors for pest management. This broadening of the training scope should not only improve management outcomes but support the development of best practice pest management education in NSW.

Recommendation 14(i, ii): Promote vocational education and training.

The NSW Government should:

- i. encourage the development and implementation of training courses based on the new Vocational Education Training qualifications
- ii. encourage pest management agencies to train their officers under the new qualifications to the appropriate level.

6 Recommended changes to legislation and regulation

6.1 Declaration of pests in NSW

Species currently declared pests in NSW through a pest control order are: wild rabbits, rabbits, wild dogs, feral pigs, foxes (European red) and feral camels (Western Division of NSW only). When the NSW *Biosecurity Act 2015* comes into effect, Part 10 of the NSW *Local Land Services Act 2013* will be repealed and the provisions relating to control orders will shift to the NSW *Biosecurity Act 2015*. Under the new arrangements the current pest control orders will no longer exist.

While the NSW *Biosecurity Act 2015* provides for the declaration of pests¹⁶, the intent of the new Act is to regulate widespread pest animals through the general biosecurity duty (see Section 3.2). Therefore the consultation papers released by the NSW Department of Primary Industries (NSW DPI) do not include all currently declared pest species, or consider the need for any other animals that can be considered a pest (such as deer and cats). Attachment 3 provides further detail on the differing approaches proposed by NSW DPI.

While the new regulatory arrangements do not require pests to be 'declared' to impose controls on their management a pest declaration provides an unambiguous statement of intent. The declaration of a species as a pest by the state government is an effective mechanism for raising community awareness and shifting attitudes towards the management of that species.

Widespread pest animal species will be primarily managed through the general biosecurity duty with expectations outlined in regional pest management plans and control techniques applied as per the Codes of Practice and Standard Operating Procedures (see Box 6.6 below). But it is recommended that any new regulation should list all currently declared pest animals, such as wild dogs, goats, rabbits, foxes and pigs, and add all six species of deer (see Section 6.2) as well as feral cats (see Section 6.3) as declared pest animals.

Box 6.6: Current management practices

To guide landholders, land managers and anyone involved in pest animal management in NSW, the Department of Primary Industries has published Codes of Practice and Standard Operating Procedures:

- Codes of Practice (seven available) provide general information on species biology and impact, and best practice management incorporating acceptable control techniques, and their relative humaneness.
- Standard Operating Procedures (42 available) describe individual control techniques (such as Pindone and 1080 (sodium fluoroacetate) baiting, trapping and shooting), their application and animal welfare impacts for target and non-target species.

The Commission supports the continued guidance of Codes of Practice and Standard Operating Procedures and their revision with advancements in technology and research.

¹⁶ in a regulation under Section 15

Freshwater pest enforcement

The Commission also supports that the new regulatory framework should include the continued enforcement of substantial penalties for non-compliance around the release, sale or possession of noxious fish currently listed under the *NSW Fisheries Management Act 1994*, as well as freshwater pest reptiles and amphibians. Authorised officers should retain the power to seize and destroy, or require the destruction of noxious species.

The Commission also suggests that NSW DPI consider how the *NSW Biosecurity Act 2015* regulations will deal with management provisions for common pest aquarium species, such as goldfish, that have established wild populations in NSW freshwater environments.

Recommendation 15(i): Improve enforcement and compliance for pest animals through consistent and streamlined regulation.

The NSW Government should:

- i. develop a regulation addressing pest animals under the *NSW Biosecurity Act 2015* framework. The regulation should:
 - a. list all currently declared pest animal species, including freshwater pests
 - b. include mandatory measures for pest control across tenures, as required.

6.2 Management of deer in NSW must change

In NSW, deer are currently managed under outdated, restrictive arrangements as a game and livestock animal, yet they are recognised as the most important emerging pest animal threat (West & Saunders 2007; Strahan & Van Dyck 2008). Management arrangements for deer, like other invasive species, need to recognise their pest status and be focused on more effectively controlling their population and reducing their impacts on human health, environment and production. Within these proposed new arrangements, recreational hunting of deer will continue and even be expanded.

The national Invasive Plants and Animal Committee assesses the threats posed by all species of deer as extreme (Invasive Plants and Animals Committee 2015). Nationally agreed guidelines (Vertebrate Pests Committee 2014) recommend that state and territory impose strict controls for the keeping and movement of extreme threat species. Domestic deer are included in the National Livestock Identification Scheme and this in conjunction with the application of the general biosecurity duty provisions of the *NSW Biosecurity Act 2015* should provide adequate control of the risks posed by the domestic deer population. The effectiveness of these regulations are predicated on targeted communication with deer keepers and hunters regarding their obligations and the penalties for illegal release. However, the application of such restrictions will not control the impacts of feral deer populations.

Surveys of land managers have identified the distribution and approximate abundance of feral deer populations (Moriarty 2004). In local areas usually contain fewer than 100 individuals, but may exceed 1,000 animals in some populations of rusa and fallow deer (Moriarty 2004; NSW National Parks and Wildlife Service 2002). However, there are no direct population counts so precise population sizes both locally and across the state are difficult to establish (a constraint which is common with all pest species).

Their latent capacity for growth gives most deer populations, including those in NSW, the potential to become locally overabundant or disperse rapidly to new areas or both (Burgin et al.

2014). In Tasmania, fallow deer numbers increased by an order of magnitude from the 1970s to 2000s expanding their range to 2.1 million hectares (Potts et al. 2014). The latest distribution surveys in NSW suggest a 30 percent increase in deer abundance between 2004 and 2009 along the coast and tablelands although less so across the slopes and western ranges (NSW Department of Primary Industries 2012a). Bioclimatic modelling indicates that all deer species in NSW could increase their distributional ranges (Forsyth et al. 2007; Moriarty 2004) and in Tasmania climate suitability combined with population growth models have predicted fallow deer populations of up to 1 million individuals (Potts et al. 2014).

The ecological impacts of sudden spikes in deer populations are numerous (Fuller & Gill 2001). Heavy browsing and grazing can alter vegetation (McCullough et al. 1997; Fuller & Gill 2001; Shelton et al. 2014; Perrin et al. 2011), impact bird and invertebrate populations (DeCalesta 1994; Allombert et al. 2005; Simberloff et al. 2013), and have cascade impacts on ecosystem properties and functions (Augustine & DeCalesta 2003; Côté et al. 2004; Dolman & Wäber 2008; Fisichelli et al. 2013). Indirect effects are thought to be especially significant although difficult to attribute (Rooney & Waller 2003). Most of this evidence comes from studies in countries where deer species are native.

In Australia, environmental and ecological impacts are potentially more acute as deer are exotic. As research conducted in Royal National Park noted, rusa deer - numbering some 3,000 individuals, a population established from seven escapees in 1906 - affect the regeneration of rainforest trees by reducing seed production and seedling recruitment (Keith & Pellow 2004).

Evidence from the mid-north coast and southern NSW also suggests that deer in some areas are costing some farmers between \$10,000 and \$20,000 per year in lost production (Foley 2015). In addition, evidence presented during regional tours indicated that prior to the Northern Illawarra Wild Deer Management Program there were nine fatalities caused by collisions with deer and around 100 collisions with trains per year causing up to \$3 million in damage every year. There have been no recorded fatalities since the commencement of the program (evidence presented at the regional tours for the NSW Natural Resources Commission 2015).

Localised overpopulation and range extension in deer species is an environmental and increasingly social problem. In the United States there are over 1.5 million deer-vehicle collisions annually, a problem that is growing in Australia as deer populations encroach on urban and peri-urban areas (Burgin et al. 2014). Deer also present a biosecurity risk as usually secondary vectors of zoonotic diseases such as bovine tuberculosis and foot-and-mouth disease (Ward et al. 2007; Ward et al. 2009).

Management of deer is conflicted

Recreational hunting is the method used to control deer in 90 percent of cases, an approach that is both inconsistent and inadequate (Braysher, 2013). Conflicts arise between those who see deer as game and an aesthetic addition to the landscape versus those who perceive deer as pests (Hall & Gill, 2005) usually with a local flashpoint, such as Royal National Park (Burgin et al. 2014). Landowners, recreational hunters, animal welfare groups, conservation organizations, and health authorities all have different views on the matter (Potts et al. 2014).¹⁷

¹⁷ As noted by the Game Management Council of NSW in their submission to the issues paper:

“deer are an animal with significant cultural significance to sections of the Australian community. Wild deer are often referred to as feral but it must be noted that this is misleading and factually incorrect ... Deer are recognised under legislation as a Game Animal.”

Recreational game hunting has direct and indirect economic value. The historical and current legislative approach to deer management reflects this importance. However, the use of recreational hunting as the primary population control measure for deer is ineffective.

Practicalities, animal welfare and animal ethics issues, together with current and historical legislation and regulation, limit the range of management techniques to control deer populations. Historically and in legislation, populations have been controlled through hunting but this is not sufficient to control overabundant populations (Simard et al. 2013). In the United States the reintroduction of apex predators has proven successful (Warren 2011) but is not available in NSW. Biological controls such as immunocontraceptive vaccines are available but are expensive to administer. Along with difficulties in method selection the common conclusion is that reducing deer abundance requires substantially more control effort than is currently believed necessary (Forsyth et al. 2013).

The management arrangements for feral deer populations in Australia vary considerably across jurisdictions, as outlined in Table 6.5 below.

In Tasmania, Victoria and New South Wales, regulatory arrangements still centre on the recreational and economic benefits exclusively associated with recreational hunting. Feral deer are managed as game animals, with deer hunters actively involved in their management to maintain their game resource. In these states, feral deer are protected by legislation such as annual or restricted open seasons that comply with fair chase definitions¹⁸ (Jesser 2004). In other states and territories, there is a more balanced approach, permitting recreational hunting while focused on controlling deer as a pest species.

The National Biosecurity Committee (2015) determines pest status for species and defines an established pest as one which:

has self-sustaining populations in Australia and is not considered eradicable. It may be distributed widely across Australia or only regionally. A regionally-distributed established pest or disease may be the subject of containment measures to mitigate further spread.

Queensland, South Australia and Western Australia have declared deer a feral pest.

The NSW *Game and Feral Animal Act 2002* regulates licensing and hunting of game animals on public and private land. Schedule 3 of the Act lists the game animals that can be legally hunted in NSW, including all six deer species (see Attachment 3 for full list). Deer are not a declared pest in NSW and as a consequence there are no mandatory control measures in place outside of national parks.

Conversely, the Sporting and Shooters Association of Australia stated in their submission to the issues paper:

“although currently listed as game species, many members believe that deer should also be included as an invasive pest species ... deer numbers are not being controlled to the extent they were prior to the declaration of deer as game.”

¹⁸ Fair chase definition : the ethical, sportsman-like, lawful pursuit, and taking of any free-ranging game animal that does not give the hunter an unfair advantage.

Table 6.5: Feral deer management - Interjurisdictional comparison

Jurisdiction	Species	Classification	Legislation	Policy
Western Australia	Fallow and red Species not present	Pest C3 restricted Pest C1 Prohibited	<i>Biosecurity and Agriculture Management Act 2007</i>	
Queensland	Chital and rusa Red and fallow Species not present	Pest Class 2 Pest Class 3 Pest Class 1	<i>Land Protection (Pest and Stock Route Management) Act 2002</i>	Feral deer Management Strategy 2013-18
South Australia	Fallow, red, chital, hog, rusa, sambar	Pest	<i>Natural Resources Management Act 2004</i> NRM Boards require landholders to control deer in accordance with their Regional NRM Plans.	Feral Deer Policy 2005
Northern Territory	Rusa, sambar	Pest	<i>Territory Parks and Wildlife Conservation Act 2006</i>	
Victoria	Sambar, hog, red, fallow chital, rusa	Game	<i>Wildlife Act 1975</i> <i>Wildlife (Game) Regulations 2012</i>	Code of Practice for the Welfare of Animals in Hunting
New South Wales	Sambar, hog Red, fallow Chital, rusa	Game	<i>Game and Feral Animal Control Act 2002.</i>	
Tasmania	Fallow	Game	<i>Nature Conservation Act 2002</i> <i>Wildlife (General) Regulations 2010</i>	Code of practice for the hunting of wild fallow deer

Under the NSW *Game and Feral Animal Control Act 2002* primary producers and their employees are exempt from requiring a game hunting licence to shoot deer on their property. However, if the landholder invites others to shoot deer on their property, these individuals require a game hunting licence. A general licence applies to hunting on private property only, while a restricted licence applies to hunting on public and private land. Hunting licences are discussed further in Section 7.4.

There are mechanisms under both the NSW *Local Land Services Act 2013* and the NSW *Deer Act 2006* for the Minister for Primary Industries to request a control order (also referred to by some as a temporary suppression of regulation order) to manage deer numbers. However, evidence from consultation indicates that the process for obtaining a control order may impede effective management. Applicants indicate that the process is variable, in some cases slow and generally focused on local management issues rather than population control at the landscape scale. This restricted a timely response to feral deer issues.

If NSW declared feral deer as a pest this would then enable Local Land Services (LLS) to actively support and coordinate landscape scale control efforts as well as clearly placing a responsibility for all landholders to control pests on their property.

Currently in NSW there are several constraints on recreational hunting of deer including:

- hunting during day light hours only
- restricting hunting during breeding times due to an increased likelihood of animal welfare concerns
- deer cannot be hunted if they are fleeing from fire or smoke
- spotlights or artificial lights are not allowed when hunting deer
- baits, lures, decoys are not permitted
- aircraft, watercraft or motor vehicles are not permitted
- scent trailing dogs are not permitted.

These restrictions unnecessarily curtail the effectiveness of ground shooting as they seek to remove any unfair advantage a hunter may have. For example, prohibiting the shooting of a nocturnal pest animal at night is counterproductive.

Shooting is often adequate to control or maintain numbers of small or otherwise constrained deer populations. However, shooting is proving inadequate at containing overabundant deer populations (Warren 2011, Simard et al. 2013), and the requirement for greater control efforts for deer are vastly underestimated at present (Forsyth et al. 2013).

A change in status of deer from game to pest would allow more flexibility to manage the impacts of overabundant and potentially overabundant populations or where deer are a known or a potential hazard. This can be achieved by firstly amending the NSW *Game and Feral Animal Control Act 2002* to remove deer as a game animal, followed by listing deer as a pest in the new biosecurity regulatory framework.

Recommendation 16(i,ii): Manage deer as a pest animal.

The NSW Government should:

- i. exclude all species of deer from the NSW *Game and Feral Animal Control Act 2002*
- ii. include all species of feral deer in a regulation addressing pest animals under the NSW *Biosecurity Act 2015*.

6.3 Reducing the risks from cats

Domestic cats are important companion animals and pet species, with more than 700,000 registered in NSW. The problem with cats is that their ecology allows them to readily establish feral populations from a few founders in almost any habitat and, once established, they have a major impact on native wildlife that is hard to control. Feral cats in viable wild populations are widespread throughout the state. The impact of feral cat predation is often severe and frequently cited as a primary agent in Australian land mammal extinction (Woinarski et al. 2015).

While opinions and values vary, attitudinal surveys suggest that a large majority of people would support the permanent removal of feral cats from the natural environment (Lohr & Lepczyk 2014).

Cats are categorised by the Australian Government (2015b) as:

- **Domestic** - cats owned by an individual, a household, a business or corporation; most of their needs are supplied by their owners.
- **Stray** - cats found in and around cities, towns and rural properties; they may depend on some resources provided by humans but are not owned.
- **Feral** - cats that live and reproduce in the wild (e.g. forests, woodlands, grasslands, wetlands) and survive by hunting or scavenging; none of their needs are satisfied intentionally by humans.

Feral cats are typically solitary and distributed widely across the state in home ranges of 250 hectares (Molsher et al. 2005). When prey is scarce individuals can move large distances (Edwards et al. 2001) readily colonising suitable habitats. They have the potential for rapid reproduction in favourable conditions doubling population size in eight months (Short & Turner 2005). Typically, feral populations occur at densities from 0.5 to >1 individual km⁻² although solitary and cryptic behaviours make abundance hard to estimate (Bengsen et al. 2012). An average agricultural property in central NSW might have 100-150 widely spread individuals.

Cats are opportunist hunters with a preference for small vertebrate prey (around 200 grams) and in Australia feed mainly on rabbits when they are available, but also on other species (400 vertebrate species are recorded as prey in Australia) (Doherty et al. 2015). This flexibility in diet, together with generalist habitat preference and tolerance of dry conditions, allows feral populations to both persist and impact native fauna.

Globally the International Union for Conservation of Nature lists the feral cat as among 100 of the world's worst invasive species (Lowe et al. 2004). In Australia predation by feral cats is cited as the likely cause of seven mammal species extinctions on the mainland, and currently at least 35 vulnerable and endangered bird species, 36 mammal species, seven reptile species and three amphibian species are thought to be adversely affected (Denny & Dickman 2010; Woinarski et al. 2015).

The status of feral cats as a serious vertebrate pest in Australia that have severe to catastrophic effects on native fauna is unequivocal (Woinarski et al. 2015), yet in NSW they are largely unmanaged.

The solitary and elusive nature of feral cat populations makes them difficult to control. As an example, in central NSW, 100 trap nights captured 1.3 cats on average and over 6,000 trap nights were needed to capture a local population of 76 cats (Molsher 2001). Such high effort techniques make management through non-lethal means (deterrence, exclusion, Trap-Neuter-Return) impractical (Fisher et al. 2015). Fertility control is attractive but the development of immunocontraceptive vaccines is both high cost and high risk.

Exclusion fencing is an effective technique for protecting native fauna from terrestrial predators, including feral cats, and is considered to be the most humane non-lethal feral cat control method. However, fencing works best as part of an integrated approach involving baiting, trapping and shooting to minimise pressure on the fence by predators. Further, the cost of establishing such fences can be prohibitive (Department of the Environment Australian Government 2015c).

Of the lethal methods for control, shooting can be used at local scale but requires consistency and skill (Sharp & Saunders 2012). Shooting is always expensive, labour intensive, and time consuming (Bloomer & Bester 1991). Any biological control of feral cats is considered unfeasible due to the potential impact on the domestic cat population.

Poison baits are generally the cheapest and most effective broad scale technique for control of feral predators. However, feral cats prefer live prey, only taking baits at times of low prey density (Short et al. 1997). The Australian Government has invested heavily in the research and development of a humane and target specific bait suitable for the control of feral cats. The Curiosity® bait has undergone laboratory and field efficacy trials and is awaiting registration from the Australian Pesticides and Veterinary Medicines Authority, expected to be completed in 2016.

Research is ongoing into the development of new feral cat control methods including ways that exploit the grooming habits of cats to deliver a toxin. Until more effective baits or methods are available, the extent and density of baiting necessary to achieve reductions in cat populations over large areas without presents a significant hazard to wildlife (Fisher et al. 2015).

Given these cost, efficacy and targeting issues the eradication of feral cats on the mainland is highly unlikely. Consequently, management is focused on suppressing populations in local areas where they pose the greatest threat to biodiversity and increasingly focused on prevention.

Regulation and planning for feral cats

Predation by feral cats is listed as a key threatening process under section 188 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) that includes a recently reviewed and updated Threat abatement plan for predation by feral cats (Department of the Environment Water Heritage and the Arts Australian Government 2008).

At the Meeting of Environment Ministers (Melbourne, 15 July 2015), Ministers endorsed the National declaration of feral cats as pests. As part of this declaration, Ministers agreed to review arrangements within their respective jurisdictions and, where necessary, to remove unnecessary barriers to effective and humane control of feral cats within 12 months (Department of the Environment Australian Government 2015a).

Feral cats are a class 2 pest in Queensland and the ACT is currently considering a similar approach. In NSW feral cats are not declared a pest. Until recently they were considered to pose

little or no threat to agricultural values, which has limited the ability to draw on resources for their management (Woinarski et al. 2015). It is timely for NSW to implement the national agreement and declare feral cats as pests.

Recommendation 17(i-iv): Manage feral cats as a pest animal.

The NSW Government should:

- i. declare feral cats as a pest by including them in the pest animal regulation being prepared for the NSW *Biosecurity Act 2015*
- ii. ensure any mandatory measures are consistent with the model code of practice for the humane control of feral cats
- iii. prioritise within the NSW *Invasive Species Plan 2015-2022* the management of feral cats in areas of high biodiversity value
- iv. support continued research into the scale, efficiency, cost-effectiveness, sustainability and risk of cat control methods.

Although feral cat management is a priority in the national framework, this is not reflected in the draft NSW *Invasive Species Plan 2015-2022*. NSW DPI should revise this draft to align with the *Feral Cat Threat Abatement Plan*. Similarly, the regional pest management plans proposed to be prepared by LLS (see Chapter 3) should, include programs to manage stray and feral cats. Areas of high biodiversity value should be prioritised for feral cat management, using controls such as exclusion fencing, community trapping and baiting programs where appropriate (Eyles & Mulvaney 2015).

Recommendation 17(v): Manage feral cats as a pest animal.

The NSW Government should:

- v. align the Draft NSW *Invasive Species Plan 2015-2022* with the Federal *Feral Cat Threat Abatement Plan*.

Regulation and planning for non-feral cats

Legislation in most Australian states and territories restricts the reproductive and predation potential of domestic cats. Many local government areas have introduced restrictions including the banning of cats as pets in some communities, compulsory neutering, individual identification, and containment of pet cats (Denny & Dickman 2010). These controls are important locally where predation by domestic cats can impact urban wildlife and also to reduce opportunities for domestic cats to become strays and/or establish feral populations. While controls are difficult to implement, the following steps can help communities prevent many of the problems discussed so far.

Responsible pet ownership

Despite cats' societal benefit and intrinsic value to their owners, community concerns arise when owned cats are allowed to roam beyond the owner's property and become stray and feral cats (Eyles & Mulvaney 2015). This is a common occurrence, which is why strategies to promote responsible pet ownership are important to population control (Gotsis 2014).

Table 6.6: Comparison of cat management regulations

State/ Territory	Compulsory desexing	Registration	Identification	Confinement	Roaming	Breeder registration
New South Wales	No - reduced registration fee incentive	Yes - at 4 months (lifetime)	Yes - microchip	Optional and difficult using planning law	No laws prohibiting cats from roaming	Not required
Western Australia	Yes	Yes	Yes - microchip	Local law may require confinement	Offence for a cat to be at large in contravention of confinement order	Breeders must be registered
South Australia ¹⁹	Yes	No	Yes - microchip at 3 months	Local law may require confinement	Offence for a cat to be at large in contravention of confinement order	Breeders who sell kittens must be registered
Tasmania	Yes	Not mandatory - local law may require registration	Yes - microchip at 6 months	Local law may require confinement	Offence for a cat to be at large in contravention of confinement order	Not required
Australian Capital Territory	Yes	No	Yes	Cat containment can be declared where there is serious threat to native wildlife	Offence for a cat to be at large in contravention of confinement order	Owners of a desexed cat over 3 months must have a permit.
Victoria	No - reduced registration fee incentive	Yes - at 3 months (annually)	Yes - microchip	Local law may require confinement	Offence for a cat to be at large in contravention of confinement order	Breeders with three or more fertile females must be registered annually
Queensland	No - local law may require compulsory desexing	Not mandatory - local law may require registration	Yes - Microchip ear tattoo when desexed	Local law may require confinement	Offence for a cat to be at large in contravention of confinement order	Not required
Northern Territory	No	Darwin and Alice Springs councils only.	Yes	No	Cats at large can be seized in Darwin	Not required

¹⁹ The Dog and Cat Management (Miscellaneous) Amendment Bill is currently being considered by the South Australian parliament. These table reflects the amendments proposed.

Whereas many organisations²⁰ support responsible pet cat ownership including registration, desexing and confinement, there is resistance from some sections of the community for certain cat management techniques.

Promoting the responsible ownership of cats is an objective of the *Feral Cat Threat Abatement Plan*. Performance measures for the objective include measurable increases in community support, few reports of stray and feral cats, and greater consistency with measures in other states. Table 6.6 summarises the regulations in different states.

The recent review²¹ and subsequent reduction of the mandatory registration age for cats to four months is a positive step. However, the in principle support of the breeder registration system and the current position regarding cat confinement and compulsory desexing are insufficient and should be revisited. This is discussed below.

Desexing

Apart from reducing the pool of unwanted cats entering the feral cat population, desexing also reduces nuisance behaviours and results in healthier cats that live longer (Eyles & Mulvaney 2015). Desexing is either in place or being considered by all Australian states and territories except New South Wales and Victoria²².

In NSW, desexing is not required but is encouraged and registration costs are reduced for desexed cats. However, the cost reduction (\$133) provides little incentive for owners to desex their animals, as it is usually substantially lower than veterinary fees for the desexing operation.

NSW has lifetime registration for pets so the financial incentive to desex is not as strong as in Victoria and South Australia, where pet registration is annual. Requiring the annual registration of cats that are not desexed should provide a simple, additional incentive to desex.

Breeder licensing

A registration and licensing system that identifies persons as cat breeders should be proposed as the only justifiable exemption from the requirement to desex. The Royal Society for the Prevention of Cruelty to Animals (RSPCA) advocates a compulsory legislated registration and licensing system and mandatory standards for the conduct of dog and cat breeding (RSPCA, 2015). A breeder registration and licensing system was strongly supported by respondents and recommended by the Companion Animals Taskforce in 2012. The NSW Government supported this recommendation in principle, depending on the degree of regulatory burden to small and responsible breeders (Parliament of New South Wales 2015).

The 2015 Inquiry into Companion Animal Breeding Practices also recommended that anyone who breeds cats for sale should be licensed. The NSW Government's response to the inquiry only supported this recommendation in part. It did not support a stand-alone breeders' licensing system, preferring a redesign of the current registration system to better identify breeders.

The inquiry also recommended that the government reconsider the recommendation of the NSW Companion Animals Taskforce to introduce annual registration of cats and dogs. The NSW Government is still considering this proposal.

²⁰ Including the RSPCA and Australian Veterinary Association

²¹ Companion Animals Taskforce 2013 – Report to Government

²² For example Logan City Council.

In the absence of a stand-alone breeder licensing system, the Commission recommends that the NSW Government require that owners of reproductive cats must register as a breeder and that any reproductive cat be required to be registered annually, as discussed below.

Cat confinement

The Australian Government Threatened Species Commissioner is seeking public support for '24-hour containment requirements for domestic cats, particularly close to identified conservation area of significance' (Hasham 2015). In its discussion paper, the NSW Companion Animal Taskforce asked the question 'Do you support providing councils with voluntary powers to issue local orders to cat owners to confine their cats?' Seventy-two percent of respondents answered yes, 16 percent no and 12 percent were unsure (NSW Companion Animals Taskforce 2012).

The NSW RSPCA cat management policy²³ encourages the containment of cats to protect cats from disease and injury through fighting and accidents, increase the opportunity for owner-animal interaction and reduce the impact of hunting by cats and disturbance caused to neighbours.

Some NSW local governments have introduced cat management strategies by using environmental planning laws, such as planning agreements and/or conditions attached to development consents, to either impose controls or prohibit the ownership of domestic cats. The use of these mechanisms to achieve control is unwieldy, difficult to implement and a barrier to adoption (Ms. P Gray 2015, pers. comm.). Applying cat controls on an ad-hoc development site basis reduces the opportunity to link with other landscape conservation measures to protect native wildlife, and makes it more difficult to achieve coordinated approaches to manage cat predation (Eyles & Mulvaney 2015). An amendment to the NSW *Companion Animals Act 1998* to provide local government with powers to impose and enforce cat containment rules as in the ACT, Victoria, and Queensland would be simpler and would link with other conservation measures.

There is much scope to improve the current arrangements for managing domestic cats in NSW, to prevent their transition from domestic to stray to feral, and to better promote responsible pet ownership. The NSW *Companion Animals Act 1998* should be amended to require compulsory desexing and to simplify the process of establishing cat confinement areas. As with any requirement seeking behavioural changes, these reforms should be supported by a community education campaign that explains the importance of responsible pet ownership and cat management regulation.

²³ Policy A09 Cat Management

Recommendation 17(vi,vii): Manage cats as a pest animal.

The NSW Government should:

- vi. amend the NSW *Companion Animals Act 1998* to provide for:
 - a. the compulsory desexing of all cats by the age of four months if not exempted
 - b. requiring all owners of entire cats older than four months to be registered as a breeder
 - c. requiring all entire cats to be registered annually
 - d. local governments to declare and enforce cat confinement areas
- vii. partner with the RSPCA and other relevant organisations to deliver a targeted education campaign raising the awareness of the risks posed by stray and feral cats and promoting responsible pet ownership.

6.4 Wild dogs - Schedule 2 lands

Wild dogs are currently managed through Schedule 2 lands, which originally sought to minimise predation by wild dogs while also addressing dingo conservation in core areas (see Box 6.7 below). Currently under Part 10 of the NSW *Local Lands Services Act 2013* pest control orders can be made by the Minister to impose obligations on landholders and managers to undertake activities to manage declared pests under the order (see Section 6.1). The pest control orders can apply to public and private land.

Box 6.7: Schedule 2 lands

The Wild Dog pest control order identifies controlled land as Schedule 1 and Schedule 2. Schedule 2 land applies to public lands (national parks, nature reserves, state forests, and Crown land and reserves) with a management objective of maintaining the wild dog contribution to ecosystem function (i.e. addressing wild dog control and the conservation of dingoes (as a native species) in NSW). Schedule 1 land is all other land in NSW that does not fall into the former category.

On Schedule 1 land, the Wild Dog pest control order imposes a general destruction obligation on landowners and occupiers, and gives Local Land Services (LLS) powers to enforce it. On Schedule 2 lands, owners and occupiers can meet their general destruction obligation through preparing and implementing management plans that comply with the "*guidelines for the Preparation and Implementation of Wild Dog Management Plans in NSW*" and are endorsed by LLS. Pest management of wild dogs are currently managed in a 'doughnut' on Schedule 2 lands, where pest management focuses on the external perimeter of Schedule 2 lands.

Schedule 2 lands came under much discussion during this review, with many stakeholders expressing concern around the differing landholder obligations based on whether land was categorised as Schedule 1 or 2. Tensions between public and private landholders arise due to a perception that public landholders are not held accountable for not actively managing pest animals.

As discussed above, when the NSW *Biosecurity Act 2015* comes into effect, provisions relating to current control orders created under the NSW *Local Land Services Act 2013* will shift to the NSW *Biosecurity Act 2015*. This means the current pest control orders will no longer exist. This has implications for public land managers such as National Parks and Wildlife Services in particular, as Schedule 2 lands will no longer exist with potential ramifications for dingo conservation.

With the potential repeal of Schedule 2 lands, it is unclear how the balance of wild dog management and dingo conservation can be achieved. NSW DPI infers in its consultation paper that 'a wild dog management plan could for example incorporate requirements to manage important areas of dingo habitat in NSW (NSW Department of Primary Industries 2015b).

The Commission recognises the importance of dingo conservation and supports the continuation of the outcomes delivered by having Schedule 2 lands, which allow for the management of wild dogs on the perimeter of national parks whilst conserving dingoes further within the parks.

Recommendation 18(i): Maintain the outcomes delivered through Schedule 2 lands.

The NSW Government should:

- i. include schedule 2 lands in the regulation under the NSW *Biosecurity Act 2015* framework. This should include provisions for the management of wild dogs on the perimeter of national parks where they have negative impacts and allow for dingo conservation inside national parks.

7 Improved management

Whereas the previous chapter discussed changes to the regulatory framework, this chapter focuses on improving management by building on emerging breakthroughs in research, seizing existing opportunities for better control options and reducing red tape.

7.1 Biocontrol for carp

Carp are the most significant pest in NSW freshwater ecosystems. They are the dominant species in the Murray-Darling Basin, making up 83 percent of fish biomass (Environmental Protection Authority, 2015). Carp are ecosystem engineers, and have significant environmental impacts through altering river and lake habitats, which reduces habitat for native fish and invertebrates and reduces water quality. They also threaten five NSW listed threatened species.

Carp also have significant social impact. They reduce the amenity of recreational fishing and in a nation-wide community survey, were ranked as the fourth-most significant vertebrate pest in Australia (Fisher et al. 2012). Their economic impact has been conservatively estimated at \$22 million annually, based on their impacts on inland fisheries (McLeod 2016).



Figure 7.12. Distribution of carp in NSW (NSW Department of Primary Industries 2010)

Despite significant investment, research and testing of carp control methods, current techniques are costly and their effectiveness in controlling populations in large water bodies is extremely limited.

As proved with the rabbit myxomatosis virus, biological control is the most cost-effective method to control widespread, high abundance pest animals. The Invasive Animals CRC, CSIRO, other research organisations and governments have been working together to refine a biological agent to control common carp in Australia – the cyprinid herpesvirus (CyHV-3). Testing through the Invasive Animals CRC has confirmed that under optimal conditions the CyHV-3 will kill up to 95 percent of individuals within 24 hours of symptoms appearing. The virus is most effective in juvenile carp, and is transferred between fish through the water, living without a host for up to four days. The virus is specific to common carp, and genetic markers have been identified that allow differentiation between common carp and carp hybrids (McColl & Crane 2013).

It is expected that the virus will be approved for release by the Australian Government in 2018. However a number of other statutory approval processes, as well as extensive public consultation, will need to be resourced and completed before it can be used as a biological control agent in Australia (Fulton 2013).

Several significant issues need to be adequately resourced and addressed prior to the virus' release, including clean-up options of dead carp after treatment, which is estimated to cost \$30 million (NSW Department of Primary Industries 2015, pers. comm. November). Other issues include developing a virus release strategy (including follow-up control), education campaigns, cost-recovery options and transitional issues (Fulton 2013; McColl 2013). Community awareness campaigns on the carp biomass will be critical in managing public expectations and should be resourced by the NSW Government, possibly through partnerships.

The implementation of this virus as a control method is essential. Without its release, the issue of carp in NSW freshwater environments is likely to spread and intensify throughout the Murray-Darling Basin (Barrett et al. 2014). If supported, the result will be clearer, healthier waterways and fish communities throughout Australia's inland rivers (McColl & Crane 2013).

Box 7.8: Managing carp through biological control

Fast-track carp biological control

Biological control is broadly recognised as the most cost-effective method to manage freshwater pest animals (Barrett et al. 2014), if done correctly

The Commission recommends the NSW Government should continue and increase investment into carp biological control to fast-track the potential release of CyHV-3, while maintaining current management of carp in NSW. Success and lessons learnt from biological control research projects such as myxomatosis, CyHV-3 or daughterless carp should be applied and prioritised towards other highly invasive freshwater species, such as tilapia.

Recommendation 19 (i-iv): Prioritise the implementation of biocontrol options for carp.

The NSW Government should:

- i. acknowledge that carp are a significant pest animal and prioritise their removal from freshwater environments
- ii. appropriately resource research into the clean-up process for the carp CyHV-3 virus (should it be introduced), including implementation issues, cost recovery options and follow-up control
- iii. appropriately resource carp clean-up and seek shared funding arrangements and transitional arrangements where possible
- iv. acknowledge that biocontrol viruses have an effective span of control of about 15 years, based on the experience with terrestrial myxoma and RHD and that research capacity in this area should not be diminished.

7.2 Valuing science and heritage – feral horses

The issues surrounding feral horse management are complex and often contentious, attracting much public interest. Feral horses or brumbies are seen by many as a cultural icon with strong cultural and historical importance; while others view them as environmental pests.

For this reason, management for feral horses is evolving. An independent technical reference group is currently reviewing the *Kosciuszko National Park Wild Horse Management Plan*. The plan will identify objectives for managing the feral horse population within the park, and provide wide-reaching guidance on the most effective and appropriate control methods. So far, the technical review has included detailed analysis and exhaustive consultation, whereas the Commission has conducted a rapid analysis of currently available evidence. The outcomes of the technical review are due for release later in 2016.

Australia has the largest population of feral horses in the world, estimated at more than 900,000 (Dawson et al 2006). There are no known predators of feral horses, although dingoes or wild dogs occasionally take foals (Markula et al. 2009).

In NSW significant populations reside in the Snowy Mountains along with smaller isolated populations on the northern and southern Tablelands (English 2001). Feral horses are mobile animals, travelling an average 16 kilometres per day (Hampson et al. 2010), enabling them to exploit food sources further away from water points than cattle.

Anecdotally, in some areas, feral horse populations have increased significantly over the past decade. A recent report by Worboys, Freudenberger and Good, (2015) found that feral horses are having an adverse impact on the ecosystems of national parks, in particular the Australian Alps:

‘in 2015, invasive wild horses are impacting the National Heritage listed Australian Alps national parks right across their mainland mountain environments. They are directly and indirectly impacting our endangered and other Australian mountain animals. In Kosciuszko National Park (part of the Australian Alps national parks), the introduced wild horse population has increased by 30 percent in just 5 years from 4,200 (2009) to 6000 (2014) despite authorised control methods being in place. In 2015, this distribution has spilled over into the ACT from NSW and into the water supply catchments of Canberra.’

Environmental impacts of horses

As an introduced, hard-hooved and large herbivore, any established populations would be expected to impact on the native vegetation and environment. While there are no peer-reviewed studies of the situation in Australia, globally, there is documented evidence (see Nimmo and Miller (2007) for substantive review and references) of feral horse impacts on:

- soil loss, compaction and erosion
- vegetation from trampling
- reduction of plant species richness at large scale but also localised plant species enrichment
- mortality of native trees through bark chewing
- damage to bog habitat
- damage to water bodies
- facilitation of weed invasion

- community composition of birds, fish, crabs, small mammals, reptiles and ants.

Feral horses are hard to observe, track and capture. For this reason, a range of techniques are applied to achieve population control, depending on mob size, geography and season that include fertility control, fencing, shooting, and capture and removal (NSW National Parks and Wildlife Service 2008).

Key stakeholders in feral horse issues

There is always a strong human dimension to feral horse management, given the place brumbies have in Australian folklore. Management techniques to control overabundance can draw equal amounts of criticism from animal welfare groups lobbying for their preservation, farmers who view them as a resource to be harvested, and conservationists concerned about their impacts on native habitats. Yet there are currently no peer-reviewed studies that focus on the social dimension of feral horse management in Australia (Nimmo 2007).

The solution to date has been to develop collaborative feral horse management plans, typically through a workshop process (NSW National Parks and Wildlife Service 2008). The *NSW Model Code of Practice: Humane control of feral horses* guides land managers on the most appropriate technique to use for differing circumstances. The Code of Practice is also supported by a number of Standard Operating Procedures for particular techniques, based on sound scientific research and consideration of animal welfare.

Management objectives and techniques for feral horses

The aim of feral horse management is to reduce the damage caused to an acceptable level. The available control techniques vary in efficiencies, cost-effectiveness and humaneness (see Table 7.7) and multiple techniques are used in each state and territory (Table 7.8). The most successful instances of control have integrated several techniques, such as mustering, commercial sale and aerial shooting (Peacock 2006). Surveys of feral horse populations pre- and post-control is important, as rigorous maintenance of methods ensures ongoing success (Peacock 2006).

The techniques currently used in NSW do not appear to be effectively managing numbers. For example, Kosciuszko National Park contains an estimated 6,000 feral horses and although over 2,000 horses have been removed over the last five years, horse numbers are still increasing by approximately 6 to 17 percent per year²⁴.

The recent Worboys et al. (2015) report also noted that 'current wild horse control actions in NSW and Victoria are inadequate, underfunded and inconsistent with Federal and State legal responsibilities to protect threatened Australian species'.

Suggested feral horse removal rates can be estimated using both conservative and worst-case projections, noting that these estimates do not take into account wider influences. On the conservative side, feral horses are projected to increase to approximately 15,000 by 2030, assuming an annual increase rate of 11.5 percent and a removal of 400 horses per year (the average annual rate for the past five years). By contrast, a higher growth rate of 17 percent would result in more than 37,000 feral horses in Kosciuszko National Park by 2030 if removal rates were to remain at the current levels. Therefore, removal rates of around 10 percent are required to maintain horses at or near current levels, compared to the current rates of around 7 percent.

²⁴ Evidence presented by National Parks and Wildlife Services Officer at the Yass Regional Tour for the Natural Resources Commission, 12 November 2015.

Table 7.7: Humaneness, efficacy, cost-effectiveness and target specificity of feral horse control methods

Control technique	Humaneness*	Efficacy	Cost-effectiveness	Target specificity	Comments
Aerial shooting	Conditionally acceptable	Effective	Relatively expensive. Can be cost-effective when horse density is high	Target-specific	Suitable for extensive areas and inaccessible country. Most effective way of achieving quick, large-scale culling.
Trapping	Conditionally acceptable	Effective	Cost-effective	Can have an impact on non-target species. Traps at natural water holes may restrict access by native species. Horse traps should be designed so that most wildlife can go through fences or under gates.	Most effective when conditions are dry and there are few waterholes around where horses can drink. Cost-efficient method of capture.
Mustering	Conditionally acceptable	Effective	Cost-effective. Can be expensive if helicopters are used.	Target-specific	Efficient and cost-effective where horses are present in high densities, terrain is relatively flat and horse prices are high. Welfare concerns associated with capture and transport of horses. More costly than trapping.
Ground shooting	Acceptable	Not effective	Not cost-effective	Target-specific	Labour-intensive, only suitable for smaller scale operations. Most useful during drought and where horses cannot be captured by trapping or mustering. Impractical in good seasons when water is plentiful and in rugged country where large-scale control is required.
Immobilisation and lethal injection	Acceptable	Not effective	Expensive	Target-specific	Not practical for large scale control.

Control technique	Humaneness*	Efficacy	Cost-effectiveness	Target specificity	Comments
Fertility control	Conditionally acceptable	Not currently effective	Expensive	Target-specific	Not currently available. Not practical for large-scale control.
Exclusion fencing	Acceptable	Limited	Expensive	Can be in certain situations	Expensive, therefore impractical for large-scale application. Fencing can be effective for small, critical (economically or environmentally) areas, though the maintenance costs are high.

Acceptable methods are those that are humane when used correctly.

Conditionally acceptable methods are those that, by the nature of the technique, may not be consistently humane. There may be a period of poor welfare before death.

Methods that are not acceptable are considered to be inhumane. The welfare of the animal is very poor before death, often for a prolonged period.

(Flemming & Ballard 2014)

Table 7.8 Management control techniques for feral horses in Australia

Jurisdiction	Control techniques
Victoria	Captures and removes feral horses
Queensland	Various techniques are used depending on land tenure
South Australia, Western Australia and Northern Territory	Mustering is used where it is economical in with aerial and ground shooting as alternatives
Australian Capital Territory	Aerial and ground shooting, trapping and fencing (border with NSW)
New South Wales	Aerial shooting is currently banned so other control methods are used such as trapping and mustering

Without agreement on an efficient means to control numbers quickly, ongoing efforts will be limited to more resource and time-intensive techniques, slowing down the number and rate of removal. All control techniques proven to be effective should be available to bring populations to acceptable levels. There will be occasions when aerial shooting is the most effective way to reduce feral horse numbers, and as Table 7.8 above shows, this applies to extensive areas of inaccessible country such as national parks.

Ongoing public consultation will be critical to program success, as demonstrated following an aerial shooting operation of 2000 in Guy Fawkes River National Park, which prompted severe reactions from sections of the community. In response, the NSW Government cancelled aerial culling operations from its future horse management programs within NPWS lands. However, an independent review of the protocols and procedures used in the operation subsequently found that the aerial shooting was both appropriate and carried out humanely (NSW National Parks and Wildlife Service 2003). Nevertheless, the ban on aerial shooting was reiterated in 2015 by the then NSW Environment Minister.

What constitutes a successful feral horse management program?

Dawson et al (2006) suggest that feral horse management programs work well when they:

- are adequately resourced
- have clear objectives based on sound science, best practice guidelines and local knowledge (i.e. community)
- set control targets
- determine appropriate methodology
- consider the welfare of feral horses.

Good relationships with land owners, animal welfare groups, horse and conservation advocates, and professionals (such as horse handlers and scientists) are essential if a program is to be successful. This has been proven in other jurisdictions. Involvement should range from representation on a working group, to holding public meetings (Peacock 2006). Working groups can set objectives and participate in the management program, and should meet regularly throughout program planning and implementation. They can also disseminate information to interest groups and relay any concerns back to the group in a controlled setting, helping to resolve conflicts (Peacock 2006).

Future management plans for feral horses should balance the need to minimise impacts on sensitive ecological areas via population control, while also recognising the heritage value of horses across the wider landscape. Any further changes to the management of feral horses across NSW, including using best practice management techniques, should be based on the research and consultation currently being undertaken for the Kosciusko Plan of Management.

Recommendation 20(i-iii): Reduce the impact of feral horses.

The NSW Government should:

- i. finalise the work of the technical reference group and respond to its findings
- ii. remove feral horses in ecologically sensitive areas using best practice management techniques after consideration of the recommendations of the independent technical panel
- iii. recognise the heritage value of feral horses within its management program and maintain an acceptable population level across the landscape.

7.3 Greater consistency in managing introduced birds in NSW

Introduced birds such as the Indian (or common) myna and common starling are widespread across eastern Australia. The factors that affect introduction outcomes and eventual range size are well understood (for example Grarock et al. (2014); Blackie et al. (2014); Forsyth et al. (2004)) and genetic analysis can show the pathways and history of invasion (Rollins et al. 2006). Introduced birds readily invade altered and natural habitats and where they occur few habitat patches are likely to be unaffected (Antos et al. 2012).

It is not always easy to determine if introduced bird species are responding to habitat change or actively disrupting local species or both. For example, the common myna is primarily a passenger of habitat change, invading readily into altered habitats (Grarock et al. 2014) although it does have a negative impact on the long-term abundance of some cavity-nesting bird species and some small bird species (Grarock et al. 2012). In urban areas there is an impact on both urban aesthetics through the generation of noisy communal roosts and horticultural production through crop damage. Both common myna and common starling have been identified as vectors for a number of human health issues, including Avian influenza (H5N1).

Both native and introduced bird species can be pests where there is detrimental impact on economic, social or conservation values or resources. Multiple species can cause many types of harm from damaging crops, especially in grain and horticulture crops, to hazards at airports (Wilson et al. 1992). It is hard to know where, when and how often harm will occur and there are few reliable techniques to estimate damage (Bomford & Sinclair 2002).

Control of pest birds is difficult due to the widespread and erratic distribution of introduced birds, a lack of technically feasible control techniques, the absence of specific legislation or policy direction for bird management and the lack of both reliable data and scientific research.

Distribution of pest birds

The difficulties in controlling pest birds are exacerbated due to their distribution and mobility. Different pest birds have different feeding strategies and movement patterns, which influence the nature, timing and severity of the damage they cause (Tracey et al. 2007). Bird damage can

also be influenced by a number of independent factors including the success of the previous breeding season and the availability of natural foods (Temby 2003).

This is of particular concern in the horticulture industry, where bird damage to national horticultural production is estimated at nearly \$300 million per year (Tracey et al. 2007). Of the introduced birds in Australia, starlings are the most serious and widespread agricultural pest, causing high levels of damage to fruit, particularly grapes, olives and stone fruit. In NSW the damage from starlings is around \$12 million per year (McLeod 2016). Other species that particularly impact horticulture are European blackbirds, sparrows and the Indian myna (Temby 2003).

Control techniques

Broad-scale control of pest birds would require the trapping of communal roosts, which has proven to be technically unfeasible (Tidemann 2010). In horticultural settings, netting and shooting treatments are effective but the cost of netting can be almost three times higher than the cost of shooting (Tracey 2010). Additionally, shooting appears to scare birds from the crop rather than cull numbers, as the extent of damage caused is irrespective of the number of birds shot (Tracey et al. 2007).

In a study of the efficacy of community trapping of myna birds, Garrock et al. (2014) reported that community trapping was successful in reducing local populations. However, it was not viable as a control method over larger scales due to the reproduction rate and mobility of the species.

The Invasive Animals CRC (2014) found that the main priority for myna management specifically is prevention of the transportation and hence establishment of new myna populations. The lag period before establishment (Garrock et al. 2012) is usually less than three years, and a rapid response takes advantage of this lag (Invasive Animals CRC 2014a). Control of Indian mynas, particularly in urban areas, should include reducing food availability, limiting nesting sites and manipulating habitat (i.e. planting native trees) (Invasive Animals CRC 2014a; Pham et al. 2009).

Legislation and policy

Despite the social and environmental impact of introduced pest birds, there is little impetus for regional, state or national approaches to manage them. No specific legislative or policy direction currently exists to manage introduced pest birds in NSW and most other jurisdictions. However, Victoria (Agriculture Victoria 2014) is seeking to address this legislative gap. Its Non-indigenous Birds Policy seeks to provide risk-based, clear and robust management direction for introduced bird species (Agriculture Victoria 2015).

The absence of collective management policy for introduced and pest bird species is likely a combination of:

- highly localised impacts
- the difficulties of long-term control (Antos et al., 2012)
- the lack of evidence that introduced birds are a major threat to avian diversity globally (Baker et al. 2014)
- the fact that bird impacts on environmental and production values are relatively modest (in comparison to other pest and invasive species, notably cats, foxes and rabbits).

In the absence of specific legislation in NSW, many local councils have taken the initiative themselves and operate bird control programs on an ad hoc basis²⁵. Measures include:

- providing information relating to non-lethal methods of reducing the presence of pest birds
- assisting in controlling or removal of pest birds.

Lack of reliable data and research

The lack of available data and research around introduced bird impacts limits the degree of evidence-based guidance for effective control. For example, introduced birds, habitat clearing and urbanisation all have impacts on native species, making it difficult to attribute the problem to any one cause (Invasive Animals CRC 2014a; Grarock et al. 2014). Habitat modification may reduce native species abundance but benefit introduced species (Grarock et al. 2014), but more research is needed to better understand the efficacy and suitability of control techniques.

A consistent approach is required so that local councils can increase community awareness and action to manage Indian mynas. The state government should work with local government to develop and adopt practical and cost-effective techniques to manage pest birds such as these. This should include:

- planting local native trees and shrubs to make the environment less attractive to Indian mynas and encourage native species
- providing traps to the community on a cost recovery basis (where the amount paid for a trap by the community should not be greater than the original purchase price)
- providing guidance on managing pest birds.

Recommendation 21(i): Adopt and resource a strategic risk-based approach to managing urban and peri-urban pest animals.

The NSW Government should:

- i. work with Local Government to provide cost recovery and practical techniques to manage urban pests such as Indian myna birds.

7.4 Recreational hunting as a management tool

Recreational hunting is a valid and valued recreational pursuit and is widely used to hunt several pest species (particularly foxes, dogs and pigs). While recreational hunting can be a valuable part of a pest management program, population control is not the primary purpose of most recreational hunters.

²⁵ Examples of existing local council programs include:

- i. Campbelltown and Wollongong Indian Myna Bird Action Programs. Both councils' programs include holding workshops after which the participants can purchase Myna bird traps made by the local Men's Shed organisation
- ii. Byron Shire Council, Coffs Harbour City Council and Tweed Shire Council Myna Control Projects and publications – Indian Myna Control Project Handbook: Managing the invasion of Indian Mynas in Northern NSW (LG, 2010).

During the regional tours conducted by the Commission for this review, many landholders raised issues with recreational hunting. These included illegal hunting practices, trespassing and anti-social behaviour. All contribute to a loss of trust between landholders and hunters.

Animal welfare is another concern. For example, the Royal Society for the Prevention of Cruelty to Animals (RSPCA) favours shooting by professional marksmen over poisoning, as it is considered more humane, but does not support recreational hunting. In the limited circumstances where shooting does comprise a pest animal management program, the RSPCA believes marksmen have been more effective in achieving animal welfare outcomes than recreational hunters (RSPCA, 2015).

Shooting on its own is rarely an effective population control method. The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) and the Australasian Wildlife Management Society state that shooting is ineffective in significantly reducing pest animal densities and impacts, particularly over the longer term.

Recreational hunting does have a place as a control technique when used in combination with tools and techniques which maximise its effectiveness, namely if it is:

- in the right sequence (in relation to other control methods)
- at the right time (diurnal, seasons)
- undertaken by suitable operators in the right geographic location and for the right species
- coordinated across tenures.

Recreational hunting is mostly valuable as a complementary pest control tool when used in combination with primary control mechanisms. Recreational hunters are knowledgeable regarding the distribution and behaviour of pest animals, and should be actively engaged in the regional pest management planning processes to achieve agreed outcomes.

Recommendation 22(i): Actively engage recreational hunting groups in regional pest animal management.

The NSW Government should:

- i. engage recreational hunters in the preparation of regional pest management plans and include recreational hunting resources in management programs.

Hunting licences in NSW

There are two types of hunting licence administered by the NSW *Game and Feral Animal Act 2002*. The restricted game hunting licence (R-licence) allows individuals to hunt game and feral animals on public land declared open for hunting, or on private land with the permission of the landholder. The general game hunting licence (G-licence) is required for individuals to shoot deer, game birds and other game on private property. A G-licence is not required to shoot declared pest animals on private property.

Of the 18,000 licensed game hunters in NSW, approximately 75 percent hold R-licences and 25 percent hold G-licences (pers comm., Game Licencing Unit 2016).

Both licences are inexpensive, at \$75 per annum or \$325 for five-years. In addition to personal information, the application also requires supporting documentation such as NSW firearm licence number and in the case of R-licences, membership details of an approved hunting organisation. Training and membership of a shooting or hunting association is required only when applying for an R-licence, while a G-licence requires neither.

Box 7.9: Bounty system

Bounty systems have been used in an effort to control pest animals in Australia since the late 19th century but have consistently failed to achieve the desired outcome. They offer financial incentives to hunt and destroy pest animals and generally require hunters to present part of the animal (such as a scalp or tail), or the entire animal in return for the bounty.

Using bounties as an incentive for hunters to assist in the control of pest species was raised in many submissions, generally from recreational hunters. However, a number of submissions state that bounties are an ineffective means of control and recommended against their use.

For example, Victoria recently had a fox bounty scheme which rewarded hunters \$10 for every fox harvested. A 2002 evaluation conducted by the Victorian Institute of Animal Science of the fox bounty trial concluded that it had no effective impact on fox densities and had a number of serious drawbacks, including that they are:

- counter-productive to more efficient, longer-term options
- administratively inefficient and utilise resources better spent elsewhere
- not achieving an appreciable reduction in the density and impact of pest animals (Victorian Institute of Animal Science, 2003).

Streamlining current arrangements

The current arrangements for the issuing of hunting licences on private land for invasive species is unnecessary. As a regulator, the government has a responsibility in controlling firearm ownership and managing the risks posed by hunting activities to populations of native game species and on public land and the R-licence performs this role²⁶ However, the need for government involvement in licencing hunters to access private land is regulatory overreach and unnecessarily complex²⁷.

As indicated above, most licensed hunters obtain an R-licence. To do so, a hunter must be a member of an approved hunting organisation and pass an accreditation course. The NSW Department of Primary Industries Game Licensing Unit has a policy and procedures in place for the approval, audit and suspension or cancellation of approved hunting organisations.

The larger approved hunting organisations such as the Sporting Shooters Association of Australia (SSAA) and other clubs provide training, accreditation and insurance coverage to their members, effectively providing similar services to manage risks that a hunting licence does without the need for government involvement.

²⁷ The regulation of native game birds on private land should be through the R-licence

Approved hunting organisations are able to train novice hunters and accurately assess the competency of applicants. They are also best placed to monitor the behaviour of hunters and identify and exclude those that present unacceptable risks.

Hunting is based on a mutually beneficial relationship between the hunter and the landholder. Both parties need to be assured that the risks associated with the hunting activity are managed effectively.

Approved hunting organisations currently run programs designed to foster relationships between landholders and hunters. An example of such a community based program is Farmer Assist, developed by the SSAA to enable its members to help farmers with pest animal control. The program aims to provide more hunting opportunities for recreational hunters, and help farmers control pest animals on their properties. Before a SSAA member can be registered for the Farmer Assist Program, he or she has to undergo a formal assessment to ensure their skill level is compatible with professional shooter accreditation (Sporting Shooters Association of Australia 2015). The program has gained participation in Queensland, South Australia and Western Australia, while 241 members have registered interest in NSW since the program opened in December 2015 (Sporting Shooters Association of Australia, 2016 pers. comm.).

Recommendation 23(i,ii): Reduce red tape surrounding recreational hunting on private land.

The NSW Government should:

- i. remove the requirement for hunters to be licensed to target non-indigenous species on private land
- ii. promote the use of approved hunting organisation membership and programs to link hunters with landholders.

7.5 Market mechanisms - wild boar and deer management

The potential economic value of some pest animals provides opportunities for commercial or market mechanisms to be incorporated in the mix of policies targeted at managing their impacts. For example, feral pigs and deer can be perceived as pests but also can have a commercial value to some restaurants, individuals and export markets.

The use of game meat for human consumption is regulated by the NSW Food Authority, a unit within NSW DPI. There are a number of regulations around harvesting game meat which aim to maintain State and National food safety and health standards.

The infrastructure (chilling rooms, game meat harvesting vehicles and game meat field depots) required to meet these standards can have high capital costs. These infrastructure requirements are the same for deer and wild boar as they are for harvesting wild goats and kangaroos (NSW Department of Primary Industries 2008).

Unlike the market for goat meat, it would appear that the low uptake of commercial wild boar and deer harvesting is driven by two major factors: low demand and the high costs of harvesting due to the cryptic nature of these animals. However, government needs to minimise any barriers to potential market development for exports or domestic use.

Recommendation 24(i): Maintain access to markets for pest animals.

The NSW Government should:

- i. work with the Australian Government to allow the development of markets, both export and domestic, for pest animals while minimising regulatory impediments.

7.6 Non-commercial use of kangaroo meat for baits

During consultation the Commission heard that landholders were not permitted to use non-commercial kangaroo carcasses for pest animal baiting. In some instances, landholders have to source bait meat from the nearest town rather than using the carcass of a kangaroo that had been killed for non-commercial purposes.

Before a licence can be issued under the NSW *National Parks and Wildlife Act 1974* to harm a kangaroo, the current policy on the non-commercial destruction of kangaroos requires landholders to provide evidence that:

- there is damage occurring to a land occupier's property
- the landholder has tried non-lethal means to disperse the animals.

The current practice does not adopt a risk based approach for issuing this licence. All applicants have to meet the same criteria and abide by the same approach. Licence applicants are issued with tags for the number of animals they have been licensed to destroy and these tags are required to be fixed to carcasses to aid compliance checks.

Historically, the licensing approach for non-commercial kangaroos has been to disallow secondary use of the kangaroo carcass, meaning the animal is left in situ when shot. This aids compliance checking to ensure the number of animals licensed to be destroyed is not exceeded. It also avoids the secondary use of carcasses in a way that might impact on the commercial kangaroo management program and industry (such as using the carcass for commercial gain under secondary use approval).

The secondary use of non-commercial kangaroos to feed dogs or for use in pest animal baiting program is permitted from time to time at the discretion of authorised officers. In these instances, the authorised officer believes it is appropriate to do so for the following reasons:

- the risk of non-compliance with the licence approval is low
- the use of the kangaroo carcasses for commercial gain is low or non-existent.

This approach is not currently reflected in National Park and Wildlife Service policy. A risk based review of the non-commercial kangaroo licensing approach could modernise the National Park and Wildlife Service approach to the issue of secondary use of kangaroo carcasses, and might also include whether and when tags and compliance inspections are required.

The Commission recommends that the current system be clarified so that kangaroo carcasses can be used for pest animal baits. To maintain the integrity of the tag system the landholder or Local Land Services would need to hand the tag back to the authorised officer who would record the non-commercial destruction of the animal and use of that carcass for baiting purposes against the relevant tag number.

Recommendation 25(i): Increase non-commercial use of kangaroo carcasses.

The NSW Government should:

- i. revise the current policy to include a risk-based approach to the non-commercial use of kangaroo carcasses to allow for the use of carcass for approved baiting programs.

7.7 Conservation and pest management collaboration

The importance of exploring all techniques, including conservation programs, is paramount in achieving triple bottom line objectives for pest management. Throughout consultation, environmental stakeholders reiterated the importance of considering emerging management techniques such as rewilding²⁸ and argued their potential to simultaneously strengthen ecosystems and suppress impacts of invasive species.

The Australian Wildlife Conservancy is undertaking conservation and rewilding projects in regions of NSW, Western Australia and South Australia. The construction of an 8,000-hectare 'feral predator-free' area in Scotia, NSW creates a rewilding site for the bilby and numbat and has provided a cat and fox-free habitat for over 40 threatened species (Australian Wildlife Conservancy n.d.).

Separately, Rewilding Australia is also advocating the reintroduction of Tasmanian devils and two quoll species on Australia's mainland, with the dual purpose of protecting the species from extinction and providing benefits for feral cat and fox management (Rewilding Australia 2013). According to Rewilding Australia, the benefits of reintroduction include:

- increased competition and predation with invasive cats and foxes
- increasing populations of endangered species
- contributions to missing ecosystem function
- reducing current reliance on baiting and shooting as pest management techniques (Rewilding Australia 2013).

Such programs could either inform or be integrated with agencies undertaking pest management, highlighting opportunities to achieve multiple management goals while effectively using community and government resources.

²⁸ Rewilding is when native species are reintroduced into the natural environment.

8 Improved knowledge base

This section explores the current research arrangements and options for improvement, along with emerging research priorities, the role of technology such as a central online portal in mobile pest mapping, and the contributions of citizen science.

8.1 Long-term research capacity

The NSW Department of Primary Industries' (NSW DPI) Vertebrate Pest Research Unit and its associated activities with the Invasive Animals Cooperative Research Centre (Invasive Animals CRC) is the lead pest animal management research unit in NSW. Direct investment in pest animal research and development in NSW is approximately \$4 million per annum (NSW Natural Resources Commission n.d.)²⁹. This investment is primarily for staff costs and covers research areas such as reducing pest animal impacts on production, fisheries, conservation management and hunting efficiency programs. Current government investment in the Vertebrate Pest Research Unit is approximately \$700,000 per annum. The rough breakdown of where research within the unit is targeted is 60 percent to wild dogs and 20 percent to rabbit biocontrol. The remaining 20 percent is directed to research on kangaroo and game management (spending on carp can be found in Chapter 9) (Vertebrate Pest Research Unit 2016, pers. comms., February).

The NSW Government also contributes to national research, providing \$250,000 in cash to the Invasive Animals CRC, along with in-kind support of approximately \$3.55 million over the CRCs current five-year term. This is mostly made up of staff time from across NSW DPI branches.

The main role of the Invasive Animals CRC is to coordinate and develop research on pest animals across Australia. Outputs derived from these investments are significant.

Although the Invasive Animals CRC is due to close in 2017, transition to a new institution is unclear as the proposed Centre for Invasive Species Solutions has not yet been funded (Invasive Animals CRC 2015, pers. comm., 17 December). Without funding to a central body such as the Invasive Animals CRC, the research capacity of NSW will be significantly diminished. Government agencies would likely revert to individual silos, competing for limited research funding targeted at state-specific priorities. They would also have less investment and resources for field-testing and social research. This could result in lower rates of adopting best practice management techniques, and a lack of capacity to develop and test the applicability of new methods.

The Invasive Animals CRC investment is critical to NSW having a long-term research capacity as it provides operational funding, additional staff and opportunities for collaboration. Until the establishment of the centre in 2005, research collaboration only occurred at relatively low levels and was mostly driven by individual researchers. The collaborative model for the Invasive Animals CRC includes 27 partner organisations across Australia, such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and other research units from other states, and provides for enhanced research opportunities, better outcomes and

²⁹ Noting investment in research includes the NSW DPI, the Invasive Animals CRC, Local Land Services, the Office of Environment and Heritage, Meat and Livestock Australia and Australian Wool Innovation. These figures represent estimates due to the majority of research projects, other than those by the NSW Department of Primary Industries' Vertebrate Pest Research Unit, having multiple objectives.

minimised wastage (Campbell 2011).

Examples of successful outcomes emanating from NSW include:

- **Rabbit control** – NSW has been instrumental in deploying new biological control agents for rabbits. NSW DPI led the registration process for bait delivery of Rabbit Haemorrhagic Disease (RHD) as well as the development of best practice for this technique. It also provides ongoing leadership in developing new strains of RHD which, when released, will partially overcome declining efficiency of the current strain. Biological control of rabbits has saved agriculture over \$1 billion per year over the last 60 years.
- **Best practice** – NSW has led the development of national best practice guidelines, animal welfare based Codes of Practice and Standard Operating Procedures, training packages for practitioners and exotic disease contingency planning (for example: Sharp & Saunders 2005).
- **Wild dog management** – NSW conducted the research which led to restoring effective aerial baiting rates for wild dogs and has an ongoing role in improving management practices (Fleming & Ballard 2014).

The case for maintaining a central coordination and collaborative body is all the more pressing because of recent reductions in Commonwealth-funded programs, such as the closure of the Australian Pest Animal Research Program in 2013, which provided almost \$1 million in grants in 2011-12 (PestSmart Connect 2015) and the Wildlife and Exotic Disease Preparedness Program which ran from 1984 to 2014 (Department of Agriculture and Water Resources Australian Government 2015).

Recommendation 26(i,ii): Expand research capabilities.

The NSW Government should:

- i. lead advocacy for and invest in the creation of Centre for Invasive Species Solutions, the proposed successor to the Invasive Animals Cooperative Research Centre
- ii. collaborate with the Commonwealth Government and other states and territories to enhance research opportunities and outcomes.

8.2 Setting effective research priorities

NSW currently participates in establishing national research priorities through the Invasive Plants and Animals Committee, as well as setting ongoing priorities for the Invasive Animals CRC. This effort should be strengthened and maintained.

National research priorities for pest animals have in the past been set through two processes: through the Invasive Plants and Animals Committee and the *Australian Pest Animal Strategy*. These prioritisation processes have been developed separately to industry research priorities, resulting in minimal investment by industry to implement the research priorities (NSW Department of Primary Industries 2016, pers. comm., February).

The Invasive Plants and Animals Committee recently established the Invasive Plants and Animals Research, Development and Engagement Working Group, to identify key national research, development and engagement investment priorities. This working group presents an

important opportunity for government and industry to work together to develop and implement joint priorities for invasive species research and development.

Although both the Invasive Plants and Animals Committee and the Invasive Animals CRC investment is guided by risk assessment³⁰, the risks faced from new incursions or unexpected changes in existing issues are particularly important. The current Invasive Animals CRC foresighting strategy addresses this need, and aims to 'enable pre-emptive invasive animal management in priority regions using macro-ecological modelling to assess potential patterns of biological invasion under extreme weather events and climate change and determine the most cost-effective pest management strategies' (Invasive Animals CRC 2014b). NSW should support the Centre for Invasive Species Solutions to maintain this research, and if it is not continued should prioritise improving its own foresight capability to monitor trends, risks and invasion pathways.

Recommendation 26(iii): Expand research capabilities.

The NSW Government should:

- iii. support the Centre for Invasive Species Solutions maintaining a foresighting capacity, or in the absence of a national approach, establish a unit to build foresight capability, monitor pest trends, risks and invasion pathways.

In addition to foresight capacity, specific areas where research is currently needed include:

- **Biological control of rabbits** – rabbits continue to pose a serious risk. Proactive management is essential, particularly through developing effective new biological control. Viruses such as the current biocontrol for rabbits (RHD) eventually become less effective as hosts develop a genetic resistance, as has been the case with myxomatosis. Identifying new strains from overseas, or developing new strains in Australia which could be introduced to complement the original strain (Czech strain 351), remains an ongoing priority if NSW is to maintain rabbits at below damage density thresholds into the future.
- **Improving early detection** – as the invasion of a new species spreads across the landscape from its point of introduction, damages rise roughly with the square of the distance from the original invasion (Epanchin-Niell & Wilen 2014). The benefits of early detection and eradication are undoubted. Early detection can be improved through a better informed community, citizen science, improved pathway analysis, more responsive passive and active surveillance activities, stronger regulation, contingency planning and training for rapid response.
- **Feral cats** – effective control of feral cats is complex and requires ongoing research, particularly in the area of ecosystem dynamics and environmental protection. Regardless of the predator species (dogs, cats and foxes), the need for a multi-species approach is required. Removal of all pest predators from a system will have both production and conservation benefits, and will have inbuilt cost-efficiencies over and above single species

³⁰ The *Australian Pest Animal Strategy* has twelve key principles - number four of is "Setting priorities for and investment in pest animal management must be informed by a risk management approach". The Invasive Animals CRC also has a risk management approach, outcome one in its annual report is "No new vertebrate pests established in Australia" and it has a program specifically aimed at "National incursions response and pest intelligence" which specifically deals with risk management.

approaches. New control methods such as the Eradicat (compound 1080) and pending Curiosity (PAPP) baits for feral cats need to be further evaluated in NSW under local operating conditions. New techniques that exploit the cleaning habits of cats to deliver toxins should be developed.

- **Deer** - Little is known about the ecology of deer in NSW, including disease status, management and impacts. Management options are currently limited to mostly ground shooting (West & Saunders 2006), although the use of cyanide is currently being researched. There is an urgent need to build more knowledge on impacts, management options other than shooting and the potential for landscape control programs.

These proposed research areas align with current national and state invasive species plans and include emerging issues identified in this review, such as deer.

Recommendation 26(iv): Expand research capabilities.

The NSW Government should:

- iv. commit long-term funding to maintain pest animal research capacity to develop and evaluate cost-effective and humane control techniques prioritising:
 - a. biological control of rabbits
 - b. improving early detection mechanisms
 - c. feral cat control
 - d. deer control.

8.3 Sharing research

Access to and sharing of world class research is important to ensure timely on-ground delivery. Centralising research information helps achieve this, which in turn facilitates communication and knowledge building, reduces the risk of duplication, and generates new research initiatives. This function is currently performed by the Invasive Animals CRC's PestSmart program, an online portal which could be expanded to include data, methods and information.

Recommendation 26(v): Expand research capabilities.

The NSW Government should:

- v. support and expand the Pestsmart portal as a centralised, accessible, web-based portal for collating research outcomes, data, information and results.

Currently, scientists studying pest animals do not have a consistent means of sharing their results and data, relying instead on ad-hoc collaborations. Furthermore, the dissemination of scientific data is impeded by poor formatting of data or use of proprietary software that makes it difficult to share. Culturally, scientists are also reluctant to publish data (as opposed to final research) for fear of losing control of how the information is used (Molloy 2011).

An example of just how effective such centralised data portals are is eWHIS, the national electronic Wildlife Health Information System database, maintained by national research body Wildlife Health Australia. A similar resource would work in pest animal research and could be included in the PestSmart program.

8.4 Pest mapping and citizen science

In addition to research, strategic pest management requires up-to-date pest animal data to set priorities, monitor outcomes and plan for the future.

Maps of pest animal abundance and impacts form one such data repository, although data is collected consistently in some areas and not at all in others. Wild dog plans, for example, include provisions to collect information on pest animals but there is no data reporting facility available.

In the absence of a data collection facility that can be used to spatially express pest animal data and impacts, investment decisions are based on the recall of individuals and on partial information. In addition, a lack of monitoring data makes it extremely difficult to report on investment outcomes (such as control interventions), which in turn makes it difficult to justify ongoing expenditure. This shortfall has been recognised by NSW DPI and Local Land Services (LLS) as they expand and develop electronic reporting mechanisms and digital platforms.

The Biosecurity Information System, being developed by NSW DPI, has the potential to capture state-wide information on pest animal impacts, populations (including distribution and density), control efforts (for example, quantities of 1080 (sodium fluoroacetate) use or aerial baiting runs) and collaborative programs. LLS does not currently have the capacity to accurately report on pest management as it is developing new information management and performance reporting protocols. This is an important process and should be aligned with the Biosecurity Information System.

Community based reporting

The Invasive Animals CRC offers similar systems to the Biosecurity Information System, such as FeralScan, to promote community-based reporting of pest animal issues. Other community based tools that have been developed and are being used or trialed include WildDogScan to report on wild dog attacks or sightings, and MouseAlert to report mouse numbers and to guide early control interventions to manage or prevent plagues.

Community-led or industry driven pest recording systems can gather and pool data quickly and effectively through apps and offline data capture tools. Although less accurate than formal research or official reporting, these systems can also provide real-time data on pest numbers, impacts and control efforts, and feature built-in links to important information about pest animal management. This can help private and public land managers work collaboratively to identify pest problems, document and measure impacts and implement and assess integrated pest control programs.

These systems all need to be further developed to guide on-ground control activities and to demonstrate the economic and environmental returns of implementing best practice control programs.

In addition to data collection, five-yearly surveys (much like NSW DPI's previous Pest Animal Surveys) are a cost-effective way of obtaining broad-scale and cross tenure information about both incursions across landscapes, and natural or enforced changes in populations. Surveys are estimated to cost \$100,000 and were last done in 2009 due to resource constraints (NSW Department of Primary Industries, pers. comm., 2015). As these surveys involve consultation with expert field and operational staff they can provide more context than raw data. Surveys

should also provide regional information back to survey participants to maximise knowledge and understanding of pest problem areas and new incursion sites. Making this data available for these purposes should be a prerequisite for agreed mapping processes.

A missing element from surveys of this type is the verification of inputs, which at present rely partly on the subjective assessment of individuals. A combination of active and passive surveillance (data, surveys and on-ground inspections) in selected areas would help refine population assessments. Modern technologies, such as density mapping via aerial drones, may also assist in improving the quality of the data collected.

Recommendation 26(vi, vii): Expand research capabilities.

The NSW Government should:

- vi. conduct five yearly surveys of invasive species incursions, distribution, abundance and impacts
- vii. transparently share results and analysis of these surveys with the community.

8.5 Standardising data protocols

Once data is collected, it must be aggregated to provide clear, up-to-date information on pest populations and the effects of control efforts. Data-sharing across key agencies and platforms is necessary to examine regional and state trends in pests, particularly in response to control programs and collaborative investments.

Standard data protocols need to be adopted to establish consistent and reliable pest animal information. These protocols provide the basis for delivering current best practice control methods in priority regions. At present, there is no national agreement on core attributes for collecting pest animal information although they are in place for weed management. These attributes might include time, impacts, coordinates, density and control effort.

The National Indicators Working Group of Invasive Plants and Animals Committee has explored core attributes, but progress has been slow. The NSW DPI is working with LLS to examine options for a state-specific on-line system for recording key pest animal attributes with appropriate mapping capabilities. As an example, the National Wild Dog Action Plan is currently developing nationally agreed indicators for managing this species. These will be included in the updated *NSW Wild Dog Management Strategy*, due for release later in 2016. A similar process should be expedited for all pest species.

Recommendation 27(i-iv): Adopt standardised data collection.

The NSW Government should:

- i. adopt standard data protocols and record keeping requirements, which are mandatory for anybody receiving funding for pest animal management
- ii. establish a metadata standard for collection of pest animal information
- iii. develop and maintain a state-wide data sharing system for tracking pest animal distribution, density and impacts, that has current data from all Local Land Services
- iv. ensure data is readily available to stakeholders and regional managers for use in adapting management plans and actions.

8.6 Research and development in freshwater pest management

Improvement in freshwater pest research and development requires:

- **Sustained research capacity** – The NSW Government should strengthen and maintain collaborative investment in freshwater pest research with the Invasive Animals CRC (and its successor), CSIRO, other research organisations and government jurisdictions, noting the success of collaborative research programs such as CyHV-3 carp control research. Within the NSW Department of Primary Industries, research activities between Fisheries NSW and the Vertebrate Pest Research Unit could also be better integrated to leverage resources more effectively.
- **Better monitoring and information sources** - The NSW Government should also look to external monitoring data sources, such as industry (irrigator) or environmental river health monitoring systems to broaden the information base.

8.6.1 Research needs for freshwater pest management

The NSW Government should continue to invest in research and development to monitor freshwater pests and their risks; devise control strategies that are applicable and cost effective; and enable the community to take greater responsibility in freshwater pest management. This includes:

Surveillance through biotechnology – Improving surveillance and monitoring technology is an essential step in early detection and rapid response to freshwater pest incursions. eDNA and NextGen genomic sequencing are two new technological innovations that the NSW Government should further champion and collaboratively invest in (Hall & Fulton 2012).

Increasing uptake of these surveillance technologies as monitoring or prevention tools at border points will improve efficiencies and allow increased surveillance for freshwater pests across NSW freshwater environments. However, further work is required to refine the techniques for both applications.

Recommendation 28(i,ii): Support for aquatic pest research and development.

The NSW Government should:

- i. appropriately resource the NSW Department of Primary Industries for research funding. In particular:
 - a. biological and genetic control of tilapia and other freshwater pest animals
 - b. complimentary measures for carp biocontrol and removal
- ii. fast track use of tools such as environmental DNA and NextGen (for monitoring and surveillance).

9 Targeted funding

This chapter explores current government investment into pest animal management, and recommends three new funding streams. Landholders, industry and government in NSW spend a significant amount of resources on pest management, accounting for around 30 percent of total national funding of pest management (McLeod 2016).

9.1 Current investment in pest management

There is currently no comprehensive resource which documents where and how much the state government and individuals spend on pest management. As such the Commission engaged a consultant to conduct a national study which disaggregates expenditure to the state level (McLeod, 2016), and interviewed NSW public pest managers (including the Department of Primary Industries (NSW DPI), Local Land Services (LLS) and the NSW Office of Environment and Heritage (OEH)).

Using a combination of approaches, the Commission estimates that current spending on pest management is around \$61 million per year, with \$22 million directly contributed by landholders and an additional \$5 million collected via rates (see Table 9.9 and Figure 9.13).

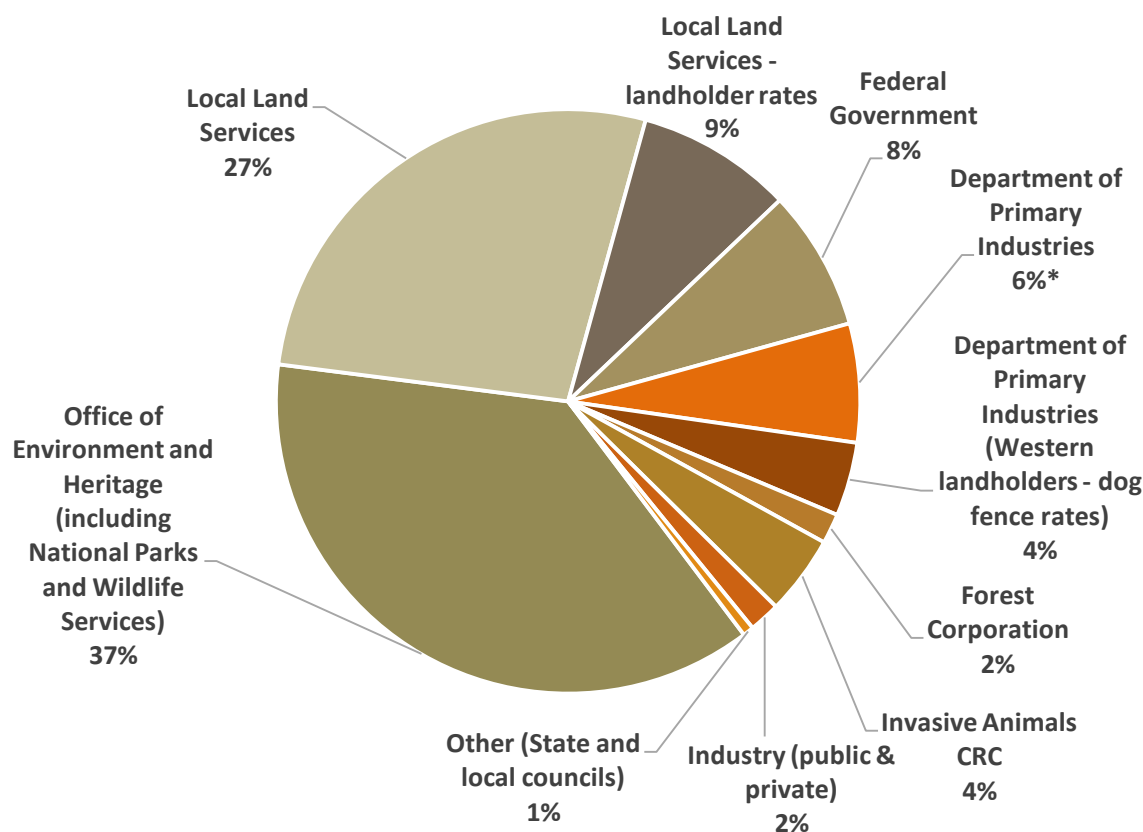
Table 9.9 Average expenditure on pest animals in NSW

(NSW Natural Resources Commission 2015c)

Management costs of pest animals in NSW*		Source
Landholder expenditure	\$22 million	McLeod (2016)
Government expenditure (including landholder rates and industry levies)	\$39 million (incl. \$3.4 million LLS rates & \$1.6 million Western landholder dog fence rates)	McLeod (2016); Commission analysis of government spending
Total	\$61 million	

*Note: Pest animals included were rabbits, goats, pigs, foxes, dogs, introduced birds and carp. Average farm pest expenditure outlined in Gong et al (2009) included "fixed costs of management" which has been updated and is reflected in the landholder management costs. Government expenditures are derived from interviews of public pest managers conducted on behalf of the Commission. LLS expenditures including rates are also included as part of government costs. There is a high degree of uncertainty in estimating management costs of pest animals. The figures depicted above are intentionally conservative given this high degree of uncertainty and should be viewed as indicative only.

In addition to this funding, NSW DPI may use funding from within its cluster to respond to high-risk new incursions as and when they occur. These funds were recently used to respond to the incursion of fire ants in Port Botany in 2014-15 (NSW Department of Primary Industries 2015f), and for the protection of native turtles against disease in the Bellinger River in 2015 (NSW Department of Primary Industries 2015a).



*Department of Primary Industries funding is allocated in the following way: Invasive Plans and Animals Branch: 46%; Game Licencing Unit: 26%; Crown Lands: 12%; Wild Dog Destruction Board: 8%; Fisheries: 8%

Note: this figure includes a local government contribution to a partner program with NSW Department of Primary Industries. Estimates of total local government expenditure have not been included in this analysis

Figure 9.13: Pest animal funding contributions in NSW - 2014/15 (percentage of total)*

9.2 Current investment weightings and suggested future priorities

Funding of pest management activities in NSW is allocated to control, advisory and facilitation, research and regulation.

Using the Commission's interview-based funding analysis, data indicates that current contributions via landholder rates and state agencies are spread across the two later segments of the invasion curve (containment and asset protection). Of these funds, 47 percent goes towards control and 39 per cent to advisory and facilitation services (Figure 9.14).

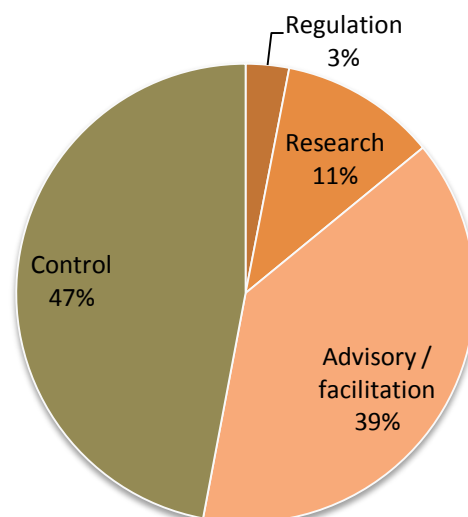


Figure 9.14 Government expenditure by pest management function

*Note: Government expenditure includes contributions from landholders via rates. If landholder expenditure was included total expenditure on control would be significantly larger.

In addition, public funds, and some private funds are allocated via industry bodies, with a focus on containment, asset protection and some research and development. This is despite the invasion curve model, which shows that the return on public funds is greatest at the early stage. However, the situation does reflect the fact that many pest animals, including rabbits and foxes, have never been eradicated and are now widespread across the state. This understandably places the onus on protecting assets, including agricultural land and national parks.

New incursions

To ensure that public and private land does not suffer widespread impacts from new incursions, it is critical that the NSW Government adequately resource and respond to new threats. Prevention and eradication components of the invasion curve currently receive funding from the Australian Government and NSW DPI from within its cluster as and when an incursion occurs. Whilst this provides confidence that the state is providing funds to manage pests across all aspects of the invasion curve, it does highlight the critical role that NSW DPI plays in preventing and eradicating new incursions. It further highlights the need for NSW DPI to conduct appropriate risk assessments when allocating funds as there are very few other sources of funding with which to manage new incursions.

The recent examples of successfully controlling a fire ant incursion and apprehending disease spread in the Bellinger River provides some confidence that new incursions are being managed. However, the rules governing access to funding are currently uncertain and require clarification.

The lack of transparency around how environmental, economic and social impacts are considered is another concern. Without clearly defined governance and decision-making processes for new incursion funding, there is a risk that some incursions will not be stopped. The Commission sees this funding as critical to biosecurity and pest management in NSW. This funding needs to continue and NSW DPI needs to clarify arrangements with the public and agencies.

Recommendation 29(i,ii): Ensure that timely resources are made available to address the risks posed by new incursions.

The NSW Government should:

- i. clarify and formalise the arrangements for accessing NSW government agency funding to manage the economic, social and environmental risks posed by new incursions.
- ii. maintain funding for emergency response to stop new incursions.

Expenditure of established species

Data on species-specific pest management is difficult to obtain for all government agencies. However interviews with OEH indicate that it allocated 43 percent (\$6.5 million) of its pest management budget on wild dog control, which equates to 16 percent of all public expenditure on pest management in NSW in 2014-15 (Figure 9.15). Expenditure on wild dogs is likely to be much higher when funding from LLS, NSW DPI and landholders is taken into account.

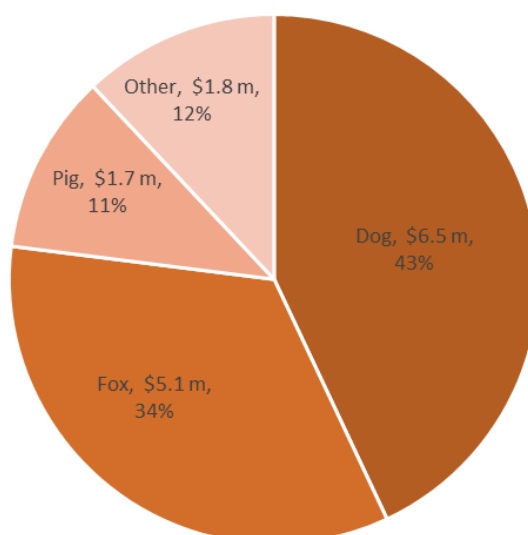


Figure 9.15: Office of Environment and Heritage (including National Parks and Wildlife Services) expenditure by pest species

Yet despite this high outlay, there is a perception among many landholders that the National Parks and Wildlife Service (NPWS) were not spending sufficient resources on managing these and other pest animals. Inaccurate perceptions such as these continue to be problematic for pest managers. Additionally, although wild dog management is recognised as being critical for agricultural production, and stopping negative spill-overs is a responsibility of public land managers, the relative priority of dog management is worth further consideration. This is particularly so given the greater biodiversity impacts of other pests.

Box 9.10 Wild dog barrier fence

The Wild Dog Destruction Board oversees the management, maintenance and upgrade of the Wild Dog Barrier Fence. These fences have been constructed to exclude wild dogs from entering NSW from Queensland and South Australia. Landholders rates (\$1.6 million) and the NSW government (\$0.2 million) jointly fund maintenance of the fence, which also acts as a barrier to camel incursions. Evidence from consultation with the NSW Wild Dog Destruction Board indicates that wild dog numbers on the South Australian side of the dog fence are significantly higher than in NSW, suggesting that the fence is providing significant benefit to NSW farmers.

9.3 Public funding drives widespread public benefits

Because pest management is a collective action problem, investment to control pests requires both public and private contributions. Identifying when and how government should contribute is complex because of the need to consider:

- where threats originate
- how risks spread across the invasion curve
- what policies, programs or services can be effective
- the relative benefits and costs of all options to public and private landholders (Department of Primary Industries Victorian State Government 2010).

These questions are further complicated for the following reasons. Landholders or land managers can have different objectives, and the potential risk of even a devastating new incursion is less visible than the impacts of established pests.

The generalised pest invasion curve demonstrates that the rate of return is 1:100 for prevention actions, 1:25 for eradication, 1:5-10 for containment and 1:1-5 for asset based protection (Department of Primary Industries Victorian State Government 2010). This is reinforced by analyses of biosecurity programs which generally show that preventive actions are the most cost-effective (Kompas 2015). There are exceptions to this tendency, including the biological control of widespread pests such as rabbits, which generate significant returns.

The challenge for policy makers and governments is in deciding where to invest, as no single approach will resolve the collective action problem. In practice, government will need to work across the entire invasion curve and balance return on investment with social, environmental and economic factors, with a view to maximising public benefit.

The 2013 NSW Independent Pricing and Regulatory Tribunal (IPART) review of LLS' funding framework is based on risk and beneficiaries, and is a useful reference point for how to fund pest management. The IPART review found that in general, LLS boards should consider the following sequence of options when determining who should fund a service:

- firstly, and where identifiable, the party causing the adverse impact requiring LLS response should fund that activity (fee-for-service)

- secondly, where there is no adverse impact being addressed, or where the impactors or risk creators are too diffuse to charge (such as pest management), then those benefiting from the activity should pay (landholder rates and levies)
- as a last resort, state government funding should be available to LLS as a funding mechanism where:
 - a public land management agency has been identified as the primary impactor or beneficiary of the activity
 - where it is inefficient or inappropriate to target actual impactors or beneficiaries with a fee or levy (Independent Pricing and Regulatory Tribunal 2013).

This framework, in conjunction with analysis of current government and landholder investment has informed the Commission's recommendations for future funding arrangements outline in Section 9.4.

9.4 Recommendations to increase funding streams

As discussed above, where there is a role for government in providing pest management services, cost-sharing may be appropriate if there are both public and private benefits. With this in mind the Commission has reviewed a number of alternative funding mechanisms, and compared these to the principles set down in the IPART review to develop three funding options.

9.4.1 Increase Local Land Services funding stream

Firstly, it is important to note that IPART recommended a reduction in the LLS minimum rateable area from 10 hectares to 2 hectares, increasing the pool of funds available.

Peri-urban areas represent a biosecurity risk that justifies greater effort due to the greater potential for collective action problems there (Roger Beale et al. 2008). As the Beale Review recognised, smaller landholders need to be engaged and made aware of their biosecurity obligations. The peri-urban environment has already been the source of a number of biosecurity incidents, including the spread of tomato leaf curl virus and periodic outbreaks of Hendra virus (Roger Beale et al. 2008).

For these reasons, the Commission supports the IPART recommendation of reducing the minimum rateable land area from 10 hectares to 2 hectares. In addition, the Commission supports the introduction of the new minimum rateable land area no later than 1 July 2017, to give LLS boards time to engage and inform the affected landholders. If rates are charged to small landholders, they need to be engaged and educated about their biosecurity obligations (see Chapter 5).

Recommendation 30(i): Provide adequate resources to deliver effective pest animal management.

The NSW Government should:

- i. implement the Independent Pricing and Regulatory Tribunal recommendation to decrease the Local Land Services minimum rateable area size from 10 hectares to 2 hectares to increase the rate base.

9.4.2 Special purpose rate - coordinators

As outlined in the NSW *Local Land Services Act 2013*, LLS boards may make and apply one or more special purpose rates for any year on any land within a district, if considered necessary to do so. Past examples include special purpose rates for noxious weed management on travelling stock reserves, or eradicating locusts.

As seen already in this report, coordinators can significantly increase the effectiveness of management activities and improve the government's return on investment (see Chapter 5 for the benefits of coordinators).

As such, the Commission recommends that a special purpose rate could be put in place in each region across the state. This rate would be used to create regional pest management coordinator positions, with matched funding from the NSW Government. These coordinators could empower local communities to more efficiently manage pest eradication, containment and asset protection and conduct surveillance for new incursions.

Initial estimates indicate, that in general, funding for additional staff such as coordinators, would amount to approximately \$100,000 per year. For 11 LLS regions this would equate to \$1.1 million per year.

Recommendation 30(ii): Provide adequate resources to deliver effective pest animal management.

The NSW Government should:

- ii. provide ongoing funding for regional coordinators. Coordinators to be funded by the NSW Government and the establishment of a new Local Land Services rate specifically for pest management coordinators.

9.4.3 Special purpose rate - rapid response fund

Pest numbers vary between seasons which presents risks and opportunities. Rapid access to funds, targeted at strategic priorities, is important because of this unpredictability. Priorities may include managing a new pest entering a region, a localised increase in a pest population, or taking advantage of opportunities to remove pests, such as pigs, during drought. This rate would not need to be matched by government as it would be used for local and regional priorities and strategic action.

The fund would allow LLS to quickly respond to risks or take up opportunities to prevent or contain a new incursion. The fund could be capped at a total of \$300,000 per LLS region, with annual contributions to the fund capped at \$100,000. The fund should be managed outside the government net cost of services. This fund would not be ongoing, nor would it be used for state-significant incursions or issues. These should remain the responsibility of NSW DPI.

A similar funding model is currently employed to target locust management through the state's locust levy, which the Commission supports maintaining. As discussed in Chapter 3, local and regional decision-making and planning is critical to success, and this funding will support those decisions.

A rate has relatively low administrative costs and imposes minimal additional regulatory burden on landholders. It would also have low collection and enforcement costs, as it can be added to existing mechanisms for rate collection.

Each LLS region would set a maximum cap for the fund and suspend special purpose rates once the cap was reached in any given year. Any unspent funds from year to year would be rolled over and accounted for separately from other LLS funding.

Recommendation 30(iii): Provide adequate resources to deliver effective pest animal management.

The NSW Government should:

- iii. establish a rapid response fund in each Local Land Services region to be funded by a new pest management rate specifically for strategic activities. The fund would be solely funded from this rate (no public investment) and be used by Local Land Services Boards to fund emerging risks and opportunities in pest animal management.

9.4.4 Provision of concessional or low interest loans

The current Farm Innovation Fund should be extended to include pest management under the natural resources or environmental thematic funding areas. This would help landholders access concessional loans for conducting priority pest management activities in a region.

Concessional loans should be extended to include activities currently not covered, such as exclusion fencing, where the initial capital costs are high, and the benefits are received by the landholder investing in the loan. As well as delivering immediate benefits to landholders, these loans help them become more resilient and ensure long term productivity and sustainable land use.

The Farm Innovation Fund currently totals \$250 million and has approved around \$50 million worth of loans to date (NSW Department of Primary Industries n.d.). The fund is managed by the Department of Primary Industries Rural Assistance Authority and is intended to assist primary producers identify and address risks to their farming enterprises, improve permanent farm infrastructure and ensure long-term productivity and sustainable land use. The fund currently provides loans for exclusion netting for bird damage to crops but does not currently fund other pest management practices, such as exclusion fencing.

The recently announced Australian Government *2015-16 Pest and Weed Drought Funding program* supports this, and other types of collaborative action, although it provides little ongoing certainty for pest management given funding is not ongoing (Local Land Services and Australian Government n.d.).

A loan approach would limit the overall budgetary impact on state funds, would promote additional landholder investment in pest management, and encourage local ownership of outcomes.

Recommendation 30(iv): Provide adequate resources to deliver effective pest animal management.

The NSW Government should:

- iv. expand the Farm Innovation Fund program for landholders for infrastructure associated with pest management such as cluster fencing.

9.5 Funding freshwater pest management

Due to the public nature of freshwater ecosystems, investment in freshwater pest management is predominately sourced from public funds. NSW DPI and the Invasive Animals CRC are the primary investors in freshwater pest management in NSW, contributing \$540,200 in 2014-15.³¹ This was 1.4 percent of total expenditure on pest animal management in 2014-15, and was mainly staff costs.³²

Of the \$540,200, NSW DPI (specifically Fisheries NSW) contributed \$280,898 to carp, tilapia and redfin perch projects (Figure 9.16). The Invasive Animals CRC directed 15 percent (\$259,302) of its total budget to carp research.

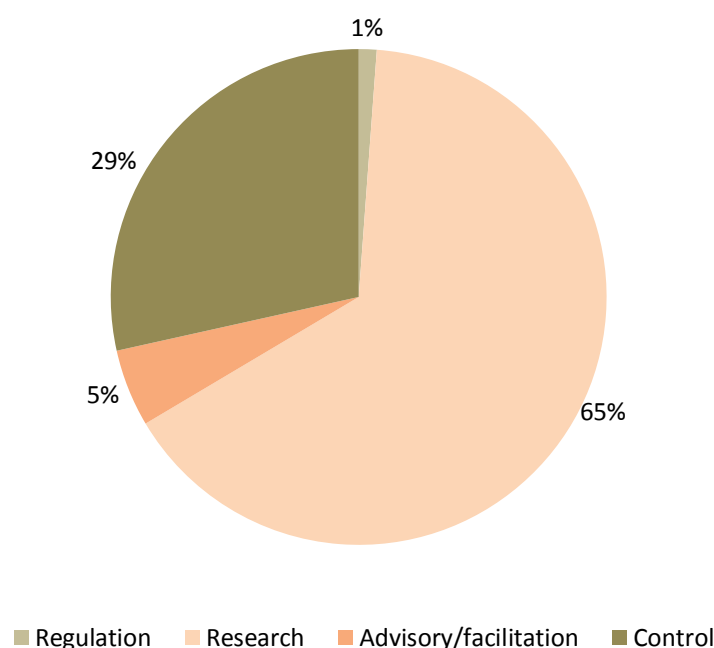


Figure 9.16 NSW Department of Primary Industries (Fisheries NSW) expenditure 2014-15

Additional investment into freshwater pest management is sourced from the NSW Freshwater Fishing Trust, which is funded through recreational fishing licencing. A small proportion of the \$4.69 million in the Trust is directed to freshwater pest management, as part of conservation or fisheries enhancement activities (NSW Department of Primary Industries 2016, pers. comm., 29 January).

The Commission recognises other contributions to freshwater pest animal management may be made by government bodies such as LLS or research institutions such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Long-term sustainable funding was highlighted as a key issue in consultation for the review, with current resource prioritisation considered ad hoc.

³¹ Note, the Invasive Animals CRC is a national contribution.

³² Total pest management expenditure includes landholder rates and industry levies.

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Attachments

Attachment 1: Terms of Reference

Terms of Reference

State-wide review of pest animal management

The Premier requests the Natural Resources Commission (Commission) to review the management of pest animals in NSW (under Section 13(1) (f) of the *Natural Resources Commission Act 2003*).

Pest animals create economic, social and environmental costs for the NSW community. Across Australia, pest animals have been estimated to cost \$745 million annually, including losses in agriculture and expenditures on management, administration and research. They also threaten the environment. Within NSW more than 350 species, populations and communities are considered to be threatened by the impacts of pest animals. The social and emotional impacts on farmers and communities are also significant, especially where pest animals kill livestock.

Pest animals are managed across different tenures by private and public land managers including the National Parks and Wildlife Service and Local Land Services. Several pieces of legislation are relevant to pest animals and their management, including the *Local Land Services Act 2013*, *Threatened Species Conservation Act 1995*, the *Game and Feral Animal Control Act 2002*, and the *Biosecurity Bill 2014*.

There is a perception that the pest animal problem is getting worse despite efforts of landholders and governments, and that more coordinated approaches are needed.

The purpose of the review is to identify opportunities to improve the management of pest animals in NSW across all land tenures for environmental, economic and social benefits.

In particular, the Commission will investigate and identify:

- quality of the evidence base and processes supporting prioritisation decisions
- priority pest animal issues in NSW and emerging risks
- examples of current good practice, including from other jurisdictions
- any policy, regulatory or organisational barriers to more effective pest animal management
- opportunities to better coordinate, redirect or grow investment and management across tenures and across different pest species and maximise benefit per dollar invested
- priority research needs
- ways to promote community understanding of and involvement in pest animal management.

The review will recommend options for improving arrangements for pest animal management across NSW, including potential funding models. The review will also consider implementation and transitional issues for any recommendations.

The review will consider introduced terrestrial and freshwater vertebrate species. Animals in the marine environment are excluded.

The Commission will chair an advisory committee to inform the review. The Committee will include one representative from each of the Department of Primary Industries, Office of

Environment and Heritage, Local Land Services and an independent member with pest animal management expertise.

The Commission will provide an issues paper followed by a draft report within six months of receiving the terms of reference, and a final report including outcomes of public consultation within four months of providing the draft report.

Attachment 2: Stakeholder Report

1 Summary of consultation

Consultation was ongoing throughout the review. Formal components included:

- a workshop
- six focus groups
- five regional tours
- submissions from public consultation.

Below is a summary of the organisations/landholders represented and key issues raised during each of these processes.

1.1 Workshop

To assist with the preparation of the issues paper, a stakeholder workshop was held in Sydney on 21 September 2015. There were 35 participants from the following organisations:

- Australian Deer Association
- Australian Wool Innovation
- Central West Local Land Services
- Consultants
- Department of Agriculture
- Far South Coast Local Land Services
- Game and Pest Animal Advisory Board
- Invasive Animals CRC
- Invasive Species Council
- Landcare NSW
- Landholders
- Local Government NSW
- Local Land Services
- National Parks and Wildlife Services
- National Parks Association of NSW
- NSW Department of Primary Industries
- NSW Farmers
- Royal Society for the Prevention of Cruelty to Animals
- South East Local Land Services
- Sporting Shooters Association of Australia (NSW)
- Sydney Feral Animal Control Ltd
- University of Canberra
- Wild Dog Destruction Board
- Winangakirri Aboriginal Corporation

1.1.1 Principles of pest animal management

When defining the principles of pest management, participants identified factors similar to those that informed the basis for good practice. The principles discussed were:

- **Set objectives** - clear and strategic, and founded on a triple bottom line approach.
- **Evidence based** - objectives that are balanced, and based both on scientific evidence and on-ground knowledge.
- **Flexibility** - having an approach that is applicable, transferrable, adaptive, dynamic, scalable and accessible.
- **Accountable and transparent** - having indicators that measure outcomes and can be monitored and evaluated. Avoiding political interference which can skew objectives.
- **Collaboration and shared responsibility for the issue** - involving the community and employing cross tenure landscape approaches to ensure true engagement and partnerships. This includes integrating currently siloed management.
- **Clarity** - ensuring all roles and responsibilities, across regions and scales, are clear and defined and support communication and leadership relevant to stakeholder needs.

- **Sustainable** – having the ability to retain and build knowledge and capabilities across time to ensure sufficient longevity of projects to prevent problems reoccurring. A long-term and consistent vision that perserveres with goals whilst remaining flexible.
- **Efficient** - making the best use of resources, preventing duplication, being cost-effective and ensuring management is well thought out and planned.
- **Current** - ensuring on-going research and development with results being delivered in a timely manner to inform innovation and more effective on-ground activities.
- **Forward thinking** - acknowledging the dynamic nature of pest management and using evidence to predict trends and emerging issues.
- **Resourced** – ensuring longterm infrastructure, staff and funding are available to cope with and prevent current and emerging issues. Support is provided for both regulatory and voluntary action.
- **Ethical** – making sure procedures follow guidelines and maintain social licence. Animal welfare is taken into account.

1.1.2 Priority Issues

A number of priority issues were identified by participants including:

- establishing an overall State plan to increase consistency
- improving institutional co-operation, allocating clear roles and responsibilities and preventing duplication and over regulation
- overcoming barriers that prevent the adoption of good practice
- maintaining funding and defining a process for resource allocation, including prioritising investment appropriately
- ensuring knowledge transfer is timely and accessible
- motivating and maintaining community engagement and increasing community education and communication
- adopting a multi-species landscape approach to management
- solving staff retention issues, critical for retaining knowledge and maintaining relationships
- exploring market based solutions and commercialising pests as a resource
- improving use of resources including hunters, Aboriginal knowledge and expertise, and new technologies
- determining a methology for species prioritisation
- finding an appropriate balance between stakeholder values
- creating a system for consistent messaging and communication
- ensuring existing and future policy is enforceable
- assessing the impacts of non-compliance, ignorance, peri-urbanisation and absentee landholders
- dealing with issues of animal welfare perceptions
- discovering methods of predicting/ foreseeing emerging issues and implementing a program to identify them such as the impact of climate and land use change, and their implications for new pest problems.

1.2 Focus groups

As part of the consultation, six focus groups were held in Sydney during October and November 2015. Participants were from the following organisations:

Pest Animal Council: 15 October 2015

- NSW Department of Primary Industries
- NSW Office of Environment & Heritage
- Local Land Services
- Forestry Corporation of NSW
- Local Government NSW
- NSW Farmers' Association
- Landcare NSW
- Invasive Animals Cooperative Research Centre
- Wildlife Preservation Society of Australia
- NSW RSPCA
- Australian Environmental Pest Manager's Association

Animal welfare: 10 November 2015

- Australian Veterinary Association
- Central West Local Land Services
- NSW Department of Primary Industries
- NSW National Parks and Wildlife Services
- Royal Society for the Prevention of Cruelty to Animals (RSPCA)

Aquatic pests: 23 October 2015

- Invasive Species Council
- Koi Society of Australia
- NSW Council of Freshwater Anglers
- NSW Department of Primary Industries
- NSW Fisheries

Environmental: 18 November 2015

- Birdlife Southern NSW
- Local Land Services
- National Parks Association
- National Parks and Wildlife Services
- Research Alliance

Local Land Services: 27 October 2015

- Central West Local Land Services
- Greater Sydney Local Land Services
- Hunter Local Land Services
- Local Land Services
- Murray Local Land Services
- North Coast Local Land Services
- North West Local Land Services
- Riverina Local Land Services
- South East Local Land Services
- Western Local Land Services

Recreational hunting: 19 November 2015

- Australian Deer Association
- Australian Pig Doggers and Hunters Association
- Local Land Services
- Game Management Council of NSW
- NSW Department of Primary Industries
- Sporting Shooters Association of Australia
- University of Western Sydney

Key issues raised by the focus groups include:

Roles and Responsibilities

- The Pest Animal Council needs to be more strategic and have 'teeth'.
- Pest management lacks the high-level, strategic direction and accountability required by regional practitioners, despite the Department of Primary Industries having a lead role to play.
- There is a need for a consistent approach across State and regional scales to build collaborative links and to replace individual ad hoc activities.

- Clarification of the Local Land Services' role - each region's role is very much shaped by varying pressures including community and expectations
- Local Land Services wants to shift to an enabler role but it is difficult to transition from providing a 'reactive' service and the legacy of on-ground support. There is a need to change community expectations as to the role of Local Land Services.
- A regional governance structure requires a centralised body with clear roles and responsibilities, to manage cross tenure approaches and funding.
- The Game Licencing Unit was seen as a positive by the recreational hunting focus group while Local Land Services was seen as more of a hindrance with relationship building required.

Shared ownership

- Local Land Services coordination with public land managers is variable and depends on personalities, landholder motivations and regions.
- There is a difference between collaboration and leadership, with landholders needing to lead the response, while the Local Land Services coordinates and provides support.
- Local Land Services philosophy should be "what can't the landholders do themselves?"
- Important to recognise the benefits of programs such as Farmer Assist and Supplementary Pest Control, where hunters assist with pest management.
- The potential for the Supplementary Pest Control program to be expanded (noting that it may not be applicable across all tenures) was also raised.
- Trust is a significant issue for landholders in relation to hunters and this is where programs such as Farmer Assist are beneficial.
- Language was also seen as crucial - there is a difference between recreational hunting and hunting as a means of pest control and protecting the environment.

Priority pest species

- Prioritisation is complex and should be conducted within species, across species and then across the invasive species continuum.
- In terms of aquatic pests, biocontrol of carp and prevention of tilapia incursion into the Murray Darling Basin are top priorities.
- There is a need to prioritise fish pathways and carriers, rather than species, as the potential pest list has 500 species.
- NSW needs to undertake more containment actions at the border and prioritise these actions based on impacts, or natural control methods.

Landscape-scale approach

- Landholders are reactive, often focusing on individual issues and not always operating at the landscape level.
- Differing management strategies and lack of coordination exacerbates the issue of cross tenure/landscape-scale management.
- Differences in management approaches between states and regions is a problem.

- Aquatic pests need to be managed on a catchment scale, as pest fish know no administrative boundaries and upstream management can impact management downstream, often across state or regional borders.
- Current control methods were seen by some as not being sustainable (i.e. baiting, shooting). Practices that build ecosystem resilience were needed such as the use of apex predators in combination with current practices.
- Hunting as a control method had its place but was not the only solution. Multi-stakeholder input is required as well as an integrated approach that considers seasonal breeding habits for targeted pest management.
- It was acknowledged that Local Land Services was best placed to coordinate landscape-scale approaches to pest management.

Emerging issues

- Local Land Services regions focus on established pests such as wild dogs and do not feel they have the funding or staff to deal with emerging pests such as deer.
- More needs to be done on prevention as it is the most efficient approach.
- Changes in operational water management activities such as environmental water releases may be a problem as the warmer top water favours both native and pest fish.
- Management of council and farm dams/ponds is also an emerging issue with the deliberate introduction of redbfin or carp common in these water bodies.
- Concerns were raised with the aquarium international import trade and the threats posed by ornamental fish.
- Increasing globalisation issues also make prevention difficult with the transport of goods, legally and illegally becoming easier.

Adequate resourcing

- Need various funding options including rate subsidy for those landholders who participate in pest control programs; levying those who do not; and generating increased revenue by decreasing the rateable land size.
- The inflexibility of funding was raised as an issue – ‘use it or lose it’ funding models do not lend themselves to the cyclical nature of pest management.
- Careful consideration is required when contemplating additional levies, particularly in relation to who the beneficiaries of those levies will be.
- Additionally, it was suggested that funding for regional Pest Animal Committees should be discretionary to allow for targeted programs in problem areas.
- Long term sustainable funding was highlighted as a key issue.
- Resourcing issues due to the conclusion of the Invasive Animals CRC and other funding cuts were also highlighted.
- Effective education methods also need to be appropriately investigated and resourced for:
 - the new HPV virus (approximately \$30 million required to research clean up methods for dead carp)
 - general biosecurity obligation of anglers
 - the prevention and control of tilapia – as no control method is currently available.

- The need for a contingency fund to manage pest emergencies was raised
- The financial burden should be shared as pests are not a localised problem.
- It was also noted there is no evidence commercialising pests reduces numbers in the wild.

Knowledge building

- Data collection was highlighted as a significant gap, but the associated cost was recognised as an issue.
- The current Business Information System data measurement systems were noted as being cumbersome and needing improvement.
- The mind-set and behaviours of anglers across the state (conservation vs deliberate introduction) have to be managed.
- The following R&D gaps were raised:
 - Limited research and control techniques for aquatic fish. More research capacity is needed.
 - eDNA is a promising technology in the next 3-10 years and should be championed / further investigated
 - potential biological control of tilapia
- The need for long term data and investment was recognised, as was the need for continued research, with much value being placed on the Invasive Animals CRC.
- Technological advances were seen as out-pacing the currency of codes of practice or standard operating procedures.
- The importance of the communication, education and training role of hunting and shooting clubs and associations was discussed.

1.3 Regional tours

Members of the Advisory Committee participated in regional tours, visiting five locations in NSW during October and November 2015. Participants included landholders and representation from organisations:

North Coast: 19/20 October 2015

- Cassegrain Wines
- Forestry Corp NSW
- Hastings Wild Deer Working Group
- Landholders
- North Coast Local Land Services
- North East Pest Advisory Committee
- NSW Department of Primary Industries
- Game Licensing Unit
- NSW National Parks and Wildlife Services
- NSW Police
- Peri Urban Wild Dog Research Project
- Port Macquarie Hastings Council
- Sporting Shooters Association of Australia

Riverina: 28/29 October 2015

- Griffith City Council
- Hay Shire
- Landholders
- Murrumbidgee LandCare
- NSW Department of Primary Industries
- NSW Farmers
- NSW Police
- Riverina Local Land Services

Northern Tablelands: 16/17 November 2015

- Barnett River Wild Dog Association
- Landholders
- Nancok Wild Dog Association
- Niangla Wild Dog Association
- Northern Tablelands Local Land Services
- NSW National Parks and Wildlife Services

South East 11/12 November 2015

- Brindabella/ Wee Jasper Wild Dog Plan
- Feral Fox Fighters
- Invasive Animals CRC
- LandCare
- Landholders
- NSW National Parks and Wildlife Services
- South East Local Land Services
- Wild Dog Group

Central West – Western: 4/5 November 2015

- Bundamar Feral Pig Group
- Forestry Corp NSW
- LandCare Barrier Area Ranges Group
- Landholders
- Local Land Services
- Mungery Feral Pig Group
- NSW Farmers
- NSW National Parks and Wildlife Services
- TPG Fencing
- West Darling Pastoralists Association
- Western Local Land Services
- Wild Dog Destruction Board

Key issues raised during the regional tours include:

Roles and Responsibilities

- Mixed views on Local Land Services role depending on region. Role varied from setting strategies and coordinating programs to managing pest control on ground.
- It was also noted that there is some conflict between stakeholder expectations and Local Land Services legislative obligations.
- The lack of consistency between different Local Land Services was a concern, as was the inconsistency between national parks and the different State Forestry regions.
- State level coordination is needed but with regional variation.
- Local Land Services is in the best position to create a hierarchy to oversee management and should remain the leader and supporter of all these activities while still maintaining communication with current networks and communities.
- NSW National Parks and Wildlife Services considered collaborative, with a prominent role in managing pests, particularly in baiting and trapping wild dogs.
- There was the view that the NSW *Game and Feral Animal Control Act 2002* does not drive participation and that current legislation creates difficulties in enforcing compliance.
- Communication is critical as locals feel that Local Land Services rather than the community is driving programs now.

Shared ownership

- Pests such as wild dogs are a shared collective problem, where relationships at a local level are critical.
- If participation is not a sustained 100 percent effort, major problems arise. With 60 new Landcare positions from January 2016, Landcare facilitators could be used to help tackle pest problems by coordinating community action.

- The Pest Animal Management and Landholder Engagement Project in New England is a good example of a regional project involving multiple stakeholders.
- There is a perception that with changing rural demographics, groups are not so effective due to absentee landowners and differences in landholder motivations.
- Some community groups are seeing the benefits in multispecies control, for example the Bundamar feral pig group started as a fox group in 2002 and has since grown to include other species – pigs, dogs and feral cats.
- The need for group coordination was raised: to avoid landholder burnout; the wide variance in pest control programs across regions and addresses issues of absentee landholders.
- Recreational hunting means that some landholders will not control deer as it is a potential revenue stream.
- Landholders can be intimidated by some elements of the recreational hunting lobby.
- Some community reasons cited for not being involved in wild dog baiting programs included dingo conservation, not wanting government involved, 1080 concerns and the belief by some that dogs control pigs and kangaroos.

Priority pest species

- Wild dogs, deer, cats and pigs were identified as the priority pests.
- Wild dogs cause widespread and significant social and financial impacts on communities, and need a considered and coordinated approach.
- Strong support for declaring deer as pests as they are becoming more a regional than localised issue.
- In terms of pest fish, carp were seen as a priority as there is substantial community awareness about the issue and this creates a big ‘noise’ for action.

Landscape-scale approach

- Stakeholders agreed an integrated cross tenure approach is required.
- Dogs also need collective landscape solutions at a range of scales.
- Stakeholders felt collective large-scale action was needed for fox and pig control. Local Land Services, landholders and managers are working together to coordinate pig control with environmental water management (as dry phases assist in pig control).
- Animal and plant pests be combined under one administrative structure as this would create savings, be more effective and would have a better chance of achieving collective action between different types of producers, including cattle producers. It was suggested the rabbit control officer model be used.
- Stakeholders noted that a system for cross tenure reporting was lacking and it was suggested that establishing a system for reporting based on the Fire Management model would be beneficial.

Emerging issues

- Peri-urban impacts were seen as an issue particularly with wild dogs and deer.
- Significant knowledge gaps in peri urban impacts and pest distribution need to be addressed to ensure control efforts are effective and targeted.

- Stakeholders in the Central West and Western NSW identified deer, camels and donkeys on park estates as emerging issues.
- Other issues include: Commercialisation of pests, disease translocation and the exploitation of technology – particularly to engage younger landholders.

Adequate resourcing

- Funding models supported were levies, reducing the rateable property size to 2 hectares and co-investment with industry. Mustering of goats and/or pigs, the revenue from which could be reinvested in pest control.
- In terms of aquatic pests, prioritise for prevention rather than asset based protection, but if species are not present there is no funding provided.
- Stakeholders felt there should be contingency funding for emergency responses. Drought assistance funding is useful but comes too late and a lack of flexibility around timeframes for spending means funds are not invested efficiently.
- The brevity and episodic nature of funding was criticised as was the lack of funding and support provided by the NSW Department of Primary Industries.
- The lack of investment in deer management was stressed as particularly concerning. While funding for wild dog management was considered sufficient.
- Need more education and continued increases in research.
- Strategic control is viewed as more cost effective than reactive control. The cost of ground baiting is substantial compared to aerial baiting.
- Lack of human resources was also seen as an issue, with insufficient people on the ground in Local Land Services, national parks and State Forests.

Knowledge building

- Data on pest animals is sporadic. When data has been collected, the reporting platforms have been an issue.
- The use of helicopter surveys has demonstrated data can be collected for a range of pests, over a large area, using a fraction of the time and cost of ground-based surveys. These surveys demonstrated the value of control versus non-control with neighbours, which could be used as an evidence tool to persuade collective action.
- There are no surveillance programs for aquatic pests other than eDNA in some regions. The community is relied upon to detect new incursions and over the last 14 years has detected one new incursion each year. There are limited case studies to guide strategy for early detection and eradication.
- Continuity of experience within groups was seen as important to ensure continual learnings and improvement. Information sharing between government departments was also seen as critical.
- The need for increased research and development was identified particularly in reference to: developing control methods for deer, establishing a stronger connection between research and on ground knowledge, increasing education around aerial baiting and establishing clear indicators for pest animal management.
- Communication was mentioned as vital in knowledge building, with the style of language used being noted as critical for increasing engagement.

- NSW National Parks and Wildlife Services collect data in the Pest and Weeds Information System (PWIS). However, the PWIS monitoring system does not 'talk' to the NSW Department of Primary Industries system. This needs to be resolved to improve data sharing.

1.4 Summary of submissions

The issues paper was released for public consultation for six weeks from the 16 October to 30 November 2015. A total of 176 submissions were received. Of these, 23 percent were from organisations and 77 percent from individuals. These submissions can be viewed on the NSW Natural Resources Commission website at: <http://www.nrc.nsw.gov.au/pest-animal-management>. A number of submissions were confidential and as such the views and opinions expressed have not been referenced in this summary.

Principles

- Few submissions discussed general principles. Those that did advocated the need for coordination, flexibility, transparency and prioritisation, particularly in reference to impacted valuable areas. The need for evidence based decisions was also seen as fundamental to policy development.
- There was support for pest management being centred around best outcomes on the ground with suggestions noting that programs should focus on reducing pest animal impacts in lieu of focussing solely on a reduction of total animal numbers.
- It was recommended that ethics be included in defining best practice. Submissions suggested that control methods should be as humane as possible and communication with the wider community on both the humane killing of pest species and the necessity of pest control is important in helping 'over-ride emotion'.
- The threat of political interference determining responses (or lack thereof) to pest management was noted. It was noted that transparency and education around pest animals and their effects on Australian landscapes would serve as tools to prevent political pressure being a determinant of management strategies.
- One submission heeded caution when prioritising cost effective approaches as it was argued that the state of the natural environment has potential to decline under these conditions. The Invasive Species Council similarly mentioned that "*environmental impacts of pests tend to be accorded a lower priority than agricultural impacts through these [national intergovernmental] processes and are sometimes neglected altogether*".
- One submission expressed concern around private landholders being held accountable for pests as they already incur costs for managing them.

Focus on aquatic and terrestrial pests

- A number of submissions noted the lack of acknowledgement of aquatic pest species in comparison to terrestrial pests. It was suggested that more needed to be done with aquatics due to their unique nature and small share of funding.

Roles and responsibilities

Confusion in roles and responsibilities

- A large number of submissions made suggestions relating to roles and responsibilities. Submissions across all stakeholder groups highlighted the lack of clarity in this area and it was noted that this impinges on various industry bodies, farmers and landowners, the public both in urban and rural settings and government agency staff.

- Legislative inconsistencies were also highlighted as contributing to the lack of clarity in pest management. Inconsistencies pertaining to the 'level' of potential threat presented by particular species and obligations for pest management on Crown land versus private land were specifically mentioned throughout submissions. NSW Farmers suggested that pest management obligations should be "*completely consistent across all tenures to set a foundation for true shared responsibilities*".
- In reference to aquatic pests, the role of agencies in pest fish management was similarly highlighted as unclear in a number of submissions. The NSW Council of Freshwater Anglers noted that "*the Department of Primary Industries is responsible for managing the ecology of the State's waterways and pest fish, [though] most of NSW waterways are regulated by various water authorities and commercial users*".

Establish clarity in roles and responsibilities

- Various submissions highlighted the urgency for partnerships with clear structure and consistency across regions and levels of management.
- When establishing clarity, a large number of submissions either advocated the need for a single management committee or expressed the need for a specific hierarchy within pest management. Among these submissions the NSW Department of Primary Industries was recognised as holding the highest responsibility in terms of defining and legislating pest management while Local Land Services was acknowledged as the most appropriate agency to deliver management on a regional basis. These agencies were concurrently noted for their role in communication with landholders. Submissions also expressed the need to include various other bodies including NSW Farmers, Landcare and the Office of Environment and Heritage, etc.
- Many submissions suggested that NSW National Parks and Wildlife Services and State Forests are failing to control pests properly and that their lands act as breeding grounds and refuges for pest species. However other submissions note positive aspects of NSW National Parks and Wildlife Services' pest management including their willingness to continue pest management programs past contract dates to ensure their effectiveness, their 'excellent' support in providing bait supplies and their general support and participation in pest programs. State Forests were also positively mentioned in terms of their collaboration with hunters in control efforts.

Triggers

- When looking at government involvement in pest management, numerous submissions strongly recommended that government's role be one of shared responsibility throughout the entire process.
- Other submissions noted specific triggers for government intervention:
 - At the state level, submissions suggested that triggers include pests impacting triple bottom line objectives, pest management moving beyond the realm of private burden and beginning to impact the greater public good, and land managers being incapable of handling the problem independently.
 - At a regional level, impacts on whole industries were said to be a trigger for intervention while the Shoalhaven City Council stated that council triggers are "*risk management in public areas, threats to endangered species and complaints or requests for action by the public*".
 - On a local scale, intervention was deemed necessary when individuals were not participating

- The Scientific Fisheries Committee indicated that the State Government's role was unclear in the management of aquatic pests.

Biosecurity Act and legislation

- The Biosecurity Act was not discussed widely throughout submissions. When mentioned, submissions acknowledged biosecurity as paramount in preventing new incursions and important in guiding decisions relating to pest management.
- One submission noted that the government should 'set the tone' of pest management through the Act.
- It was highlighted that enforcement is resource intensive and that education and shared responsibility are more effective in delivering outcomes.
- Several submissions recommended that the public, hunters, anglers, the environmental sector and water authorities be included in the planning process due to their ability to detect early warning signs of pest animals and their impacts.

Shared ownership

Shared responsibility

- The necessity of shared responsibility was repeatedly mentioned. It was noted there is a disjunct in current management practices which results in inefficiencies. Flexibility, consistency, coordination, communication and a combination of approaches were highlighted as being significant components of shared responsibility.
- The involvement of the community was frequently cited with the importance of citizen centred programs being crucial in maximising participation. It was suggested that local projects have the most chance of success as they can be tailored to local needs while simultaneously aiding in improving engagement.
- The NSW Aboriginal Land Council advocated the formation of partnerships with Local Aboriginal Land Councils and local Aboriginal communities *"as they have an existing network of significant landholdings...and unique TEK [Traditional Ecological Knowledge] of Country and local landscapes which can be built on for pest animal control"*.

Involvement of recreational hunters

- The overwhelming majority of submissions from recreational hunters expressed the will to be included in the responsibility of pest control and to include hunting as a pest management tool. The Sporting Shooters Association of Australia stated that effective results could only be achieved through framework which incorporates *"inter-agency cooperation, a composite stakeholder body, and ensures engagement of all stakeholders to align pest management approaches and strategies across all land tenures"*.
- Various recreational hunting submissions outlined the need to remove institutional bias which precludes the use of hunting and prevents currently available pest control methods from being fully exploited.
- These submissions expressed the view that hunting should form part of the management process as it has the ability to provide sustained pressure between pest management operations and aids in extending the time between them.
- Several submissions mentioned the collaborative benefits of the Sporting Shooters Association of Australia's Farmer Assist program and the NSW National Parks and Wildlife Services' Supplementary Pest Control program. Supplementary Pest Control was acknowledged for its success in integrating pest management with National Parks activities

while concurrently being accepted by the wider community. The Farmer Assist program was noted for its collaboration with farmers at their discretion and its success in other states.

Priority pest species

Determining priority species

- When determining priority species, a large number of submissions stated that priorities should not be based solely on population size but should also consider impacts and the likelihood of pest management success.
- Submissions cited the need for a clear process with distinct criteria to determine priority species. When defining this process, consultation with the community was regarded as vital. Other specific criteria mentioned were:
 - environmental impacts
 - levels of encroachment/limiting expansion
 - possibilities of disease transmission
 - agricultural impacts
 - triple bottom line impacts
 - future risk
- The importance of the invasion curve (prevention, eradication, containment, asset protection (PECA)) was repeatedly emphasised with Landcare NSW stating that it is *“essential for the prioritisation of pest animal species needs”*.
- Prioritising pest species to local areas was frequently suggested as it was noted that impacts of pest species differ according to location. Additionally, various submissions suggested that pest management operations in National Parks, State Forests and Crown Lands should be prioritised. The NSW Aboriginal Land Council suggested this prioritisation of pest management on Crown Lands as pests have significant effects on Aboriginal people *“predominantly as it affects Crown Land transfers to Local Aboriginal Land Councils via the land rights system”*.
- It was further recommended in one submission that prioritisation of pest species should not shift rapidly once the population of that species declines. This is one of the limitations of current pest management and leads to predictable re-establishment.

Specific priority species

- Generally, submissions referred to priority pest species as those specific to their local area or within their area of concern. However wild dogs were the most frequently cited pest, with a significant number of submissions mentioning their impacts. The impacts of pests in agriculture were frequently mentioned with wild dogs and foxes, goats, rabbits and feral pigs being cited throughout various submissions, particularly in reference to their effects on livestock.
- Species of high priority noted throughout submissions were camels, cane toads, carp, cats, deer, wild dogs, foxes, goats, wild horses, Indian Mynas, feral pigs, rabbits, rats and mice, redfin, starlings and tilapia.
- Cats and foxes were referred to throughout submissions in reference to the large amounts of harm they cause to populations of native species. Pigs, goats and feral horses were mentioned in relation to their impacts on vegetation and soils and, in some instances, the subsequent damage to freshwater ecosystems.
- Submissions from urban centred organisations or individuals focused predominantly on foxes, cats and Indian Myna birds.

- A notable number of submissions suggested there is a pressing need for deer to be transitioned from game status to pest status and highlighted that deer are an emerging threat. This was particularly mentioned in relation to road and train accidents. The Australian Deer Association opposed this transition.
- It was noted that aquatic pests are not given enough priority. The Central Acclimatisation Society noted that once an aquatic pest species becomes established it becomes virtually impossible to eradicate.

Landscape approach

Integrated cross tenure

- An overwhelming majority of submissions expressed support for a landscape approach and cross tenure was acknowledged as forming an essential component of 'shared responsibilities' for pest management.
- The Central Acclimatisation Society highlighted that terrestrial pests negatively impact freshwater habitats and supported a landscape approach to simultaneously manage terrestrial pests and preserve aquatic freshwater environments.
- One submission noted that a landscape approach would help prevent confusion around responsibility and provide advantages to landholders who are experiencing similar pest issues though fall into different Local Land Services regions.
- Equal support was provided by submissions for the coordination of a landscape approach to be based solely on locality or on species and locality.

Ensuring success of a landscape approach

- Planning, monitoring, reviewing, communication, seeking feedback, building genuine partnerships and sharing results were cited throughout submissions as important in ensuring the success of a landscape approach. Landcare NSW suggested that "*the four principles (broad scale, coordinated, cooperative, integrated)*" should inform pest management along with decisions regarding "*whether activities should be coordinated by species or locality, and the scale at which a program should occur*".
- In reference to communication the NSW Council of Freshwater Anglers stated that "*there is a need to have more effective communications with the public on freshwater biosecurity issues*" particularly communication that is targeted and expressed through an avenue most likely to capture the required audience.

Absentee Landholders

- The issue of absentee landholders and the lack of cooperation or involvement of neighbours was raised in numerous submissions. It was highlighted that these landholders are either unaware of or ignore the responsibilities of pest management and fragment the management process. Participation is often very hard to legislate and it was noted that a cross tenure approach could provide the basis for a solution to this fragmented management.

Integrating pest and weed management

- The integration of pest animal and weed management had mixed responses throughout submissions although there was majority support for integration.
- Similarities in management tools (e.g. education, early intervention etc.) provided the foundations of support for integration. Two submissions noted the collaborative relationships between various pest and weed species and the opportunity these relationships create for management options.

- However, there was concern for the loss of specialised expertise if the tasks of controlling pests and weeds were integrated. Additionally, the Shoalhaven City Council noted the possibility of creating confusion among landowners at the local level or the possibility of regional loss of attention on important issues if pest animal and weed management were integrated. One submission opposed integration.
- Bushfire and weed management techniques were also suggested as significant lessons for pest management and were suggested as best practice methods.

Emerging issues

- Emerging issues were not discussed widely in the submissions. Specific emerging issues raised included the increasing number of hobby farms and their contribution to fragmented land management, climate change and globalisation, the emergence of feral cattle as a pest, the issue of exotic pests and the lack of restrictions on these animals, the identification of risks and opportunities, the new fox and wild dog poison (PAPP), the use of mechanical bait ejectors and new bio controls.

Urbanisation

- Urban expansion and peri-urbanisation were repeatedly raised as problems. These issues complicate pest management through further land fragmentation and varying individual motives. Peri-urbanisation presents a problem as *“competing demands for asset protection, bushland management, and pest and weed incursions... reduce the community’s capacity to manage pests”* (Shoalhaven City Council). One submission noted the increased amount of domestic pets which have the potential to increase pest problems.

Animal Welfare

- Animal welfare was raised in a number of submissions as an emerging issue particularly in reference to its negative public perception.

Rewilding

- Two submissions mentioned rewilding as an emerging management technique whereby the resilience of an ecosystem is strengthened by the reintroduction of native apex predators with the potential to suppress invasive species. However, it was noted that rewilding is understood to have varying levels of success and is context dependent.

Commercialisation of pest products

- The potential for commercialisation of pest products was strongly supported provided the subsequent impact of commercialised species does not burden those who do not benefit from their commercialisation. The St George Hunters and Anglers Club and the Sporting Shooters Association of Australia respectively stated *“given suitable conditions, it is also possible that some feral animals can be treated as a commercial resource and this could provide win-win solutions for governments and hunters alike”* and *“since deer are appreciated for their aesthetics, and are a valuable hunting resource, it is unlikely that they will ever be eradicated, but rather controlled within an acceptable population density. Deer and other non-indigenous hunting support industry and generate economic activity in regional areas”*.
- However, two submissions recommended caution when commercialising pest products as there is potential for commercialisation to jeopardise the maintenance of pest animal numbers for economic gain. One submission opposed commercialisation entirely.

Bounties

- The use of bounties was mentioned in many submissions, generally those from recreational hunting stakeholders.

- Various viewpoints were presented with the overwhelming majority of these submissions highlighting positive aspects of bounties as an incentive for hunters to aid in the control of pest species.
- Victoria's \$10 bounty for foxes was presented as an example of the benefits of bounties in pest control. The St George Hunter and Anglers Association stated that bounties were a method for government to acknowledge the efforts of hunters in pest management. However they note that this bounty system needs adjustment and could be more effective if reviewed.
- A number of submissions recommended against the use of bounties as a management technique, stating they are an ineffective means of control. One recreational hunter suggested that bounties were not necessary and greater access to hunting areas would be more beneficial.

Technology

- The use of technology, particularly remote sensor cameras, was mentioned in four submissions as an effective method for monitoring and recording the presence of pest animals including determining effective methods of control and where methodological improvements can be made.
- The use of drones was generally supported throughout submissions while highlighting the fundamental need to respect the privacy of landholders by building trust between landholders and drone operators.
- A number of submissions noted the importance of rapidly disseminating information on the availability of new technologies to ensure they can be absorbed by the community and utilised in effective pest control.

Pest management industry

- One submission suggested the development of a pest management industry to reduce the burden on government or increase efficiency where possible.
- Standardised 'Regional Pest Animal Committees' should be considered as a management tool as they would provide a framework for landscape based programs, give support to existing programs and help in establishing new programs.

Adequate resourcing

- The overwhelming majority of submissions mentioned the need for increased funding or more efficient use of funding.
- The issues that were raised in relation to funding mention:
 - the general lack of funding
 - the wastage of funding due to fragmented planning
 - the issue of ad hoc funding
 - the ineffectiveness of short term funding in achieving long term suppression of pest populations
 - the 'disparity' in funding between terrestrial and aquatic pests with aquatic environments being "*severely underfunded in comparison*"
 - the ineffective use of funding at the wrong times "*just to tick the correct process boxes*"
 - the need for transparency
 - the need for funding to account for the 'full impacts' of pest damage including stress factors on landholders
 - the barrier to success induced by three year funding cycles, particularly in relation to ongoing data collection and management.

- Specific suggestions for future funding noted that funding should:
 - not be spent entirely on research as there is the potential for it to be wasted on bureaucracy and administration with nothing being achieved on-ground
 - be carried over between financial years to allow for long term management strategies and results; and
 - be invested in research to ensure the reliability and currency of data.

Levies

- Approximately one third of submissions that mentioned funding also mentioned increasing or exploring levies as an effective source of funding for pest management.
- Those submissions expressing support noted the possibility of sourcing levies from mining corporations, water storage bodies, hydro power generators, hunters, anglers, fishers, irrigators, commercial freshwater users and industrial water users to support pest management. The Sporting Shooters Association of Australia mentioned that a large percentage of its members were *“willing to pay a levy on all hunting merchandise purchased in Australia if it were to support conservation programs”*.
- A number of submissions emphasised the need for the recognition of existing private landholder contributions to pest management with the Pastoralist Association of West Darling noting that *“it would be grossly unfair to simply fund pest management through increased Local Land Services rates on private landholders”*.
- Specific levy recommendations were made by various submissions including:
 - creating a new pest levy in lieu of the ‘pest insect levy’ as it would be more relevant across regional and temporal scales
 - broadening the Local Land Services rating base from 10 hectares to 2 hectares in order to *“significantly improve the true ‘shared responsibility’ aspect of pest animal management”*. This is particularly applicable as currently *“only private landholders over 10 hectares (20 hectares in some Southern areas and 40 hectares in the Western Division) are rated through Local Land Services, creating a bigger burden on those landholders who are already shouldering a lot of the cost”* (NSW Farmers).

Education

- The need for improved education across the public and private sector and across all stakeholder groups was advocated as important.

Knowledge building

Knowledge Building

- Submissions that addressed the issue of knowledge building noted the need for increased knowledge and stressed the wide sharing of information.
- A number of submissions mentioned that knowledge building and sharing should not be restricted to facilitators and advisors of pest animal management. Stakeholders from all avenues should be involved, particularly considering knowledge building in the community underpins participation and leads to success. Three submissions noted the importance of educating the younger generation of landholders.
- Several submissions highlighted the significance of long term knowledge developed over years of experience on the land and in associated industries. It was noted that long term job security for staff and long term local and historical knowledge is invaluable to pest animal management. Additionally, the NSW Aboriginal Land Council stated *“unique knowledge and skills of Aboriginal people in regards to land management needs to be better recognised and valued by*

Government Departments and staff coordinating pest management strategies [as there is] potential for mutually beneficial two-way transfer of knowledge”.

- Submissions acknowledged the importance of resources such as PestSmart in providing accurate, up to date and easily accessible information to landholders. It was noted that they are valuable for preventing pest management operations being influenced by personal opinion or historical practices. Landcare also notes that consistent messaging across multiple sources is important

Training

- A very limited number of submissions raised the need for training. Those that that did were supportive of establishing more training programs, increasing the frequency of training, improving current training and education involving community and landholders in developing and executing training, and providing free training for landholders and reducing the length of training courses.
- It was also noted that there is a need for *“robust research to provide an evidence-base on which to develop engagement strategies to support more effective pest species control”* (Fauna Research Alliance).

Research and Development

- Increasing research was frequently mentioned.
- The need for ongoing funding to establish and maintain a centralised data management system was highlighted in two submissions on the basis that having a centralised and standardised system improves capacity for the application of adaptive management.
- Various submissions presented specific research aims including:
 - research into the impacts and threats of pest fish and *“what levels of control are required to demonstrate a reduction of pest fish impact”* (Fisheries Scientific Committee)
 - developing research partnerships
 - research into new methods of deer control as they are lacking a *“diverse toolkit of control methods”* unlike other pest species
 - research and evidence on the implementation of hunting in national parks and the potential benefits specifically in relation to how it aligns to the *“Guiding Principles of Pest Management within NSW particularly in providing triple bottom line outcomes”* (Australian Deer Association)
 - social research into *“the behaviours of those who deliberately or unwittingly spread pests, to guide policy responses”* (Invasive Species Council)
 - research into rewilding as a control for pest species
 - research into humane methods of killing.
- Additionally, three submissions highlighted the need for more rapidly available data and research results to ensure management practices do not lag behind possibly updated best practice methods.
- It was also noted that there is a need for *“robust research to provide an evidence-base on which to develop engagement strategies to support more effective pest species control”* (Fauna Research Alliance).

Barriers

- Specific barriers noted include:
 - landholders being oblivious or ignoring the issue of pest management and its relevance across all stakeholder groups
 - barriers being diverse as the issue is not consistent across time or space

- a lack of funding and finances preventing implementation of successful and best practice pest management
- accountability and reporting acting as a barrier to success.

Other issues

Communication

- Communication was frequently noted throughout submissions as being extremely important in forming the basis for successful pest management outcomes.

Aboriginal Cultural heritage

- The issue of pest control was highlighted as important in terms of its impacts on Aboriginal culture and culturally significant sites in a number of submissions.
- The NSW Aboriginal Land Council advocated that “*some Local Aboriginal Land Councils (LALCs) should be exempt from pest control requirements because of long term strategic plans being negotiated which take into account the limited capacity of LALCs*”. It was noted that large amounts of pressure are applied to Local Area Land Councils when land ownership is transferred and previous pest management was scarce or non-existent leaving heavy pest burdens. In these cases, the NSW Aboriginal Land Council outlined that financial assistance and incentives must be provided.

Pets and Pests

- A number of submissions raised the issue of pets and their impacts on pest management, particularly in peri-urban areas. The majority of these submissions highlighted cats and rabbits that destroy native flora and fauna.
- Pets were also mentioned in relation to owners not taking responsibility for containing their animals in regions of ecological sensitivity or at night, leading to death of native species or destruction of native habitats. These submissions suggested particular methods for minimising these impacts:
 - education and training regarding the potential threats that domestic animals pose to native species
 - mandatory cat confinement laws; and
 - de-sexing and microchipping to prevent issues of pets straying or becoming feral and to control breeding with undomesticated animals.
- Four submissions expressed concern about the release of viruses to control feral populations without an available vaccination. The release of the Koi Herpes Virus (KHV), Myxomatosis and possible new strains of the Rabbit Haemorrhagic Disease Virus (RHV) – formerly Calici virus - were noted.
- The possibility for species to build immunities and disease resistant populations as a result of the inoculation of domesticated pet species was also a concern noted in one submission.

Increasing penalties for criminal behaviour / non compliance

- A number of submissions advocated the need for more stringent measures to be taken in relation to pest animal related crimes. Issues such as illegal hunting on properties, theft on properties by hunters, releasing pest species to boost numbers for recreational activities and damaging monitoring devices, were mentioned throughout submissions as increasing the severity of pest animal issues though suffering no appropriate consequences.
- The issue of non-compliance was also mentioned in relation to the difficulty and time consuming nature of enforcing legislation.

Chemical Baiting

- There were mixed opinions regarding the use of chemical baits.
- Several submissions cited reasons for opposition to the use of chemical baits with the majority of these submissions coming from recreational hunters. Concerns for animal welfare and inhumane methods of management, the lack of information and education regarding their use, their impacts on non-target species, their effects in areas of cultural significance – particularly in relation to bush tucker, their potential to bio-accumulate and the flow-on impacts in terms of water and human health were specifically mentioned.
- However a number of submissions across all stakeholder groups including recreational hunters noted the importance of chemical baits and argued their necessity in the control of pest animals.

Attachment 3: Supplementary information: Regulatory Framework

NSW Regulatory Arrangements

Biosecurity Act 2015

With the introduction of the NSW *Biosecurity Act 2015*, the NSW Government has sought to streamline the regulatory framework by consolidating the legislative requirements for pest management under one Act. The *Biosecurity Act 2015* consolidates provisions from 14 existing Acts, either wholly or in part.

The broad objectives of the *Biosecurity Act 2015* are to manage biosecurity risks from animal and plant pests and diseases, weeds and contaminants by:

- preventing their entry into NSW
- quickly finding, containing and eradicating any new entries, and
- effectively minimising the impacts of those pests, diseases, weeds and contaminants that cannot be eradicated through robust management arrangements (*Biosecurity Act 2015* Factsheet, DPI 2015).

The principle of shared responsibility is embedded in the *Biosecurity Act 2015* through a number of biosecurity duties – a general biosecurity duty; duties relating to prohibited matter; and a duty to notify biosecurity events.

The inclusion of the general biosecurity duty is a fundamental shift in the legislative framework. Rather than imposing prescriptive regulatory requirements, this duty approach seeks to provide flexibility by enabling individuals to take reasonable steps to manage biosecurity risks. The general biosecurity duty only applies to people who:

- deal with biosecurity matter¹ or a carrier², and
- have knowledge of the biosecurity risk posed.

For example, if a landholder is aware of a declared pest animal species living on their property (such as pigs, dogs or foxes) and chooses not to manage or control it, they will be contravening the *Biosecurity Act 2015*.

Consistent with the principle of shared responsibility, the *Biosecurity Act 2015* adopts a cross-tenure approach. It does not differentiate between public and private landholder obligations, with legislative requirements applying equally regardless of land ownership.

Tools provided through the Biosecurity Act apply to manage pests

In addition to the general biosecurity duty, the *Biosecurity Act 2015* includes a range of tools for the management of biosecurity threats and risks, including emerging and widespread pests. Further explanation of these tools is provided in Table A3.1.

¹ biosecurity matter: as defined under section 10 of the *Biosecurity Act 2015*

² biosecurity carrier: means any thing (whether alive, dead or inanimate, and including a human) that has, or is capable of having, any biosecurity matter on it, attached to it or contained in it (as per section 11 of the *Biosecurity Act 2015*)

Table A3.1 Explanation of the primary management tools relevant to pest management

Name of tool	Explanation
Prevention / incursion control of new pests	
Prohibited matter	Species listed in Schedule 2 of the Biosecurity Act have been identified as posing a high risk, meaning there would be severe consequences to the economy, environment or community if these species were present (examples of aquatic pests include tilapia). No terrestrial vertebrate pest animals are currently listed.
Emergency powers/orders	Enable swift action to be taken to respond to significant biosecurity risks to the economy, environment and community.
Registration	Applies to non-indigenous animals as per the requirements of the <i>Non-Indigenous Animals Act 1987</i> , which have been incorporated into the Biosecurity Act (e.g. for zoo animals).
Permits	Permits are issued to authorise and manage transport, movement, releasing, keeping in captivity or selling of exotic animals that pose a risk to the environment, agriculture, or public safety (e.g. for zoo animals). The keeping of exotic animals is currently regulated under the <i>Non-Indigenous Animals Act 1987</i> .
Certification and Auditing	Applies to industry certification schemes for tracking animal movement. Auditing can be undertaken as a condition of accreditation and registration under the Biosecurity Act.
Established pests	
Control orders (in Biosecurity Management)	Made by the Minister, a control order establishes one or more zones to prevent, eliminate, minimise or otherwise manage a biosecurity risk or impact (noting that a biosecurity impact includes <i>the introduction, presence, spread or increase of a pest into or within the State or any part of the State</i>). A control order can remain in place for up to five years. [This replaces the pest control orders currently under the <i>Local Land Services Act 2013</i>].
Biosecurity directions (in Biosecurity Management)	Given by an authorised officer, can be a general (broad) or individual direction and has legal force. A general biosecurity direction applies to the public generally or to a specified class of persons. A direction specifies the action required to prevent, eliminate or minimise a particular biosecurity risk or to enforce requirements of the Biosecurity Act. Non-compliance with a direction can lead to prosecution and hefty penalties.
Regulation (in Biosecurity Management)	Regulations can be made that prescribe mandatory measures. Mandatory measures detail what actions must be carried out for a person to meet his or her general biosecurity duties under the Biosecurity Act.

Department of Primary Industries proposed management of pest animals under the *Biosecurity Act 2015*

The Department of Primary Industries is currently developing the regulations, instruments, policies and procedures that will underpin the *Biosecurity Act 2015*, and has recently released consultation papers outlining the proposed approach to pest management.

In terms of introduced animals that are currently declared as pests, the Department is proposing to manage them in differing ways:

- relying on the general biosecurity duty under the *Biosecurity Act 2015* for wild dog management, landholders will be encouraged to implement wild dog management plans
- in addition to the general biosecurity duty, mandating measures in a regulation that prohibit the keeping in captivity of wild rabbits, feral pigs, camels and European red foxes on any land except under the authority of a permit.
- repealing the provisions³ under the *NSW Fisheries Management Act 1994* and relying on the general biosecurity duty and mandatory measures prescribed in the *Biosecurity Act 2015* regulations in regard to aquatic pests.

Game and Feral Animals Act 2002

The *Game and Feral Animal Act 2002* regulates licensing and hunting of game animals on public land and private land. Schedule 3 of the *Game and Feral Animal Control Act 2002* lists the game animals that can be legally hunted in NSW. The animals are divided into two categories and different rules apply to hunting the animals in each category. There are also different requirements for public and private land.

Public Land

A NSW Restricted Game Hunting licence is required to hunt the following animals on public land:

- Deer (Fallow, Red deer, Rusa, Sambar, Chital, Hog deer, Wapiti)
- Birds (Bobwhite Quail, California Quail, Guinea Fowl, Partridge, Peafowl, Pheasant, Spotted Dove, Turkey)
- Non-indigenous animals (cat, dog (other than dingo), goat, fox, hare, rabbit, pig, common Starling, common or Indian Myna, feral pigeon)

Private Land

A NSW Restricted Game Hunting licence or General Game Hunting Licence is required to hunt the following animals on private land:

- Deer (Fallow, Red deer, Rusa, Sambar, Chital, Hog deer, Wapiti)
- Birds (Guinea Fowl, Partridge, Peafowl, Pheasant, Spotted Dove, Turkey)
- Ducks (Australian Shelduck or Mountain Duck, Australian Wood Duck or Maned Duck, Black Duck or Pacific Black Duck, Blue-winged Shoveler or Australasian Shoveler, Chestnut Teal, Grass Whistling Duck or Plumed Whistling Duck, Grey Teal, Hardhead Duck or White-eyed Duck, Pink-eared Duck, Water Whistling Duck, Wandering Whistling Duck or Whistling or Wandering Tree Duck)
- Quails (Brown Quail, Stubble Quail, Bobwhite Quail, California Quail)
- Pigeons (Common Bronzewing Pigeon, Crested Pigeon)

The duck, quail and pigeon species listed above may only be hunted under the Native Game Bird Management Program. To participate in the program, hunters must have successfully completed the Waterfowl Identification Test. Unlike public lands, a game hunting licence is not required to hunt non-indigenous animals (as listed for public land above) on private land.

³ Under the *Biosecurity Act 2015*; Part 6 Division 4, Part 7 Division 6, Schedules 6B and 6C of the *Fisheries Management Act 1994* will be repealed.

Fisheries Management Act 1994

Currently, the *Fisheries Management Act 1994* is the primary piece of legislation for managing aquatic biosecurity in NSW. It provides a number of controls to help the NSW Department of Primary Industries (mainly Fisheries NSW) manage aquatic pests and diseases, including:

- managing noxious species – a number of species have been declared as noxious fish in NSW. Although some of these species can still legally be kept in NSW (with a permit)
- importation of live fish – restricts importation of certain live species into NSW without a permit. These are species which have been identified as potentially posing a significant threat to native wildlife, ecosystems, human health or the State's aquaculture industries
- fishing closures - fishing closures help protect fish stocks or vulnerable habitats. Fishing closures can also be used to help limit the spread of pests, weeds and diseases.

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