ACT Government

Environment and Sustainable Development

ACT Pest Animal Management Strategy

2012-2022

ACT Pest Animal Management Strategy

2012-2022

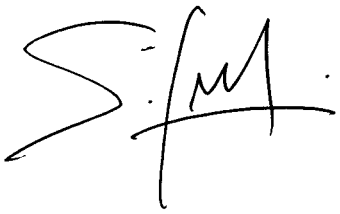
Foreword

The social, environmental and economic damage caused by pest animals in the ACT requires ongoing management and the provision of significant financial and human resources by the ACT and Australian Governments, rural landholders and community groups across conservation, rural and urban land uses. This strategy builds on the principles and strategic approach adopted in the ACT Vertebrate Pest Management Strategy 2002 to promote beneficial, cost-effective and enduring outcomes from pest animal management programs.

Cooperation and coordination between land managers and other stakeholders across land tenures and jurisdictional boundaries is the key to achieving desired outcomes from pest animal management programs. Coordinated management programs will be facilitated over the next decade through the establishment of a Pest Animal Management Group and a five year management plan that complements the activities of the Weeds Advisory Group and Weeds Working Group (ACT Weeds Strategy 2009-2019).

The ACT Government wishes to acknowledge the invaluable support received from rural and community groups in the coordinated wild dog, fox and rabbit management programs. We look forward to working with you over the next decade to manage ongoing and emerging pest animal issues.

Katy Gallagher MLA
Minister for Territory and Municipal Services



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The principles and strategic approach for pest animal management presented in this strategy were derived from key publications by Braysher and Olsen and the ACT Vertebrate Pest Management Strategy 2002.

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Abbreviations

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ACT	Australian Capital Territory
ACT PCS	ACT Parks and Conservation Service
Animal Welfare Act	*Animal Welfare Act 1992* (ACT)
ANU	Australian National University
APAS	Australian Pest Animal Strategy 2007
AQIS	Australian Quarantine and Inspection Service
ATCW	Authority to Control Wildlife
AusBIOSEC	Australian Biosecurity System for Primary Production and the Environment
BoM	Bureau of Meteorology
CIMAG	Canberra Indian Myna Action Group
COAG	Council of Australian Governments
COG	Canberra Ornithologists Group
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Cwlth	Commonwealth
DAFF	Department of Agriculture, Fisheries and Forestry
DAFWA	Department of Agriculture and Food Western Australia
DEC	NSW Department of Environment and Conservation (now Office of Environment & Heritage)
DECC	NSW Department of Environment and Climate Change (now Office of Environment & Heritage)
DECCEW	ACT Department of the Environment, Climate Change, Energy and Water (now Environment & Sustainable Development Directorate)
DI	Disallowable instrument (ACT Government legislation)
DPI	Department of Primary Industries
DSE	Victorian Department of Sustainability and Environment
DSEWPac	Department of Sustainability, Environment, Water, Populations and Communities
EADRA	Emergency Animal Disease Response Agreement
EGK	Eastern grey kangaroo
EPPRD	Emergency Plant Pest Response Deed
ESDD	Environment & Sustainable Development Directorate
IACRC	Invasive Animals Cooperative Research Centre
IAE	Institute for Applied Ecology (University of Canberra)
IGAB	Intergovernmental Agreement on Biosecurity
ISSG	Invasive Species Specialist Group
LMU	Land management unit
MoU	Memorandum of Understanding
NAMP	Native Animal Management Plan (proposed for ACT; equivalent to PAMP)
NC Act	*Nature Conservation Act 1980* (ACT)
NEBRA	National Environmental Biosecurity Response Agreement
NLWRA	National Land & Water Resources Audit

NNP	Namadgi National Park
NRM	Natural resource management
NRMMC	NRM Ministerial Council
NRMSC	NRM Standing Committee
NSW	New South Wales
NSW ISP	NSW Invasive Species Plan
OFMIG	Ornamental Fish Management Implementation Group
PAMG	Pest Animal Management Group (proposed for ACT)
PAMP	Pest Animal Management Plan
PAMS	ACT Pest Animal Management Strategy 2012-2022
Pest P&A Act	*Pest Plants and Animals Act 2005* (ACT)
QDPI&F	Queensland Department of Primary Industries & Fisheries
RHD	Rabbit Haemorrhagic Disease
RSPCA	Royal Society for the Prevention of Cruelty to Animals
SoE	State of Environment (report)
TAMSD	Territory and Municipal Services Directorate
Tidbinbilla	Tidbinbilla Nature Reserve
UC	University of Canberra
VPC	Vertebrate Pests Committee
VPMS	ACT Vertebrate Pest Management Strategy 2002

Part One

Policy and Strategic Directions

Strategic Goal

To set the framework and approach for managing the undesirable social, environmental and economic impacts of pest animals across conservation, rural and urban lands in the ACT.

Purpose of the strategy

The ACT Pest Animal Management Strategy 2012-2022 has been developed to support all stakeholders with responsibility for, or interest in, managing pest animals in the ACT. Part 1 of the strategy focuses on the key principles, objectives and strategic actions for reducing the damage caused by pest animals and is consistent with the Australian Pest Animal Strategy 2007. The strategy builds on the ACT Vertebrate Pest Management Strategy 2002, but has been expanded in scope to cover invertebrate pest animals and pest animals in urban areas. The rationale for the strategy, key pest management issues for the ACT and implementation of the strategy are addressed fully in Part 2 of the strategy. Part 2 also provides a source of readily accessible information on pest animal management for ACT land managers and community groups.

The ACT is managed for a variety of land uses and the strategy has been developed so that the different pest management objectives of all land managers can be addressed. The strategy complies with pest animal, animal welfare and other relevant legislation, and complements regional and national pest animal policies and management initiatives.

What are pest animals and how are they managed?

Pest animals are exotic species that cause damage to valued social, environmental or economic resources. Pest animal damage typically includes loss of biodiversity, structure and function in conserved ecosystems, loss of crop and livestock production on rural land, and loss of public amenity and increased health and safety risks in urban areas.

The most cost-effective option for managing pest animals is to prevent their incursion into the ACT. New pest animals migrate naturally across the border from NSW, or are deliberately or accidentally imported via land or air transport routes. Incursions by new pest animals are prevented by supporting national biosecurity and quarantine initiatives, and by implementing effective regulatory, surveillance and response activities in the ACT. Where new pest animal incursions occur, effective surveillance and response activities facilitate early intervention, improving the likelihood of successful eradication or containment of the species.

Pest animals that have potential as invasive species or are already established in the ACT include mammals, birds, insects, fish, turtles and freshwater crustaceans. Because there are gaps in knowledge and understanding relating to the pest animals, the damage that they cause and the options for their management, a risk management approach is recommended for the development of management programs. Damage caused by pest animals, or their potential to cause damage, is assessed using damage and/or species abundance and distribution measures. Risk assessment is used to determine whether damage levels are unacceptable, and whether a management program for damage reduction is feasible and cost effective. The risk assessment process also assists land managers in the allocation of limited resources to the highest management priorities.

A major consideration in undertaking a pest animal management program is whether suitable management options are available for achieving damage reduction. The most common management options include exclusion barriers, biological control, habitat manipulation, culling and translocation of pest animals. Integrated pest management, in which several management options are applied strategically, is usually the most effective

means of reducing pest animal damage levels. Effective management options that avoid or minimise the pain, suffering and distress of pests and other non-target animals are used preferentially in accordance with animal welfare Codes of Practice.

Management programs for reducing pest animal damage should have clearly defined objectives and performance criteria. These are used, in combination with operational and performance monitoring, to evaluate the success of the management program and to allow for adaptive management of the pest animal problem.

Animals native to Australia are also capable of causing unacceptable damage to social, environmental or economic resources. The principles for reducing the damage caused by native animals are similar to those for managing pest animals except that native animals are a natural and integral part of Australian ecosystems and are managed for conservation as well as damage reduction purposes. To protect the viability of native animal populations, the ACT Government will investigate amending legislation so that native animals are managed for damage reduction exclusively under the *Nature Conservation Act 1980* and the *Animal Welfare ACT 1992*. Where a native animal causing damage is not indigenous to the ACT, the ACT Flora and Fauna Committee will be consulted on appropriate damage reduction and conservation management objectives.

Many pest and native animals that cause damage in the ACT have home or migratory ranges that extend across the ACT and into NSW. For these species, achieving desired damage reduction levels requires a coordinated management program supported by all of the affected stakeholders. Coordinated management programs are most successful where stakeholder awareness and understanding of the problem is high, and where there is strong public and political support for managing the species. Success of coordinated management programs is also high where land managers cooperate and communicate effectively, are intimately involved in the development of the program, and have clearly defined roles and responsibilities throughout its implementation. Engaging the interest of community groups in resolving pest or native animal management problems can provide valuable support in achieving coordinated management program objectives.

The ACT Government promotes community awareness and understanding of pest and native animal management issues through web-based information, media releases, brochures, signs and regulatory activities. The ACT Government also facilitates stakeholder communication and cooperation through leadership of, and participation in, stakeholder meetings and coordinated management programs. However, the knowledge, skills and management options that underpin pest and native animal management programs need to be maintained through effective education, training and research programs. The ACT has high-quality tertiary education courses in pest and native animal management, with active collaboration amongst local and regional research groups to resolve knowledge gaps and management problems. Training courses in pest management options, including chemical application and risk management, need to be made locally available to ACT operational staff and contractors on a regular basis.

Review of the strategy

National frameworks and approaches for managing pest and native animals are periodically reviewed and updated to reflect new knowledge and understanding of management issues. It is recommended that this strategy be fully reviewed ten years after its release to incorporate changes to national frameworks and approaches, and to changes in the pest and native animal management objectives of ACT stakeholders.

Key elements of the strategy

A. The strategy has 10 key principles for managing pest and native animals for damage reduction, in summary:

1. pest animals are exotic species that cause unacceptable social, environmental or economic damage;
2. it is essential to seek and understand the attitudes and concerns of the key individuals and groups that have a significant interest in the pest animals;
3. prevention and early intervention are the most cost-effective management techniques;
4. management programs should strategically target actual (rather than perceived) pest problems;
5. pest animal damage should be managed using a whole-of-system approach;
6. management priorities and resources require a risk management approach;
7. accurate monitoring and evaluation of management programs is required;
8. coordination among all levels of government in partnership with industry, land and water managers and the community is required;
9. native animals may require management for damage reduction but management programs should take into account the value and vulnerability of affected assets and the expected benefits from intervention, with reference to the overall conservation status of the species in the ACT; and
10. effective management requires capacity building across all stakeholder groups.

See the following box for a full version of the key principles.

B. The strategy has four key objectives.

1. Prevent the incursion of new pest animal species, detect and eradicate or contain new incursions.
2. Reduce damage caused by established pest animal species.
3. Manage native animals appropriately to achieve damage reduction and conservation.
4. Increase awareness, understanding, coordination and capacity building.

The following table lists, for each of the strategy's objectives, the strategic actions required for damage reduction, the key stakeholders responsible for their delivery, and the performance indicators and review dates against which the success of their implementation will be assessed.

Key principles for managing pest and native animal damage (Braysher 1993, Olsen 1998, Braysher and Saunders 2003)

1. **Pest animals are exotic species that cause unacceptable social, environmental or economic damage** to a valued resource. Hence humans determine whether an animal is a pest or not. The pest status of an animal can vary over space and time according to the degree of damage caused and the attitude towards the animal of those affected by the damage.
2. When developing programs to manage the damage due to pests, it is essential to **seek and understand the attitudes, concerns and capacity of the various key individuals and groups that have a significant interest in the pest animals**, their adverse impacts and the actions undertaken to manage them. These attitudes and concerns need to be fully understood and valued, and considered in the design and implementation of the management program. This includes engendering appropriate ownership of the program by key individuals and groups.
3. **Prevention and early intervention are the most cost-effective techniques** for managing pest animal incursions because, once established, only rarely can pest animals be eradicated. Ongoing management is the usual approach to managing the damage due to established pests.
4. **Management programs should strategically target actual (rather than perceived) pest problems** at appropriate locations and times, using scientifically valid techniques that optimise animal welfare in accordance with agreed Codes of Practice.
5. Pest animals are only one of several factors that can cause damage to a human or biological system. Other factors include weeds, varying climatic conditions, fire, and land management or production activities. Hence **pest animal damage should be managed using a whole-of-system approach** to achieve the most beneficial social, environmental or economic outcomes, namely, to reduce the damage that pests cause to an acceptable level, not merely to reduce pest numbers.
6. Most biological systems, whether they are managed for production, conservation, urban amenity or a combination of these goals, are complex and our knowledge of them is imperfect. There is a risk that interventions to manage the damage due to pests may not have the desired outcome. Pest animals may adapt their behaviour as a result of intervention measures or respond unexpectedly to factors such as climate change. **Priorities and resources for pest animal management** therefore **require a risk management approach** to identify, assess and address often imprecise threats within acceptable risk levels.
7. **Accurate monitoring and evaluation is required** before, during and after the implementation of pest management programs to ensure that the benefits obtained exceed the risks and costs of management activities. Continuous improvement should be achieved by implementing an adaptive management approach..
8. Effective management of pest animal damage requires **coordination among all levels of government in partnership with industry, land and water managers and the community**, regardless of land tenure. Active engagement and consultation with key stakeholders is required to promote a clear understanding of roles and responsibilities among government, industry and/or community partners.
9. **Native animals** are a natural and integral part of urban, rural and conserved ecosystems but **may require management for damage reduction** where adverse impacts on social, environmental or economic assets are unacceptable. Management programs for damage reduction should **take into account the value and vulnerability of affected assets and the expected benefits from intervention**. Desired outcomes from native animal management programs may vary according to land use, but should always be developed **with reference to the overall conservation status of the species in the ACT**. Consideration should be given to managing and regulating native animals under nature conservation and animal welfare legislation.
10. **Effective management requires capacity building across all stakeholder groups** to provide the education and training necessary to address pest and native animal problems and to increase awareness and understanding in the broader community.

Table of objectives and strategic actions, and measures for their implementation.

Objective	1. Prevent the incursion of new pest animal species, detect and eradicate or contain new invasions.
Strategic action	1.1 Identify potential invasive animal species. 1.2 Review available risk assessments for high-risk species and identify potential damage, likely sources and incursion pathways, potential barriers to incursion, and key ACT stakeholders. 1.3 Develop and implement effective identification, surveillance, response and reporting strategies in accordance with national approaches. 1.4 Monitor invasion sources and pathways to ensure early detection of incursions. 1.5 Eradicate or contain invasions (including 'sleeper' populations) based on risk assessment and cost benefit analyses.
Responsibility for action	1.1 Pest Animal Management Group (PAMG), the Territory and Municipal Services Directorate (TAMSD) Biosecurity Manager and the ACT representative on the Vertebrate Pests Committee (VPC). 1.2 PAMG and the TAMSD Biosecurity Manager. 1.3 TAMSD Biosecurity Manager, TAMSD Licensing and Compliance Unit and the PAMG. 1.4 TAMSD Licensing and Compliance, ACT Parks and Conservation Service (ACT PCS), ACT land managers and community members (coordinated through PAMG where necessary). 1.5 ACT PCS, TAMSD Biosecurity Manager and affected ACT stakeholders (coordinated through PAMG where necessary).
Performance indicators	1.1 Species most likely to invade the ACT identified through review of the National Categorisation System for Invasive Species, Australian Quarantine and Inspection Service pre-border and border seizure data, and jurisdictional post-border incursion reports to the VPC. 1.2 Risk assessments for high-risk species collated. Prohibited and notifiable species updated in the ACT Pest Plants and Animals (Pest Animals) Declaration 2005 (No 1) (DI2005-255). Link provided on TAMSD website to NSW invasive species database (NSW Invasive Species Plan 2008-2015 Objective 1.2) on its completion. 1.3 ACT identification, surveillance, response and reporting strategies developed in accordance with the Intergovernmental Agreement on Biosecurity (IGAB), its Emergency Animal Disease Response Agreement (EADRA), Emergency Plant Pest Response Deed (EPPRD) and National Environmental Biosecurity Response Agreement (NEBRA) schedules, and the National Categorisation System for Invasive Species. Animal licensing and enforcement activities carried out in compliance with the *Nature Conservation Act 1980* (NC Act) and the *Fisheries Act 2000*. Key stakeholders (pet owners and retailers, zoos and aquaria, research institutions) and the ACT community educated about potential pest animals and stakeholder responsibilities. 1.4 TAMSD websites (Licensing and Compliance and ACT PCS) and Canberra Connect provide clear instructions for reporting invasive species incursions and for accessing help with species identification. New incursions, particularly declared notifiable and prohibited species, detected and reported promptly. 1.5 Provisions under national IGAB schedules (EADRA, EPPRD and NEBRA) are complied with. Minimum management actions specified under the National Categorisation System for Invasive Species are undertaken. If no IGAB agreements or minimum management actions are specified, an ACT-specific risk assessment and cost benefit analysis is undertaken and, where appropriate, an eradication or containment program is developed and implemented.
Review date	1.1 Review annually in conjunction with the VPC meeting at which jurisdictional post-border incursion reports are tabled. 1.2 Review high-risk species annually in conjunction with Strategic Action 1.1. Update prohibited and notifiable species in DI2055-255 every five years or in response to an incursion. 1.3 ACT strategies developed in accordance with national biosecurity arrangements. 1.4 TAMSD Licensing and Compliance, ACT PCS and other ACT stakeholders report annually to PAMG on seizures and incursions. ACT representative subsequently reports to VPC (see Strategic Action 1.1). 1.5 Incursions eradicated or contained in accordance with IGAB schedules and minimum management actions, or with an agreed timeline specified in an ACT-specific eradication or containment program.

Table of objectives and strategic actions, and measures for their implementation (continued).

Objective	2. Reduce damage caused by established pest animal species.
Strategic action	2.1 Identify established pest animal species in the ACT. 2.2 Assess damage against management objectives. 2.3 Assign priority to high-impact pest animal species and high-value sites/assets using a risk management approach, and implement priority management programs with appropriate operational and performance monitoring and assessment. 2.4 Develop Pest Animal Management Plans (PAMPs) to specify management methods and stakeholder responsibilities, and to provide the statutory basis for compliance and enforcement.
Responsibility for action	2.1 ACT PCS and PAMG. 2.2 ACT PCS and other ACT land managers (coordinated through PAMG where necessary). 2.3 ACT PCS and other ACT land managers (coordinated through PAMG where necessary). 2.4 ACT PCS and the Environment and Sustainable Development Directorate (ESDD).
Performance indicators	2.1 Established Pest Animals of National Significance and established pests listed in the ACT Pest Plants and Animals (Pest Animals) Declaration 2005 (No 1) (DI2005-255) reviewed and updated. 2.2 Damage and/or abundance and/or distribution of pest animal species causing damage, assessed according to published/accepted methods where available (eg, the NSW Government Monitoring Techniques for Vertebrate Pests series). Management priorities identified. 2.3 Risk assessments completed in accordance with the ACT Pest Animal Management Strategy 2012-2022 (PAMS). Resources allocated preferentially to high-risk species and high-value assets. Cost-sharing arrangements for ACT and regional coordinated pest management programs negotiated. Additional resources sought for priority species and assets where necessary. Follow–up cost benefit analysis of management activities undertaken. 2.4 PAMPs for individual species assigned priority and then produced sequentially. PAMPs consistent with the IGAB, National Categorisation System for Invasive Species minimum management actions, national and ACT Codes of Practice, and the *Pest Plants and Animals Act 2005* (Pest P&A Act), *Animal Welfare Act 1992* (Animal Welfare Act) and other relevant legislation.
Review date	2.1 DI2005-255 and Appendix 1 of the PAMS updated for established pest animals every five years (in conjunction with Strategic Actions 1.1, 1.2 and 4.6). 2.2 ACT PCS damage assessments reported in the ACT Vertebrate Pest Management (and other relevant) Annual Report(s). Damage assessments conducted for other coordinated management programs reported to the PAMG according to agreed timelines. 2.3 ACT PCS risk assessments and resource allocation reported in the ACT Vertebrate Pest (and other relevant) Annual Report(s). ACT and regional coordinated pest management programs reported as specified in program agreements. 2.4 PAMPs produced according to ACT Government budgetary processes and agreed timeframes. PAMPs reviewed every five years to incorporate changes to legislation, policy and/or preferred management options.

Table of objectives and strategic actions, and measures for their implementation (continued).

Objective	3. Manage native animals appropriately to achieve damage reduction and conservation
Strategic action	3.1 Investigate amending legislation so that management of native animals for all purposes is specified exclusively under the NC Act and the Animal Welfare Act. 3.2 Determine overall population viability thresholds for high-impact native animal species requiring management for damage reduction in the ACT. 3.3 Support research and development of humane management options for high-impact native animal species requiring management for damage reduction.
Responsibility for action	3.1 ESDD and ACT PCS, TAMSD 3.2 ESDD and ACT PCS, TAMSD and external research collaborators. 3.3 ESDD and ACT PCS, TAMSD, external research collaborators and the ACT Animal Welfare Advisory Committee.
Performance indicators	3.1 All relevant ACT Government agencies and key stakeholders consulted on excluding management of native animals that cause damage from the Pest P&A Act. If supported, legislative amendments to the NC Act and other affected legislation agreed, and Native Animal Management Plans (NAMPS; equivalent to PAMPs – see Strategic Action 2.4) developed under the NC Act. 3.2 Population viability threshold research projects developed and completed. Viability thresholds incorporated into NAMPs and into conditions for licences to kill under the NC Act. 3.3 Research projects developed and completed. Feasible humane management options specified in NAMPS, conditions for licences to kill under the NC Act and Codes of Practice under the Animal Welfare Act.
Review date	3.1 Consultation between ACT Government agencies and key stakeholders completed by December 2012. Legislative amendments, if required, completed by December 2013. NAMPs, if required, developed subject to ACT Government budgetry processes and the timeframe agreed for each plan. NAMPs reviewed every five years to incorporate changes to legislation, policy and/or preferred management options. 3.2 Review according to agreed research project timelines. Amend NAMPs and licensing conditions as required. 3.3 Review according to agreed research project timelines. Amend NAMPS, licensing conditions and Codes of Practice as required.

Table of objectives and strategic actions, and measures for their implementation (continued).

Objective	4. Increase awareness, understanding, coordination and capacity building.
Strategic action	4.1 Establish an ongoing pest and native animal management group (the PAMG) for ACT stakeholder communication. 4.2 Engage in operational, regional management groups and forums to improve cross-border pest and native animal management, and engage in the VPC. 4.3 Maintain regular communication and pathways for information exchange between key stakeholders and the community. 4.4 Encourage education and training in pest and native animal management to promote awareness and address skills shortages through linkages with appropriate institutions. 4.5 Identify gaps in knowledge and initiate, or link with, relevant research projects. 4.6 Review the strategy after five years (brief review) and ten years (major review) to incorporate changes to legislation, policy and management frameworks, advances in pest and native animal management, and the impacts of climate change.
Responsibility for action	4.1 PAMG. 4.2 ACT PCS and ACT representative on the VPC. 4.3 PAMG. 4.4 ACT PCS, TAMSD, ESDD, relevant external educational institutions and other providers. 4.5 ACT PCS, TAMSD, ESDD and relevant external research institutions. 4.6 PAMG and ESDD.
Performance indicators	4.1 PAMG established, Terms of Reference agreed, stakeholder representation decided and filled. Five year management plan developed in accordance with the 2007 State of Environment report recommendation. 4.2 ACT PCS officers provide ACT representation on relevant operational, regional management groups and forums. ACT representative on the VPC appointed. 4.3 PAMG meetings and stakeholder and community forums held. ACT Vertebrate Pest (and other relevant) Annual Report(s) provided on TAMSD website. 4.4 Education and training opportunities provided by ACT PCS or through agreements with other institutions and providers. 4.5 Coordinated research projects developed and funded. Milestones achieved and reporting requirements met. Results published and communicated to relevant stakeholders. 4.6 Review completed and signed off by relevant Minister.
Review date	4.1 PAMG established by June 2012. Five year management plan developed by December 2012. 4.2 Attendance as scheduled by regional management groups and forums, and the VPC. 4.3 PAMG members report annually on stakeholder meetings and forums. 4.4 Education and training opportunities audited annually by PAMG and updated in the PAMS every five years (in conjunction with Strategic Action 4.6). 4.5 Reporting and communication completed according to individual project agreements. 4.6 PAMS reviewed every five years against performance indicators and reported publically.

Rationale, Issues and Implementation

CHAPTER 1 INTRODUCTION

1.1 Purpose of the strategy

1.1.1 What is a pest animal?

In this strategy a pest animal is an exotic species that causes unacceptable social, environmental or economic damage to a valued resource. Pest animals include vertebrate species (eg, foxes, deer, carp and starlings) and invertebrate species (eg, the European wasp, an insect, and the red swamp crayfish, a freshwater crustacean). Pest animals that have established and persisted in Australia, or have the potential to become established, share common attributes. These attributes include a potential for rapid population increase and spread, the capacity to exploit favourable habitat changes, and few natural predators and diseases (Box 1).

An animal species may be viewed as a pest and/or a resource or neither, depending on circumstances that can change with time and location. For example, trout, an introduced fish, is considered to be both a significant threat to native fish and a valuable recreational resource. The value of a resource often differs with land use zoning and land management objectives which, in the ACT, include conservation, rural production, urban and suburban living and associated land uses (public amenities and services, light industry, government infrastructure and cultural heritage sites).

Animal species that are native to Australia may also require management for damage reduction because modification of their environment has led to population imbalances, altered distribution ranges and other behaviours that are incompatible with land management objectives. The principles for managing native animals that cause damage are similar to those for managing exotic pest animals (Part 1; Section 1.2.2) but management objectives must be determined with regard to the overall conservation status of the species and associated legislation in the ACT. Objectives that are specific to managing native animals that cause damage are considered in Chapter 5.

1.1.2 Strategic goal

To set the framework and approach for managing the undesirable social, environmental and economic impacts of pest animals across conservation, rural and urban lands in the ACT.

Pest animals can have significant harmful impacts on biodiversity, productivity and urban amenity and have been estimated to cause more than $1 billion damage per year in Australia (NLWRA and IACRC 2008). Pest animals can have direct effects as competitors and predators of other animals, harbour parasites and diseases, cause habitat degradation, damage crops, pastures and agricultural assets, and reduce the safety and aesthetic value of urban open spaces. However, pest animal damage is but one of several factors that influence land management practices and priorities. Management of pest animals needs to be integrated into a whole-of-system approach based on a balanced consideration of the social, environmental and economic implications of management actions.

Box 1: Attributes of pest animal species

Pest animals continue to thrive despite the best efforts of humans to eradicate them. Explanations can be found not only in the attitudes of people to pest animals, but also in pest animals' special characteristics. Certain aspects of their biology, combined with habitat changes that provide favourable conditions, and an absence or scarcity of predators and diseases that would normally limit numbers, have contributed to pest animal success in Australia. The following elaboration of the reasons behind the adaptability of pest animals is based on material in *Australia's Pest Animals: New Solutions to Old Problems* (Olsen 1998).

Population dynamics: high potential for increase

Many pest animals in Australia can rapidly increase their numbers when conditions are favourable. This helps them to recover quickly from high losses due to management programs, drought or other factors. For example, a pair of rabbits in a large open enclosure near Canberra increased to a population of 184 within 18 months without supplementary food or water (Williams *et al.* 1995). Both their reproductive rate and survival rate contributed to the potential for these pests to increase. Even pests with a relatively low rate of reproduction may increase their numbers rapidly if survival is unusually high, such as when management creates more favourable conditions for survivors. Pest management programs often are *ad hoc* and reactive, being conducted when pests are in high numbers and the damage they cause is obvious. However, especially for boom or bust species such as rabbits, a better strategy would be to take advantage of conditions when pest densities are low, such as during the non-breeding season or in drought.

Ability to spread rapidly

Many pest animals are highly mobile which makes them excellent dispersers and colonisers. For example, the omnivorous leafroller (*Platynota stultana*), a high-priority plant pest threat to the viticulture industry (Plant Health Australia 2009), produces 4-6 generations per year with wind dispersal of young larvae on silk threads (Gilligan and Epstein 2009). The impressive colonising ability of such pests has major implications for pest animal management. A landholder conducting pest management in isolation may have only short-lived success due to the potential for subsequent reinvasion of animals from neighbouring land. Even after extensive coordinated management programs, preventing recolonisation can be a continuing challenge.

Favourable habitat changes

The successful establishment of some pest animals in Australia was assisted by the creation of disturbed habitats. Activities such as clearing, pasture improvement and provision of additional water supplies have altered pre-existing habitats in favour of introduced species. For example, rabbits flourished in expanded pastures containing fallen trees and burrows of native mammals and, in turn, rabbits provided an abundant source of food for foxes (Williams *et al.* 1995). Some of the disturbance to Australian habitats has made them less suitable for native animals and more suitable for pests. An example is the changes in nutrient and oxygen levels, salinity and water flow patterns of many inland waterways that have benefitted European Carp and adversely affected native fish such as Golden Perch and Murray Cod (Olsen 1998). It is also likely that some animals, including species not currently recognised as pests, will cause increased damage in future through expanded populations and distribution ranges in response to climate change (Steffen *et al.* 2009). Long-term, effective management of pest animal damage can often be achieved through modifying habitats to make them less favourable to a pest animal or to reinstate preferred habitat for native species under threat from a pest (Olsen 1998).

Box 1: Attributes of pest animal species (*continued*)

Few diseases and predators

Most pest animals in Australia have few of their natural agents of control present, such as predators, competitors and pathogens (Olsen 1998). For example, there are few predators in Australia capable of capturing the larger pest animals such as feral goats and pigs. In the days of European settlement, the long voyage to Australia was an effective quarantine measure that weeded out diseases and parasites of stock and of other introduced animals destined to become pests. Today, one of Australia's great advantages as a major international trader in agricultural products is the lack of many common diseases and parasites of domestic stock. However, the same lack of diseases and parasites may also have helped many pest animals to prosper. It follows that the introduction of pathogens may help to manage pest animals. The introduction of diseases such as myxomatosis in 1951 and Rabbit Haemorrhagic Disease in 1995-96 has met with some success.

The ACT has a strong record in the management of pest animals in terms of competency and program standards. However, continuing competition for finite resources means that having clear management objectives that can be pursued cost effectively is important. This ACT Pest Animal Management Strategy 2012-2022 (PAMS) builds on the management framework and approach published previously in the ACT Vertebrate Pest Management Strategy 2002 (VPMS; ACT Government 2002). The scope of the revised strategy has been expanded to cover all pest animal species as management of invertebrate pest animals is not covered elsewhere. The PAMS complements the ACT Weeds Strategy 2009-2019 that promotes partnerships between government, non-government and community stakeholders to achieve effective weed management.

The PAMS has been developed to be consistent with the Australian Pest Animal Strategy 2007 (APAS; NRMMC 2007a). The APAS recognises that management success is dependent on building and maintaining pest animal management capability (Goal 1). Management capability is enhanced by a high level of awareness and understanding of pest animal issues among land managers and the wider community, and by good communication amongst stakeholders to achieve well coordinated management programs. The national strategy also recognises that prevention of pest animal incursions is the most cost-effective means of managing the damage from pest animals (Goal 2). Once pest animals are established, efficient and effective ongoing management is usually required (Goal 3). These national goals are reflected in the key objectives and structure of the PAMS.

1.1.3 Who is the PAMS for and how is it to be used?

The PAMS provides information and guidance for all land managers, community groups and individuals (Section 2.2.2) that have responsibility for, or interest in, cost-effective, efficient, humane and enduring pest animal management outcomes in the ACT. The changing legislative, policy and institutional frameworks within which pest animal management is conducted in the ACT are described in Chapter 2. The key principles (Part 1; Section 1.2.2), objectives, strategic actions and performance indicators (Part 1; Chapters 3-6) provide guidance for the development of pest and native animal management programs that are applicable to all ACT land managers. Management activities and issues associated with individual pest and native animal species that cause damage are provided in Appendix 1. As all pest animal management programs are subject to resource constraints, and may have gaps in knowledge that limit the predictability of program outcomes, a risk assessment guide has been provided in Appendix 2 to assist priority setting in local pest and native animal management programs. Key principles for facilitating good communication and cooperation between stakeholders in coordinated management program workshops have been collated in Appendix 3.

1.2 Pest animal management

1.2.1 A strategic approach

A strategic approach to pest animal management is required if enduring and cost-effective outcomes are to be achieved. The VPMS described a seven-step process of planning, action and evaluation developed to help managers of both public and private lands address pest management problems which has been retained for this strategy (Figure 1). The focus of the approach is on mitigation of pest animal damage rather than on reduction in pest numbers as a goal in itself. The arrows for feedback, research and refinement (Figure 1) indicate an adaptive management approach that allows flexibility in responding to changes in pest animal status, management options and stakeholder priorities (Braysher and Saunders 2003).

Step 1 Define the pest problem

The problem should be described in terms of its extent, the damage occurring and its significance, and key stakeholders. Supporting maps can be helpful. Major operating factors should be determined to ensure that the problem is attributed correctly to the activities of a pest animal and not to some other factor such as management practices or environmental influences. The benefit being sought from pest management should be articulated in terms of the desired land management outcome. Definition of the problem may involve collecting the information necessary to understand it before identifying practical solutions for alleviating damage caused by the pest. If there are gaps in knowledge, the program should identify a strategy for improving the knowledge base. Specific research needs may be indicated.

Figure 1 Summary of the strategic approach to pest animal management (Braysher and Saunders 2003).

1. Define the problem or potential problem

- Who has the problem
- Define the damage
- Measure the damage
- Mapping
- Fill knowledge gaps

2. Determine management priorities

- Levels of damage
- Significance of damage
- Sensitivity to damage
- Areas for treatment

3. Decide feasibility

- Economic
- Social
- Environmental factors

4. Determine objectives

- Select performance criteria
- Identify risks
- Knowledge gaps
- Adaptive management

5. Develop the program

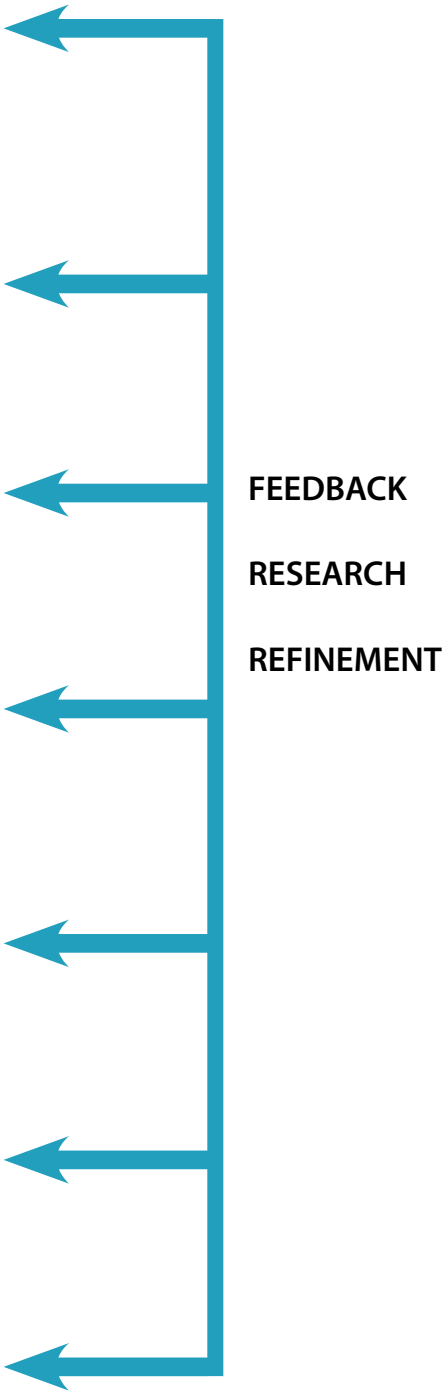
- Consider management options
- Decide on techniques
- Allocate treatment units
- Work program

6. Implement the program

- Group action (ownership)
- Government role
- Role of others

7. Monitor and evaluate

- Assess damage reduction
- Compare over time
- Monitoring techniques
- Evaluate outcomes



Step 2 Determine management priorities

The resources required to undertake pest animal management programs on an ACT-wide basis are unlikely to be available for every species that causes damage. Also, the significance of pest animal damage in terms of mitigation effort that can be justified will vary between areas in accordance with land use, management objectives and community perceptions. Consequently, if limited resources are to be assigned efficiently, it is important that a process of prioritising areas for treatment be adopted rather than the more traditional method of establishing a list of pest animal species and tackling them in a piecemeal fashion. Prioritising should include identifying areas where pest animal activity causes significant harm in terms of management values, and those areas that are most at risk from pest animals (Species Survival Commission 1999). Quantifying levels of damage and their significance is important. Initial best estimates may need to be refined over time by targeted research. To assist in allocating resources it is usually necessary to identify the management units requiring action and rank them on their priority for managing pest animal damage.

Step 3 Assess the feasibility of a management program

Once priorities are determined, managers can decide what form of management is appropriate. While it may be agreed that a social, environmental or economic asset has high value and that pest animals are a significant threat, it does not automatically follow that a pest animal management program is either desirable or feasible. For example, available techniques for a predatory pest may necessitate the introduction of poison baits to an area. The potential for damage to domestic pets or non-target native animal species may be unacceptable. Alternatively, available techniques may be unacceptable on animal welfare grounds. However, it should be kept in mind that early intervention in pest animal problems or intervention at times when the population is small is often the most efficient and cost-effective management option.

Step 4 Determine objectives for the management program

The success of a pest animal management program is assessed by evaluating progress made against predetermined objectives and by making judgements about related costs. To aid this process, management objectives should be clear, realistic, time limited if possible and focussed on the desired outcomes. In practice, management outcomes are often difficult to measure directly. It may be more practical to define a management objective in generalised terms with associated performance criteria that establish targets for management effort as a measurable output. This approach is also useful when knowledge about the system is incomplete. When designed correctly a management program can help to increase the knowledge base through an adaptive management approach.

Step 5 Develop the management program

An examination of management options, including that of no management, will enable the most cost-effective method to be determined and appropriate techniques to be selected. Only rarely is eradication a viable pest management option. At a national level, the pest animals that were here 100 years ago are still present. Typically, management is an ongoing activity that has a variety of objectives. While there are several different strategic approaches that can be adopted they should have two factors in common. First, the desired outcomes from pest animal management need to be clearly identified and articulated, and supported by all key stakeholders. Second, there needs to be management and landholder commitment to provide the resources required over time to achieve the outcomes. Badly focused and half-hearted management efforts waste resources which might be better spent elsewhere (Species Survival Commission 1999). The relevant measure of management success is the response in the resource that the management aims to benefit. It is important to concentrate on quantifying and reducing the damage caused by pest animals, not concentrating on merely reducing numbers of pests. Rarely is the relationship between pest numbers and the damage that they cause a simple one. Hence a reduction in the density of a pest animal subject to management will not necessarily reflect an improvement in the condition of the resource that is suffering damage (Species Survival Commission 1999).

Step 6 Implement the management program

At this stage, the steps required to implement the program need to be identified, a timetable of works determined and agreed, and resources committed. In other words what equipment is needed and who does what by when. Coordination between adjacent landholders, including simultaneous implementation of management actions, may be necessary to achieve desired outcomes. One of the advantages of early consultation with stakeholders is that it fosters group understanding and ownership of the problem and the solution, and greatly assists in the cooperative implementation of the plan.

Step 7 Monitor and evaluate

Monitoring and evaluation are essential elements of a pest animal management program. They provide information that can be used to improve the efficiency and effectiveness of the program or, if necessary, modify the objectives. Effective monitoring will require planning at the outset of the program and may require a considerable allocation of resources. Practical monitoring techniques that give valid and useful information need to be determined.

1.2.2 Management objectives

The 10 key management principles, four objectives and associated strategic actions provided in Part 1 of the strategy were derived from the information and strategic approach outlined in this chapter, with reference to the 12 key principles in the APAS and to Braysher (1993), Olsen (1998) and Braysher and Saunders (2003).

The rationale for, issues associated with, and implementation of, the strategy's objectives in the ACT are addressed in detail in Chapters 3-6. Relevant key principles and strategic actions are summarised at the beginning of each chapter. The chapters focus on how to:

- prevent and contain the spread of new pest animal incursions (Chapter 3);
- provide effective and efficient management of established pest animal species (Chapter 4);
- manage native animal populations that are causing unacceptable damage (Chapter 5); and
- ensure that the capacity to undertake pest and native animal management programs is enhanced and supported by a community that is aware of and understands the management issues (Chapter 6).

PEST ANIMAL MANAGEMENT IN THE ACT

2.1 A background perspective

2.1.1 The ACT Vertebrate Pest Management Strategy 2002 (VPMS)

The VPMS guided vertebrate pest management activities in the ACT from 2002 until 2012. The strategic goal of the VPMS was *'to contribute to the conservation of our natural and cultural heritage and the maintenance of a productive rural capacity by efficient and effective management of the harmful impact of vertebrate pests'*. The VPMS was beneficial in guiding the application of the strategic approach (Section 1.2.1) to ACT Government vertebrate pest management programs and assisted in the definition of clearer management objectives within those programs. Other beneficial outcomes from the VPMS were:

- increased interaction with community groups and participation by stakeholders in the delivery of ACT Government coordinated pest animal management programs;
- greater participation in a broad range of national and regional networks and forums on pest animal management;
- improved education and training opportunities for ACT Government staff and pest animal contractors;
- increased collaboration on ACT- and interstate-based research projects; and
- more effective operational monitoring of selected pest animal management programs.

While the strategic goal and much of the content of the VPMS have ongoing relevance to pest animal management in the ACT, the legislative and policy frameworks, and the ACT Government structure under which the VPMS was delivered, have changed significantly. Accordingly, the VPMS was reviewed in 2009 by a working group comprised of pest animal management experts and ACT stakeholders to identify the changes necessary for development of the PAMS. The key outcomes of the review are discussed in this chapter.

2.1.2 Review of the VPMS

The strategic goal of the VPMS was targeted at the management of vertebrate pest animals primarily for conservation and rural production purposes. The strategic goal reflected location of the legislation for pest management under the *Nature Conservation Act 1980* (NC Act) at that time, and responsibility for management of non-urban lands by Environment ACT (the government agency that published the VPMS). The need for complementary or pre-emptive management of vertebrate pests in the urban environment was recognised in the VPMS, but this issue was not specifically addressed. Similarly, lands managed by the Australian Government for official business and cultural heritage purposes were not considered. To achieve coordinated management of pest animal species throughout the ACT there is a need to consider all land uses and the differing management objectives of land managers and other stakeholders within them (Section 2.2). The enactment of dedicated legislation for pest animals in the *Pest Plants and Animals Act 2005* (Pest P&A Act) has provided a statutory basis for improved coordination of pest animal management programs. The relationship between the Pest P&A Act, the NC Act and other ACT and Australian Government legislation relevant to pest animal management is explained further in Sections 2.3 and 2.5.

The scope of the VPMS was, by definition, limited to the management of vertebrate pest animals in the ACT. Invertebrate pest animals such as insects and freshwater crustaceans were not considered in the VPMS or in any other ACT Government management strategy. As the principles for managing vertebrate and invertebrate pest animals are broadly similar (Section 1.2.2) the scope of the VPMS has been expanded in the PAMS to include invertebrate pest animals. This inclusion should facilitate the extension of the strategic pest management approach (Section 1.2.1) to invertebrates, some species of which are already declared as pest animals under ACT legislation (Section 2.3.1).

National and regional policy frameworks for pest animal management have also changed significantly since publication of the VPMS in 2002, with the release of the APAS, the NSW Invasive Species Plan 2008-2015 (NSW ISP; NSW DPI 2008) and new national biosecurity arrangements. The national and regional policy frameworks within which the PAMS will operate are detailed in Section 2.4.

2.2 ACT land uses, land managers and management objectives

2.2.1 Land uses

Territory lands are classified by the ACT Government into residential, commercial, industrial, community facility, parks and recreation, transport and services, rural and other non-urban land uses. Pest animals are present across all land uses and pest animal management programs need to be consistent with the primary objectives of the land managers within them. For example, objectives of urban open space are to protect flora and fauna habitats and corridors as well as to provide parks and open spaces for recreational and social needs. Management of pest animals (eg, rabbits) for this land use will have higher priority than in suburban and urban residential areas where the primary objectives are the provision of affordable and sustainable housing and residential amenity. In contrast, management of aggressive pest animals that harm humans (eg, the European Wasp) will have higher priority in suburban and urban residential areas than in other, less densely populated areas. Management objectives of different land managers need to be considered in the preparation of statutory Pest Animal Management Plans (Section 2.3.1).

Not all lands in the ACT are the responsibility of the ACT Government. National Lands (eg, Australian Government office sites, national cultural institutions such as the National Library and Australian War Memorial, the parliamentary triangle, Lake Burley Griffin and foreshores, CSIRO lands, and Department of Defence and communications lands) are managed by, or on behalf of, the Australian Government. Management of National Lands is subject to Australian Government legislation such as the *Environment Protection and Biodiversity Conservation Act 1999* (Section 2.5; Table 2). Pest animal management may be required on National Lands in relation to Australian Government legislation and to achieve coordinated pest animal management outcomes within the ACT.

2.2.2 Management objectives and responsibilities of land managers and other stakeholders

Understanding of, and respect for, different management objectives by key stakeholders is essential to the success of coordinated pest animal management programs (Sections 6.2 and 6.3). Key stakeholders are those with responsibility for managing pest animals on all land tenures in the ACT (Table 1). Key stakeholders in the ACT include the ACT Government, Australian Government and rural landholders, assisted by input from pest animal researchers and the RSPCA. The ACT Government also collaborates with NSW Government agencies in cross-border pest animal management programs. Other stakeholders with a management role or interest in pest animal management include community conservation, ParkCare, catchment management and animal welfare groups, the ACT Aboriginal community and animal traders, breeders and keepers (Table 1). The management objectives, responsibilities and/or interests of each stakeholder group are summarised in Table 1.

Table 1 – Major stakeholder roles and responsibilities.

Stakeholders	Pest animal management objectives	Responsibilities
ACT Government		
Pest animal managers ACT Parks and Conservation Service (ACT PCS) and City Services, Territory and Municipal Services Directorate (TAMSD)	• Protect native species and communities in urban open spaces and non-urban rural (unleased), hills, ridges, buffer, river corridor, mountain and bushland areas. • Protect public amenities and safety in residential, commercial, industrial, transport and services, restricted access recreation and community facility areas.	• Undertake pest animal management programs in accordance with statutory requirements that address potential and actual pest animal damage to ACT environments and public amenities. • Detect and report notifiable and prohibited pest animal occurrences. • Provide leadership and coordination of pest animal management programs across different land uses. • Deliver nationally consistent pest animal management outcomes through cooperation with regional and national pest animal forums and networks. • Contribute to pest animal research and education programs. • Promote wider public understanding and awareness through community engagement and provision of information on pest animal damage and management issues. • Monitoring and evaluation of pest animal management programs.
Regulators– Licensing and Compliance, TAMSD	• License animal imports and exports; inspect premises and facilities for licence compliance and prohibited pest animal species.	• Implement regulatory requirements and support programs that encourage responsible importing and keeping of animals with pest potential. • Maintain a register of importers and keepers of pest animals.
Legislation and policy makers – Environment and Sustainable Development Directorate (ESDD) and TAMSD	• Develop and amend pest animal legislation and policies that guide management and regulation.	• Provide legislative and policy frameworks that encourage responsible pest animal management. • Consider pest animal stakeholder and community interests in policy development.
Advisory bodies[1]	• Consider pest animal management issues in the ACT region.	• Provide advice on pest animal management issues to government agencies.
Commissioner for Sustainability and the Environment	• Report on the damage caused by pest animals to biodiversity and the management undertaken to reduce it in the ACT.	• Provide recommendations to the ACT Government regarding pest animal management through State of Environment reports, referred investigations and complaint resolution processes.
Australian Government – Managers of National Lands	• Manage pest animals in accordance with statutory responsibilities.	• Manage in accordance with Commonwealth legislation. • Detect and report notifiable and prohibited pest animal occurrences. • Collaborate with other ACT land managers on coordinated pest animal management programs to enhance outcomes on adjacent land management areas and maximise efficiency and benefits. • Provide input to Australian and ACT Government legislation, policy, regulation and management frameworks.
NSW Government agencies	• Effectively manage pest animals in NSW including regions adjacent to the ACT border.	• Cooperate with ACT pest animal stakeholders to address management issues and to develop and implement coordinated cross-border pest animal management and research programs to maximise efficiency and mutual benefits.

1 Natural Resource Management (NRM) Advisory Committee, Flora and Fauna Committee and the ACT NRM Council.

Table 1 – Major stakeholder roles and responsibilities (continued)

Stakeholders	Pest animal management objectives	Responsibilities
ACT rural landholders	• Undertake productive and sustainable agriculture and/or lifestyle activities.	• Recognise the nature and causes of pest animal damage to agriculture and biodiversity. • Detect and report notifiable and prohibited pest animal occurrences. • Manage pest animal problems using appropriate techniques and practices. • Cooperate with adjacent land managers to deliver pest management outcomes. • Provide input to government legislation, policy, regulation and management frameworks. • Protect threatened species and communities.
Water catchment managers	• Provide safe drinking water to the residents of Canberra and the surrounding region.	• Liaise and cooperate with other land managers to minimise pest animal damage and potential adverse impacts of pest animal management on the integrity and quality of waterways.
ACT Aboriginal community	• Prevent damage to native plants, animals and ecosystems, and cultural assets of significance to the Aboriginal community.	• Recognise the nature and causes of pest animal damage to significant native plants, animals and ecosystems, and cultural assets. • Advise the ACT Government and other land managers of damage to significant assets and work collaboratively to reduce, remove or restore damage. • Provide input into government legislation, policy, regulation and management frameworks.
Pest animal researchers[2]	• Improve understanding of the biology and ecology of pest animal species and research on management techniques and practices.	• Undertake research to address gaps in knowledge on pest animal species and management techniques and practices in collaboration with stakeholders. • Ensure research outcomes are delivered to relevant stakeholders.
Animal traders, breeders and keepers	• Importing, exporting, keeping and breeding of potential pest animals for commercial purposes and/or personal interest.	• Obtain a licence and registration when required to import, export, keep, sell and take animal species, or release them from captivity. • Maintain records in accordance with licence requirements. • Minimise the risk of escape of species with pest animal potential. • Report escapes in accordance with legislative requirements. • Promote awareness and understanding of pest animal management issues by trade, keeper and breeder groups. • Provide input to government legislation, policy, regulation and management frameworks.
Commercial pest operators	• Pest animal control for commercial purposes.	• Undertake commercial pest operations in accordance with ACT Government regulations. • Adopt best management practices and humane control methods.
Community members and groups	• Voluntary leadership and participation in the management of private and public lands including conservation (eg, National Parks Association; Conservation Council), ParkCare and catchment groups. • Ensuring that threats to conservation are appropriately managed.	• Provide leadership and coordination for local group development and action on pest animal problems. • Cooperate with other land managers to achieve local and regional pest animal management outcomes. • Promote awareness and understanding of pest animal management issues amongst community groups. • Represent members' interests at pest animal management networks and forums. • Provide input to government legislation, policy, regulation and management frameworks.
Animal welfare groups	• Ensuring that threats to animal welfare are appropriately managed.	• Promote awareness and understanding of pest animal welfare issues amongst community groups. • Represent members' interests through input on animal welfare issues.
Royal Society for the Prevention of Cruelty to Animals (RSPCA)	• Preventing cruelty to animals by actively promoting their care and protection.	• Provide input to government legislation, policy, regulation and management frameworks that reflect contemporary values and scientific knowledge. • Ensure enforcement of existing animal welfare laws.

2 Refer to Section 6.5 for key research organisations.

2.3 Legislation

2.3.1 Pest Plants and Animals Act 2005 *(Pest P&A Act)*

The objects of the Pest P&A Act are to:

- protect the ACT's land and aquatic resources from threats from pest plants and animals;
- promote a strategic and sustainable approach to pest management;
- identify pest plants and animals; and
- manage pest plants and animals.

The Pest P&A Act applies to animals that have been declared as pest species in the Pest Plants and Animals (Pest Animals) Declaration 2005 (No 1) (DI2005-255) (http://www.legislation.act.gov.au/di/2005-255/current/pdf/2005-255.pdf). Many declared pest animal species are classified as prohibited (keeping and supply is prohibited) and some declared and prohibited species are also classified as notifiable (their presence in the ACT must be notified). A statutory Pest Animal Management Plan (PAMP) may be prepared for a declared species to prescribe the practices required for its management. Management practices in PAMPs must be consistent with any Codes of Practice adopted under the *Animal Welfare Act 1992* (Section 2.3.3). Development of a PAMP is most likely to be beneficial where a coordinated pest management response is required from multiple stakeholders across one or more land uses and is essential where compliance with management practices needs to be enforced. Compliance with the Pest P&A Act is achieved by issuing the occupier of premises with a written pest management direction in accordance with a relevant PAMP.

2.3.2 Nature Conservation Act 1980 *(NC Act)*

Until 2005, pest animals that threatened native plants, animals or ecosystems were managed under the NC Act, with provision for declaring organisms to be prohibited and controlled (Part 6) and for controlling the keeping, selling, import, export and release of native and non-exempt animals (which included some pest animal species; Part 4). Subsequently, the ACT Nature Conservation Strategy 1997 (a statutory strategy under the NC Act) articulated the principles of pest animal management and the VPMS was developed as an outcome of the strategy's actions.

The NC Act and strategy have been largely superseded by the Pest P&A Act and the VPMS as the legislative and policy frameworks for the management of exotic pest animal species. Most of the legislation relevant to pest animal management will be removed during the current revision of the NC Act. However, pest animal management actions may still be required in relation to an action plan, conservation direction or management agreement issued under the NC Act where native plants, animals or ecosystems are threatened.

The ACT Government will investigate excluding native animals from the Pest P&A Act and amending the NC Act to facilitate their management for damage reduction purposes (Section 5.3; Strategic Action 3.1). Legislation changes to the NC Act could include provision for the preparation of Native Animal Management Plans that would prescribe management practices as described for PAMPs under the Pest P&A Act (Section 2.3.1). Current licensing requirements for killing native animals would be retained under the NC Act.

2.3.3 Animal Welfare Act 1992 *(Animal Welfare Act)*

The Animal Welfare Act protects animals against cruelty (eg, inappropriate use of poisons and traps, damage to non-target species) and provides for the development of Codes of Practice for the humane destruction and control of pest and native animals. Amendments were made to the Animal Welfare Act in 2010 to allow Codes of Practice, which have always been voluntary, to be approved as mandatory.

A National Code of Practice for the Humane Control of Invasive Animals, and individual Model Codes of Practice for cats, pigs, rabbits, goats, horses, foxes and wild dogs, have been approved by the national Vertebrate Pests Committee (VPC) (they are yet to be endorsed by the Standing Council on Primary Industries). The ACT Animal Welfare Advisory Committee will need to consider their suitability for adoption (with or without amendment) under the Animal Welfare Act once the documents have been endorsed by the Standing Council on Primary Industries.

2.3.4 Commissioner for the Environment Act 1993

The ACT Commissioner for Sustainability and the Environment has responsibility for undertaking investigations and addressing complaints relating to the management of the ACT environment, and for State of Environment (SoE) reporting. The SoE reports have routinely monitored the status of pest animals as a biodiversity indicator and contain recommendations to the ACT Government for their management (http://www.environmentcommissioner.act.gov.au/publications/soe). The 2003 and 2007 SoE reports identified potential new pest animal species, emerging and re-emerging problem species, and new populations and/or wider distribution ranges of established pest animal species. Recommendations included ongoing management of key established pest animal species, the development of a five year management plan, and better assessment of the effectiveness of pest animal management programs, especially in regard to stated biodiversity conservation and catchment management objectives.

2.4 National and regional policy frameworks

2.4.1 The Australian Pest Animal Strategy 2007 (APAS)

The vision of the APAS (NRMMC 2007a) is that '*Australia's biodiversity, agricultural assets and social values are secure from the impacts of vertebrate pest animals*'. The APAS articulates 12 key pest management principles and a series of goals, objectives, actions and outcomes required to achieve this security. A primary objective of the APAS is '*to ensure nationally consistent pest animal management approaches are in place at all scales of management*'. To demonstrate consistency with the APAS, the PAMS has been structured to include prevention of the establishment of new pest animals and management of the damage caused by established pest animals (Goals 2 and 3 of the APAS) as primary objectives. Relevant actions in the APAS have also been adopted and modified to be applicable in the ACT.

Important outcomes of the APAS are the development of a National Categorisation System for [potential] Invasive Species (Section 3.1.3) and a list of Established Pest Animals of National Significance that require ongoing management through coordinated national management programs (Section 4.2.1). Nationally consistent Codes of Practice for the humane control of pest animals that have been developed as an action under the APAS will be adopted under the Animal Welfare Act (Section 2.3.3) after endorsement by the Standing Council on Primary Industries and subsequent review by the ACT Animal Welfare Advisory Committee.

2.4.2 The NSW Invasive Species Plan 2008-2015 (NSW ISP)

The goals of the NSW ISP (NSW DPI 2008) reflect those of the APAS, addressing the prevention of new pest animal incursions, management of established pest animal species and maintenance of pest animal management capacity. However, the scope of the NSW ISP has been expanded to address the management requirements of all pest plant and animal species in line with broader national biosecurity goals. The PAMS is consistent with the NSW ISP in its major objectives and in the inclusion of vertebrate and invertebrate pest animal species. Consistency between the NSW ISP and the PAMS will facilitate cross-border cooperation and coordinated pest animal management programs.

2.4.3 National biosecurity framework

Both the APAS and the NSW ISP were developed under the Australian Biosecurity System for Primary Production and the Environment (AusBIOSEC). Australia's biosecurity arrangements have been revised in response to the Beale report (Beale *et al*. 2008) and AusBIOSEC has been replaced by an Intergovernmental Agreement on Biosecurity (IGAB). Key schedules under the IGAB are the Emergency Animal Disease Response Agreement (EADRA), Emergency Plant Pest Response Deed (EPPRD) and the National Environmental Biosecurity Response Agreement (NEBRA). These schedules are activated by the incursion of any pest animal species or disease for which there are national management and cost-sharing arrangements defined under the agreements. *The Quarantine Act 1908* (Cwlth) that has provided the legislative underpinning for national biosecurity arrangements for over a century is also under review and its replacement has been recommended (Beale *et al.* 2008). Pest animals in the ACT will need to be managed in accordance with the IGAB, EADRA, EPPRD and NEBRA, and with the new quarantine legislation once it is enacted.

As part of the national biosecurity arrangements, the ACT Government contributes to national pest eradication and management programs through the Standing Council on Primary Industries. These programs generally receive 50 per cent of their funding from the Australian Government with the remaining funding cost-shared between the states and territories on a population or local value of product basis. An example of a nationally cost-shared program to which the ACT contributes is the European House Borer Program (Section 3.3.3; Box 6).

2.5 Other pest animal legislation, policies and management programs

The ACT Government has ongoing management programs for vertebrate pest animals developed in accordance with the Pest P&A Act. The annual Vertebrate Pest Management Operations Plan outlines priority activities programmed for each financial year and the Vertebrate Pest Management Annual Report provides a summary of outcomes from the previous year. These documents are provided to the Commissioner for Sustainability and the Environment to assist in SoE reporting (Section 2.3.4).

There are other national, regional and local legislative acts, policies and management programs that relate to pest animal management and which have not been described above. These are listed in Table 2 and are accompanied by a brief description of their relevance to pest animal management in the ACT.

Table 2 Other legislation, policies and management programs relevant to pest animal management in the ACT.

AUSTRALIAN GOVERNMENT	
Environment Protection and Biodiversity Conservation Act 1999	Adverse pest animal impacts are recognised as key threatening processes to native species and ecological communities under this act. National threat abatement plans have been produced for rabbits, unmanaged goats, the European red fox, feral cats and pigs, and red imported fire ants. ACT PAMPs will be consistent with national threat abatement plans. A recent independent review of this act (Hawke 2009) recommends the development of criteria and management protocols for the movement of potentially damaging exotic species between States and Territories, working towards a list of 'controlled' species for which cost-effective, risk mitigation measures may be implemented.
Australian Pest Animal Research Program	This program is managed by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) and provides funding under Caring for our Country for pest animal research and management initiatives that are consistent with the APAS, including humane destruction methods, damage reduction techniques, guidelines and extension materials, and quantification of management benefits.
Memorandum of Understanding (MoU) for the Cooperative Management of the Australian Alps National Parks	The ACT is a signatory to this MoU and has obligations for cooperative protection of its natural and cultural heritage values as decided through the Australian Alps Liaison Committee. Namadgi National Park and Tidbinbilla Nature Reserve are included in the Australian Alps National Parks. Identification and management of emerging and established invasive animal species is a key outcome of the Australian Alps National Park Strategic Plan 2008-2011.
A Strategic Approach to the Management of Ornamental Fish in Australia	Key recommendations of this strategic approach include the need for a nationally recognised noxious fish species list, new management frameworks for the ornamental sector, better communication with stakeholders, a public awareness campaign on the dangers of releasing fish where they can get into waterways, and what to do with them if they are no longer wanted.
ACT GOVERNMENT	
Animal Diseases Act 2005	This act provides for the detection, prevention and management of outbreaks of endemic and exotic animal diseases in the ACT and neighbouring jurisdictions. Land managers may be required to notify the presence of diseases in pest animal populations, prevent the spread of a disease in pest animals and/or destroy pest animals.
Fisheries Act 2000	Provides licensing for the import and export of live fish and prohibits the release of live fish into public waters and use of live fin fish as bait. The provision for the declaration of noxious fish species under this act has been superseded by the provision for pest animal declaration under the Pest P&A Act.
Bush Capital Legacy – Iconic City, Iconic Natural Assets (ACT NRM Council 2009)	Intermediate and long-term targets of this management plan are to show that endangered species and communities become less threatened and that their conservation listing status improves, respectively. A key action of the plan is to assess the damage caused by pest animals to biodiversity (in combination with other threatening processes).

PREVENTING INCURSIONS OF NEW PEST ANIMAL SPECIES

Key Principle: Prevention and early intervention are the most cost-effective techniques for managing pest animal incursions because, once established, only rarely can pest animals be eradicated.

Objective	Strategic Action
1. Prevent the incursion of new pest animal species, detect and eradicate or contain new invasions.	1.1 Identify potential invasive animal species. 1.2 Review available risk assessments for high-risk species and identify potential damage, likely sources and incursion pathways, potential barriers to incursion, and key ACT stakeholders. 1.3 Develop and implement effective identification, surveillance, response and reporting strategies in accordance with national approaches. 1.4 Monitor invasion sources and pathways to ensure early detection of incursions. 1.5 Eradicate or contain invasions (including 'sleeper' populations) based on risk assessment and cost benefit analyses.

3.1 Identifying potential invasive animal species

3.1.1 Introduction

Exotic animals that occur outside Australia or the ACT but have the potential to become pests if introduced share similar attributes to established pest animal species (Section 1.1.1; Box 1). These attributes include a capacity for rapid population increase and spread, exploitation of disturbed habitat, and few natural predators and diseases. In addition, potential pest animal species must have a pathway for entry. Prevention of incursions by new pest animal species into Australia is achieved by the regulation of animal imports, and of goods, equipment and transport vessels that can harbour pest animals (Section 3.1.2). Species that have been identified for their pest potential, or for their capacity to spread into new regions of Australia following initial introduction, are assessed under the National Categorisation System for Invasive Species (Section 3.1.3). Where the pest potential of an animal species is unknown, an import risk analysis is undertaken to identify entry pathways, likely pest animal damage, disease risks and surveillance priorities (Section 3.2). For high-risk species it may be necessary to prepare pest communication strategies and response plans, so that detection and management of incursions is undertaken rapidly thereby minimising damage and costs (Section 3.3). Management options include eradication, containment, ongoing management or taking no action, based on the level of damage that the pest animal may cause and on the cost benefit analysis of management options.

3.1.2 National and regional regulation of potential pest animals

The prevention and management of the introduction, establishment and spread of pest animals (and/or their diseases) that could cause significant damage to human beings, animals, plants, the environment or economic activities is currently regulated under the *Quarantine Act 1908* (Cwlth) (to be replaced by new Australian biosecurity legislation; Section 2.4.3). *The Quarantine Act 1908* is administered by the Biosecurity Services Group in the Department of Agriculture, Fisheries and Forestry (DAFF) which is responsible for managing borders and providing import inspection and certification. All animals, including insects, fish, crustaceans, birds and larger agricultural animals, as well as animal and plant products and other goods that may harbour pest animals or diseases, are subject to quarantine laws. Most animals permitted into Australia spend a compulsory period at

quarantine facilities to establish that they are free of disease before being released. Not all animals are permitted to enter Australia because the pest or disease risk may be considered too great (Section 3.2.1). Quarantine policies, scientific and technical advice, and import risk analyses of animals and plant pests are provided by the Biosecurity Services Group in consultation with relevant experts, government agencies and industry groups. The Australian Government has responsibilities for biodiversity conservation through the *Environment Protection and Biodiversity Conservation Act 1999*, which is administered by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). The *Environment Protection and Biodiversity Conservation Act 1999* provides for the identification and listing of key threatening processes and the preparation of threat abatement plans for such processes if required.

The ACT Government reduces the risk of new pest animal incursions through a combination of regulatory activities and communication strategies, and through being a signatory to national biosecurity response plans and pest management programs (Sections 2.4.3 and 3.3). However, the effectiveness of these risk reduction strategies will depend in part on complementary action in surrounding NSW. The keeping of exotic animals in NSW is regulated under the *Non-Indigenous Animals Act 1987* (NSW) and the *Exhibited Animals Protection Act 1986* (NSW). The NSW ISP (Section 2.4.2) provides a strategic guide for the exclusion, eradication and containment of new pest animal species. The NSW ISP, under its objective to seek consistency between state and national legislation, acknowledges the need to '*work with other jurisdictions to develop consistent invasive species management approaches*'. The development of the National Categorisation System for Invasive Species (Section 3.1.3) and nationally consistent threat categories for vertebrate pest animals (Section 3.2.1) should facilitate this task.

While nationally and regionally consistent approaches are important for minimising the risk of new pest animal incursions, individual species may warrant an independent and pro-active position in areas of concern in the ACT. This is particularly the case for animals that are a potential threat to alpine and sub-alpine environments, and to regional water systems. For example, freshwater pest animals (eg, ornamental fish, red swamp crayfish, electric eels, the red-eared slider turtle) are a major concern, as many such species are regularly imported into the ACT via the aquarium trade. There is a risk that keepers of aquarium species will release them into waterways when they are no longer wanted. There is also the potential for freshwater pest animal incursions into the ACT from the wider Murrumbidgee catchment area. At present, freshwater species comprise more than 80 per cent of the declared pest animals for the ACT (Section 2.3.1) and supply or keeping of most of these species is prohibited. Many of these species do not currently occur in ACT freshwater bodies and prevention of their incursion will conserve limited government resources for addressing established pest management issues (Chapter 4).

3.1.3 National Categorisation System for Invasive Species

Recognition of potential pest animal species through the development of national surveillance and alert lists was an objective of the APAS. This objective has been superseded by a National Categorisation System for Invasive Species developed jointly by the VPC and the Australian Weeds Committee in accordance with schedules under the IGAB (Section 2.4.3). At present, there is a list of exotic vertebrate animals already in Australia (VPC 2007) and a national noxious fish list (NRMMC 2007b). Compendiums of animal pests of timber, forestry, horticulture and grains are available online from DAFF (www.daff.gov.au/animal-plant-health/pests-diseases-weeds/animal) and from Plant Health Australia (www.planthealthaustralia.com.au).

The ACT Pest Plants and Animals (Pest Animals) Declaration 2005 (No 1) (DI2005-255) lists potentially invasive species as well as established pest animal species. This declaration requires amendment to state that pest animal species included in IGAB agreements and the National Categorisation System for Invasive Species are automatically declared as pest animals within the ACT. Actual listing in DI2005-255 need only include potential pest animals with an unacceptable risk of incursion and capacity for damage in the ACT, and established pest animals that require management. Regular revision of the list is necessary to identify new and emerging pest animal species, and to allow for their timely declaration in the ACT Legislative Assembly and for the development of communication strategies, response plans and/or PAMPs (Section 2.3.1; Appendix 1).

For example, there are few declared invertebrate pest species in the ACT (European wasp, red imported fire ant, red swamp crayfish). Other invertebrate species that are the subject of IGAB response agreements because of their high pest potential (eg, European house borer, Asian honey bee, electric ant, *Varroa* mite) should be included on the ACT declaration list.

3.2 Risk assessment

3.2.1 Assessment procedures

Vertebrate pest animal risk is assessed nationally based on whether escaped or released animals would i) harm people, ii) establish a free-living, viable population or iii) cause damage once a population is established (NRMSC 2004, Bomford 2008). The scores determined for these risk factors are used by the VPC to assign species to threat categories (extreme, serious, moderate, low) based on acceptable risk levels. An example of the risk assessment process used to determine an extreme threat category species, Canada geese, is provided in Box 2. Extreme threat category species are excluded from entry into Australia and cannot be kept in any State or Territory. Serious and moderate threat category species have restrictions placed on the type of collection in which they can be kept and often have a requirement for registration in the State or Territory of residence. Low threat category species can be imported and kept with little risk of becoming a pest problem and may be included on live import lists. Live import lists for fish and bird species are administered by DSEWPaC (www.environment.gov.au/biodiversity/trade-use/lists/import/index.html). For extreme, serious and moderate threat category species, the minimum level of security appropriate for keeping the animal is provided in assessment guidelines (NRMSC 2004). Import risk assessments for other pest animals, and for plants and goods that may harbour pest animals, adopt a similar approach (Biosecurity Australia 2009). Where a new risk assessment is required, the onus for demonstrating acceptable risk is placed on the applicant importing the animal, plant or goods, and the applicant is required to demonstrate that adequate risk mitigation measures are in place.

The risks associated with the incursion and establishment of pest animals are considered further in this chapter. The risk that an established pest animal will cause unacceptable social, environmental or economic damage is considered in detail in Chapter 4.

3.2.2 Invasion pathways – imports, escapes, border incursions, sleeper populations

There are many ways that new pest animals can arrive in Australia. Larger vertebrate species are usually imported deliberately (either legally or illegally), but smaller vertebrate and invertebrate species may be either deliberately or inadvertently introduced. Accidental introduction of pest animals may occur through incorrect species identification, or through contamination of transport vessels (boats, aircraft), equipment, plants, goods or people by the animal species. There may also be natural migration of new species into Australia across ocean barriers, including migration in response to environmental change (eg, habitat loss, climate change).

After arrival in Australia, new animal species may spread naturally from contaminated objects, escape from captivity, or be deliberately released. If the species survives and establishes a viable population (Section 3.2.3) there is the potential for it to disperse to other regions in Australia. Dispersal may occur overland, in waterways, or along air, land and water transport routes. Animals may migrate in response to innate behavioural traits, overpopulation and changes in conditions that trigger migration (eg, depletion of food sources, predation and climate change; Box 3).

Box 2: Risk assessment for Canada geese (*Branta canadensis*) – An extreme threat category species

What is a risk assessment?

Risk assessments for vertebrate pests are based on generating scores for risk to public safety, risk of establishment and risk of adverse environmental and primary production impacts. The factors that contribute to the likelihood that a pest animal will become established are described in Section 3.2.3. Simple quantitative models are used to determine the scores (Bomford 2008). However, the quality of assessment output is dependent on the availability of data for the species (eg, its range, adverse impacts and history of previous introduction) and the expertise of the assessor. Different models are used for the assessment of exotic birds and mammals, reptiles and amphibians, and freshwater fish (Bomford 2008). The following example of how scores are calculated is based on a risk assessment performed by M. Braysher for Canada geese using an earlier version (Bomford 2003) of the Bomford (2008) risk assessment models and on a report by Dawes (2008). There were deliberate introductions of Canada geese into Australia in the early 1900s and there have been several incursions involving small numbers of birds. While the species has not become established in Australia to date, immediate eradication is recommended on incursion due to risks associated with air traffic, public health, agriculture, and natural and urban environments.

Stage 1 – Probability escaped or released individuals will cause harm to people

A. Risk from individual escapees = **0 (0-3*)**; nil risk or only minor injuries possible; **not dangerous.**

Stage 2 – Probability escaped or released individuals will establish a free-living population

B. Climate match between overseas range and Australia = **4** (1-6); well established in temperate climates such as New Zealand.

C. Exotic population established overseas = **4** (0-4); New Zealand, United Kingdom, the Netherlands, Belgium and Scandinavia (Canada geese are native to North America and Mexico).

D. Taxonomic class = **0** (0-1); bird (mammals, reptiles and amphibians score 1).

E. Breeding potential = **1** (0-1); may produce more than one brood per year.

F. Non-migratory behaviour = **0** or **1** (0-1); facultatively migratory in natural range (would not be migratory in Australia).

G. Diet = **1** (0-1); generalist, broad diet.

H. Lives in disturbed habitat = 1 (0-1); lives in urban, suburban and agricultural habitats.

Establishment risk score = 4+4+0+1+[0 or 1]+1+1 = 11 or 12 (1-14);

1-7 = low establishment risk; 7-8 = moderate establishment risk; 9-10 = high establishment risk;

>10 = extreme establishment risk.

Stage 3 – Probability an exotic species would become a pest

I. Taxonomic group = **2** (0-4); bird in a family (Anatidae) that causes agricultural damage.

J. Overseas range size = **2** (0-2); over 30 million square kilometers.

K. Overseas abundance (past and current) = **1** (0-1); is common or abundant within its natural and introduced distribution.

L. Diet and feeding = **0** (0-3); herbivorous animal.

M. Competition with native fauna for tree hollows = **0** (0-2); does not use tree hollows.

N. Overseas environmental pest = **2** (0-3); competes for wetland habitat, distributes noxious weeds, carries parasites that can infect native waterfowl, has potential risk of genetic dilution of Cape Barren goose (capacity to hybridise currently unknown).

O. Climate match to area of susceptible native species or communities = **4** (0-5); overlaps with endangered species or communities.

P. Overseas primary production pest status = **2** (0-3); causes production losses in pasture and feeds on a broad range of crops.

Q. Climate match to susceptible primary production = **2** (0-5).

R. Spread disease = **2** (0-2); known carrier of avian influenza, *Campylobacter, Listeria, Eschericia coli, Salmonella.*

S. Harm to property = **1** (0-3); air transport damage, general nuisance.

T. Harm to people = **0** (0-5); nil risk.

Pest risk once established = 2+2+1+0+0+2+4+2+2+2+1+0 = 18 (0-38);

<9 = low pest risk; 9-14 = moderate pest risk; **15-19 = high pest risk**; >19 = extreme pest risk.

Cumulative risk score = 0+[11 or 12]+18 = 29 or 30; >20 = VPC extreme threat category species

* Numbers in parentheses represent the possible score range.

Box 3: Effects of climate change on pest animals

Climate change in Australia

Average land temperatures over Australia have increased by 0.7°C over the last 50 years, with some areas, including the ACT, increasing by 1.5 to 2°C (CSIRO and BoM 2010). There have also been more record hot days, fewer record cold days, and decreasing rainfall across much of southern and eastern Australia (up to 50 mm per decade). By 2070, average Australian land temperatures are predicted to rise from between 2.2 and 5°C. Further reductions in rainfall, particularly in spring, are likely in southern and eastern Australia, but there will be an increase in the intensity of rainfall events in many areas.

Effects of climate change on pest animals

Climate change is expected to lead to (Low 2008, Steffen *et al*. 2009):

- new invasions of exotic animal species;
- enhanced establishment by recent pest animal arrivals;
- expansion of 'sleeper' species into niches vacated by other native or exotic animals;
- a greater competitive edge for some established pest animal species, particularly in environments disturbed by extreme weather events (fire, cyclone, flood, drought);
- escape of exotic animals from captivity during extreme weather events;
- increased rate of spread of aquatic pest animals through flooding and diversion of water supplies over long distances; and
- changes in pest animal distribution ranges and population densities (eg, rabbits shifting south as northern areas become too hot and dry).

Managing the consequences of climate change effects on pest animals

Predicted effects of climate change on pest animal incursions, and on changes to their population size and distribution ranges, are likely to exacerbate losses in biodiversity, primary production and urban amenity due to the damage that the pest animals cause (Sections 1.1.2 and 4.3.1). For example, increased cat, rabbit, pig and horse populations at higher altitudes in the Australian alps have been linked with reduced snow cover due to climate change (Pickering *et al*. 2004). Also, insect pests of crops are expected to produce more generations each year because of higher temperatures, with greater survival of overwintering species and outbreaks developing faster in spring (Hall 2007).

Climate change analyses rarely take full account of invasive pest animal species, and future risks of pest animals are underestimated in climate change scenarios (Low 2008). Key strategies for managing increased pest animal risks under climate change include (Low 2008; Steffen *et al.* 2009):

- increasing awareness and understanding about pest animal species and the damage that they cause (Section 6.2);
- improving quarantine and biosecurity, including the capacity to identify new exotic animal species (Section 2.4 and this chapter);
- improving bioclimatic modelling to predict pest animal distribution ranges;
- greatly increasing investment in pest management technologies, including biological control (Section 4.4);
- removing 'sleeper' populations of pest animals and outliers from the leading edge of changing distribution ranges;
- managing connectivity to minimise dispersal of pest animals into new areas;
- building ecosystem resilience by ameliorating other threats to valued social, environmental and economic resources;
- developing risk mitigation and emergency plans for the outcomes of extreme weather events such as pest animal escape and dispersal, and clean-up operations; and
- conducting strategic research to address gaps in knowledge (eg, the effects of climate change on herbivorous insects).

Exotic species already established in the ACT have the potential to become pest animals by several mechanisms. Some animals may be categorised as 'sleeper' species, that is, established animal species that have not yet formed large and widespread populations but are regarded as having significant invasive potential. This potential may be realised once a critical population size is reached, in response to modification of the environment, or because population numbers reach a critical threshold where damage becomes apparent. An established animal species may also assume pest status because of a change in community attitudes (eg, the animal becomes a carrier during an outbreak of disease). The potential risk associated with established animal species can be determined using the risk assessment procedures described in Section 3.2.1.

3.2.3 Capacity for survival and establishment

The likelihood that an introduced animal species will survive and establish wild populations is greatest when it (NRMSC 2004, Bomford 2008):

- exhibits a strong correlation between its overseas climatic range and the Australian climate;
- has a history of establishing exotic populations outside Australia;
- inhabits a broad geographic range outside Australia;
- is a mammal rather than a bird, reptile or amphibian (for vertebrates);
- is non-migratory within its geographic range;
- originates from the wild;
- is a herbivore and/or prefers a generalist diet;
- can live in human disturbed habitats;
- is released in large numbers, at multiple sites, and on multiple occasions;
- is released at favourable times for factors such as weather, season, or breeding season;
- is healthy when released;
- can rapidly produce a large number of offspring in a range of nesting habitats;
- exhibits flocking or herding behaviour;
- occupies its own niche (avoids competition); and
- has low monetary value and is kept by a large number of people under poor security.

An example of a group of pest animals that display many of the attributes promoting survival and establishment in the wild are the prohibited fish species Tilapia. The Mozambique mouthbrooder is the most widely established of the Tilapia species and its attributes are described in Box 4.

3.2.4 Disease risks

An imported animal species may not cause damage in its own right, but may be a carrier of parasites or pathogens that are the agents of human, animal or plant disease. The disease risk is often considered as an integral part of animal, plant and goods import risk analyses (Biosecurity Australia 2009). Emergency response plans for disease incursions are developed under national biosecurity agreements (Section 2.4.3), including plans for outbreaks of disease in livestock and poultry (AUSVETPLAN), plants and crops (PLANTPLAN) and aquatic animals (AQUAVETPLAN) (www.daff.gov.au/animal-plant-health/emergency). Animal diseases are listed in the

National Notifiable Animal Diseases List and National List of Reportable Aquatic Animal Diseases (www.daff.gov.au/animal-plant-health/pests-diseases-weeds). Endemic and exotic animal diseases that are notifiable within the ACT are declared under the *Animal Diseases Act 2005* (http://www.legislation.act.gov.au/a/2005-18/di.asp). Information on individual animal diseases is available from the National Animal Health and Information System (Animal Health Australia 2010). Human disease responses are managed nationally by the Australian Government Department of Health and Aging and within the ACT by the Health Directorate.

Box 4: Potential for establishment by a prohibited species of Tilapia

What are Tilapia?

Tilapia are freshwater fish belonging to three genera (*Tilapia* spp., *Oreochromis* spp. and *Sarotherodon* spp.) that inhabit a wide variety of waterways including weedy streams, canals, irrigation ditches, dams and small lakes (Molnar and Daniels 2007). Approximately 150 species have been imported into Australia as aquarium fish (NSW DPI 2005a) and some of these species have been deliberately or accidentally released. The Mozambique mouthbrooder (*O. mossambicus*) is the most widely established Tilapia species in Australia, occurring in Queensland as far south as Brisbane and in Western Australia north of Geraldton (NSW DPI 2005a). It is recognised by the Invasive Species Specialist Group (ISSG 2008) as one of 100 of the world's worst invasive alien species and is a declared noxious fish species in all Australian jurisdictions (NRMMC 2007b) because of the damage it causes to native fish and invertebrates.

Breeding strategies

The Mozambique mouthbrooder produces a large number of offspring (potentially 1200 eggs per year) in up to four brooding events (NSW DPI 2005a). Multiple brooding events increase the likelihood that conditions will be favourable for the survival of fry upon hatching. The female protects her offspring from predation after spawning by taking the eggs into her mouth and keeping them there for up to two weeks after hatching. Hatched fry are allowed to re-enter the female's mouth for temporary protection for another week. Mozambique mouthbrooders are large fish up to 36 cm in length that may live for 13 years, reaching sexual maturity at around three years and 15 cm. Even when environmental conditions limit growth, stunted adults can reach sexual maturity at around 9 cm. For these reasons Mozambique mouthbrooder populations can reach extremely high population densities in Australian waters (IACRC 2007).

Damage

Tilapia are primarily algae and plant feeders (Molnar and Daniels 2007) but Mozambique mouthbrooders also prey on native fish eggs and compete with native species for a range of small invertebrates. Recent research (Doupe *et al.* 2009) has demonstrated the capacity for Mozambique mouthbrooders to prey on a range of juvenile Australian fish species, so its potential for damaging aquatic biodiversity is greater than initially thought.

Environmental tolerance

Although Mozambique mouthbrooders are not present in NSW or the ACT, they can tolerate a wide range of environmental conditions (Merrick and Schmida 1984) and have been recognised for their invasive potential in the Murray-Darling river system (NSW DPI 2005a). They can live at a range of salinity levels, at high temperatures and in low oxygen environments (Molnar and Daniels 2007). Importantly for the ACT, Mozambique mouthbrooders have shown the potential for acclimation to lower temperatures, retaining the capacity to swim and displaying a capacity to increase their metabolic activity in laboratory tests (Schnell and Seebacher 2008). This attribute means that Mozambique mouthbrooders have the potential to expand their range south and inland from established populations in Brisbane and north of Geraldton, into cooler environments.

3.3 Regulation, surveillance and response activities in the ACT

3.3.1 Prevention, rapid detection and early response

Prevention of pest animal incursions into the ACT is regulated by the Licensing and Compliance unit within TAMSD. Retailers are restricted in the exotic animals that can be sold under the NC Act (Section 2.3.2) and the *Fisheries Act 2000* (Section 2.5; Table 2) and are required by licence to notify the Licensing and Compliance unit of the species that they import. The Licensing and Compliance unit provides information on selected pest risks. For example, information is provided to the landscaping and nursery industries on the risk of introducing red imported fire ant (a notifiable species under the Pest P&A Act; Section 2.3.1) in high-risk materials such as potting mix and mulch[1]. The unit also collaborates with the NSW Government to monitor fruit fly incursions at permanent baiting stations.

Where regulatory activities are unsuccessful in preventing a pest animal incursion, or a species migrates across the border from NSW, rapid detection is essential for providing an early management response. This can be best achieved through development of a communication strategy for high-risk species that informs land managers and the public about the animal's appearance, distinguishing features, pest potential and likely habitat range. Clear contact details for reporting actual and possible sightings are also required.

In 2004, the ACT Government developed a communication strategy to address potential incursions by the red-eared slider turtle. The communication strategy was launched to gain public assistance in detecting and reporting red-eared slider turtles after unconfirmed sightings at the Belconnen Golf Course. A further goal of the strategy was to minimise false reporting of native turtles as red-eared slider turtles. Communication was achieved via a media release, identification poster (Box 5) and pamphlet, accompanied by a form for reporting possible sightings (also available online). Although a number of possible sightings were reported, none were confirmed as red-eared slider turtles. The communication strategy was complemented by a trapping survey that detected only native turtles in water bodies near the Belconnen Golf Course.

3.3.2 Response plans for high-risk species

For high-risk pest animals (Section 3.2.1) response plans may be developed under national biosecurity agreements (Section 2.4.3) to set out emergency measures for dealing with incursions or disease outbreaks. These agreements have been put in place to deal with serious pest or disease outbreaks (such as foot and mouth disease) in a nationally consistent way. The agreements establish the reporting obligations, emergency phases, response plan procedures and standards, management of response plans, cost-sharing and funding principles, and processes for consultation and accounting. The ACT Government is a signatory to these agreements.

The VPC is currently developing an interpretive guide for the National Environmental Biosecurity Response Agreement (Section 2.4.3) to be used in preparing for, or responding to, a vertebrate pest (or associated disease) incursion. ACT Government key contact details for different stages of the response process are being included in the guide to assist in the coordination of a national response to any future incursion.

3.3.3 Eradicate or contain?

One of the key decisions that needs to be made before or during a new pest animal incursion is the appropriate level of management response. Options for response include eradication, containment within specified boundaries, ongoing management (Chapter 4) or taking no action. For high-risk pest animal species (Section 3.2.1) a decision may be made to attempt the eradication of escaped or released animals, or newly established population(s). Performing cost benefit analyses of the different management options is an essential part of the risk assessment process, as demonstrated for the national European house borer eradication program (Box 6).

1 Imported mulch is also a possible source of recent cane toad incursions into Sydney (http://www.environment.nsw.gov.au/media/DecMedia10031101.htm).

Box 5: The red-eared slider turtle communication strategy poster

Box 6: European house borer eradication program

Background

In 2004, the European house borer (an insect pest of dead coniferous trees and seasoned coniferous timber) was detected in Western Australia for the first time. Prior incursions into eastern Australia had been eradicated successfully through fumigation of infested materials. The infestations in Perth were first judged to be eradicable in 2006, with the acknowledgement that eradication could take more than a decade. Because of the potential for this pest to spread to other jurisdictions, which would result in high costs for the timber and housing industries and individual home owners, a national program supporting surveillance, containment and assessment of eradication feasibility was initiated under the Primary Industries Ministerial Council. Since 2007, all government jurisdictions in Australia have contributed to the program through a cost-sharing agreement.

Cost benefit analysis

An Australian Bureau of Agricultural and Resource Economics cost benefit analysis of different management options for the European house borer (DAFWA 2009) showed that:

i) taking no action would cost $2.4 billion in damages over 30 years;

ii) adopting a containment strategy without eradication as a goal would cost $345 million over 30 years; and

iii) eradication would cost $50 million over 17 years (2004-2021).

Outcome

This example demonstrates that, although eradication programs may be considered prohibitively expensive, they may also represent the most cost-effective option in the longer term. However, one challenge for managers of long-term cooperative pest management programs is to retain ongoing commitment from the participating stakeholders. In 2009, industry partners on the European house borer program withdrew financial support covering 20 per cent of the program's operational costs. The feasibility of the eradication goal for the European house borer was reconsidered by all Australian government jurisdictions in 2010. The European house borer is no longer considered to be eradicable from infested areas of Western Australia. The focus of the national management program is under transition from eradication to prevention of its introduction into uninfested areas of Western Australia and other jurisdictions.

REDUCING DAMAGE BY ESTABLISHED PEST ANIMAL SPECIES

Key Principles

- **Pest animals are exotic species that cause unacceptable social, environmental or economic damage** to a valued resource. Hence humans determine whether an animal is a pest or not. The pest status of an animal can vary over space and time according to the degree of damage caused and the attitude towards the animal of those affected by the damage.
- **Management programs should strategically target actual (rather than perceived) pest problems** at appropriate locations and times, using scientifically valid techniques that optimise animal welfare in accordance with agreed Codes of Practice.
- Pest animals are only one of several factors that can cause damage to a human or biological system. Other factors include weeds, varying climatic conditions, fire, and land management or production activities. Hence **pest animal damage should be managed using a whole-of-system approach** to achieve the most beneficial social, environmental or economic outcomes, namely, to reduce the damage that pests cause to an acceptable level, not merely to reduce pest numbers.
- Most biological systems, whether they are managed for production, conservation, urban amenity or a combination of these goals, are complex and our knowledge of them is imperfect. There is a risk that interventions to manage the damage due to pests may not have the desired outcome. Pest animals may adapt their behaviour as a result of intervention measures or respond unexpectedly to factors such as climate change. **Priorities and resources for pest animal management** therefore **require a risk management approach** to identify, assess and address often imprecise threats within acceptable risk levels.
- **Accurate monitoring and evaluation is required** before, during and after the implementation of pest management programs to ensure that the benefits obtained exceed the risks and costs of management activities. Continuous improvement should be achieved by implementing an adaptive management approach.

Objective	Strategic Action
2. Reduce damage caused by established pest animal species.	2.1 Identify established pest animal species in the ACT. 2.2 Assess damage against management objectives. 2.3 Assign priority to high-impact pest animal species and high-value sites/assets using a risk management approach, and implement priority management programs with appropriate operational and performance monitoring and assessment. 2.4 Develop Pest Animal Management Plans to specify management methods and stakeholder responsibilities, and to provide the statutory basis for compliance and enforcement.

4.1 Introduction

When capture of escaped animals fails, or new incursions cannot be eradicated or contained (Section 3.3.3), an exotic species may either die out naturally (eg, through predation, competition or inability to adapt to the environment) or become established in wild populations (Olsen 1998). Not all established populations of exotic species represent a pest animal management problem. Established species are most likely to become pests when they (NRMSC 2004, Bomford 2008):

- have a climatic range that overlaps with sensitive primary production, native plant and animal species or ecological communities;

- are (or are related to) agricultural or environmental pests overseas;
- are predatory, grazing or browsing animals (for vertebrates);
- have the capacity to harm people;
- can be a vector or carrier of disease;
- can damage infrastructure and equipment;
- use tree hollows for nests or shelter; and
- have a wide geographic range outside Australia.

When the activities of established pest animal populations cause either perceived or actual social, environmental or economic damage, there is a need to evaluate whether management for damage reduction is required. This chapter expands on the strategic approach to developing and implementing pest animal management programs outlined in Section 1.2. The significance of the species to stakeholders as a pest animal should be determined (Section 4.2; Appendix 1) through direct (damage) or indirect (species abundance and distribution) assessment of its potential to cause damage or of the extent of damage caused (Section 4.3). The ability to initiate a management program is dependent on access to effective, economically-viable and socially-acceptable management options (Section 4.4). Even where suitable management options are available, it may be difficult to predict their efficacy in complex environments and resource constraints may limit the scope of their application. Because of these limitations, a risk management approach is required in setting desired program objectives and outcomes (Section 4.5, Appendix 2). Monitoring and assessment of resource use during the operational phase of management programs, and of performance success in reducing pest animal damage or abundance (Section 4.6), provides essential data for modifying programs to ensure the effective and efficient delivery of desired management outcomes, ie, using an adaptive management approach (Section 4.7).

4.2 Identifying established pest animal species

4.2.1 Established Species of National Significance

National lists have been developed for established exotic vertebrate animals, noxious fish species, pests of plants and plant products (Section 3.1.3) and animals that cause or carry disease (Section 3.2.4). For vertebrate pest animals, Established Species of National Significance have also been identified for assessment under the National Monitoring and Evaluation Framework (NLWRA and IACRC 2008). Designation of Established Species of National Significance is based on current knowledge of their abundance, distribution and the damage that they cause, and reflects national, state and territory pest management priorities.

Established Species of National Significance include pigs, cats, goats, six species of deer, rabbits, foxes, carp, cane toads, starlings and wild dogs. It is likely that camels, horses, donkeys, water buffalo, banteng and the red-eared slider turtle will be included in future lists for monitoring and evaluation. The purpose of the national monitoring and evaluation program is to provide baseline and ongoing data on the extent and potential range of significant species, trends in population numbers (increasing or decreasing), and the nature and cost of pest animal damage and of the management options chosen to reduce it. An evaluation of the national significance of noxious fish species is being progressed through the VPC (M. Braysher personal communication) but there has been no equivalent evaluation of the national significance of invertebrate pest animals.

In future, species will be listed according to the National Categorisation System for Invasive Species (Section 3.1.3) as Established Pest Animals of National Significance.

4.2.2 Locally significant species

A number of the vertebrate pest animals listed as Established Species of National Significance also require management for damage reduction in the ACT (Appendix 1). ACT Government management priorities have included:

- baiting, fumigating and warren ripping of rabbit populations in conservation areas, non-leased rural lands, nature parks and open spaces (Section 6.2.2; Box 12);
- ground baiting and trapping of wild dogs in conservation areas adjacent to rural lands to reduce attacks on livestock (Section 4.4.2; Box 8);
- baiting of foxes in areas of high conservation value, and in cooperation with adjoining landholders to reduce predation;
- annual baiting of pigs in Namadgi National Park and other conservation areas to reduce damage to native plants, animals and ecosystems (eg, selective feeding, trampling, rooting for underground plant parts and invertebrates in moist soils, predation, competition and disturbance of native animals, and spreading of the rootrot fungus *Phytophthora cinnamomi* – Sharp and Saunders 2004a) (Section 6.5; Box 13); and
- surveillance and trapping to prevent the establishment of feral horse populations in Namadgi National Park after incursion from adjacent areas in NSW. There is also provision for aerial shooting of trap-shy animals in Namadgi National Park.

A comprehensive list of animal species that are established in the ACT and are either managed as pests or are recognised as having pest potential is provided in Appendix 1. Some established pest species are declared as pest animals under the Pest P&A Act (Section 2.3.1). Updates on the status of priority pests are routinely provided in ACT SoE reports (Section 2.3.4) (including emerging pest animal species). Strategies for managing these pest animal species are also provided in Appendix 1.

4.3 Assessing the damage

4.3.1 Damage assessment methods

One of the key principles of pest management is '*to reduce the damage that pests cause to an acceptable level, not merely to reduce pest numbers*' (Part 1; Section 1.2.2). This principle has been developed because the relationship between pest density and the level of damage is often poorly understood or quantified (Braysher 1993, Olsen 1998, Hone 2007). When a few individuals in a pest animal population are causing most of the damage (eg, wild dogs; Fleming *et al*. 2001), or when serious damage is being caused even at very low pest animal densities, then large reductions in pest numbers may be ineffective in reducing damage levels. For example, rabbits can cause significant ecosystem damage even at low densities by preventing native plant regeneration (Box 7). Conversely, relatively high pest animal densities may be able to be tolerated in some situations. Competition between sheep and rabbits for pasture in western NSW may be low when the pasture biomass exceeds 250 kg per hectare (Williams *et al*. 1995).

Box 7: Rabbit density and damage to native vegetation communities

Damage by rabbits to native vegetation

Introduction of rabbits into Australia has had a profound effect on the regeneration and species composition of native vegetation communities (Williams *et al.* 1995). Grazing of grasslands by rabbits can shift species composition from native perennial grasses to exotic annuals and many native grassland species may have disappeared without being recorded. Rabbits also selectively browse the seedlings and shoots of palatable shrubs and trees and may ringbark small trees during periods of low feed availability (eg, drought). Removal of rabbits through poisoning, exclusion fencing, introduction of biological control agents or other methods often leads to improved growth and seedling recruitment of palatable species when other factors such as rainfall are favourable (Friedel 1985, Williams *et al*. 1995, Denham and Auld 2004). For example, when rabbits were excluded from grazing on western myall (*Acacia papyrocarpa*) seedlings in the arid zone of South Australia, all seedlings increased in height and canopy spread over 15 months (Lange and Graham 1983). Exposure to an estimated density of 0.5 rabbits per hectare was sufficient to reduce the height and/or canopy spread of unguarded seedlings at this location.

For threatened buloke (*Allocasuarina luehmannii*) communities growing in semi-arid woodland in north-western Victoria, there has been little or no seedling recruitment observed (DPI Victoria 2008; F.A. Murdoch, S.R. McPhee and B.D. Cooke unpublished data). Exceptions occurred in high rainfall years in the 1950s when rabbit numbers were reduced through myxomatosis and in 1996 when kangaroos were culled and Rabbit Haemorrhagic Disease (RHD) arrived. In this study, the damage from rabbit browsing was considered to be intolerable (ie, requiring management) when the density was greater than three rabbits per spotlight kilometre and there were more than one active warren entrance per hectare and nine accumulated faecal pellets per quadrat (0.25 m^2). In temperate environments where vegetation density and biomass are typically higher, it is likely that higher rabbit densities can be tolerated.

Rabbit damage to sub-alpine areas

In a sub-alpine area of Kosciuszko National Park, rabbits have been shown to reduce the diversity, cover and biomass of native forbs (broad-leaved herbaceous plants) and remove flowers and seed heads (Leigh *et al*. 1987). Forbs are grazed by rabbits preferentially over native *Poa* tussock grasses because of their higher nutritive value (Leigh *et al*. 1991). *Eucalyptus pauciflora* and *E. stellulata* seedlings and shoots are also grazed, with ringbarking and death of trees occurring when feed is scarce after harsh winters (Wimbush and Forrester 1988). Rabbits may prevent regeneration of these tree species from basal shoots after fire and reduce seedling recruitment, particularly around warrens. Rabbits are favoured in sub-alpine environments by human activities such as hazard reduction burning and grazing by stock, which remove dense vegetation and promote shrub-free swards of easily-grazed, palatable species (Leigh *et al*. 1987, 1991; Wimbush and Forrester 1988). Rabbit reproductive rates increase when feed of higher nutritive value is available (Leigh *et al.* 1991).

Rabbit damage on Mount Pleasant Nature Reserve, ACT

Photograph by S. Taylor

Methods for measuring pest animal damage vary widely depending on the nature of the damage caused. Types of damage include (Hone 2007, Bomford 2008):

- reduced water quality and increased run-off;
- soil structural decline and erosion, including erosion from overgrazing and soil disturbance that can lead to weed invasion;
- altered growth, reproduction and species composition of native plant communities (and consequent changes to ecosystem structure);
- crop and pasture damage;
- changes in animal populations and production (including loss of livestock);
- spread of human, animal and plant disease;
- social and political damage such as loss of aesthetics, damage to infrastructure and public safety concerns; and
- economic damage such as agricultural production and trade losses, reduced property value and the cost of pest management programs.

Damage may be assessed through field sampling or questionnaires, or predicted through modelling of field-based and experimental data (Hone 2007, NLWRA and IACRC 2008). Methods available for assessing the damage caused by vertebrate pest animals to primary production and the environment are published in the Managing Vertebrate Pests series (ABARES; www.daff.gov.au/brs/ land/feral-animals/species) and in the Monitoring Techniques for Vertebrate Pests series (www.dpi.nsw.gov.au/agriculture/pests-weeds/vertebrate pests/general/monitoring-techniques). Methods for assessing invertebrate pest animal damage are often species-specific or are specific to the plant, animal or area of human health that they affect (eg, www.dpi.nsw.gov.au/agriculture/pests-weeds/insects).

While assessing the damage is the preferred means of determining the need for, and success of, pest animal management programs, accurate and widely accepted methods are currently available for only a limited number of species. Protocols for monitoring and reporting on the damage caused by Established Species of National Significance are under development by the VPC (NLWRA and IACRC 2008). Where accurate damage assessment methods are unavailable, then measures of pest animal abundance and distribution are commonly used as a surrogate measure of the size and extent of pest animal damage (Section 4.3.2). Assessment of pest animal abundance provides a valid substitute for damage assessment where the relationship between them is understood and quantified.

4.3.2 Assessment of abundance and distribution

Pest animal abundance can be assessed directly by counting individuals (usually in a given area to provide a measure of density) or indirectly, for example, by counting animal scats or active nests or burrows. Assessing abundance provides baseline information on pest animal populations (including their normal dynamic range), with subsequent monitoring (Section 4.6) indicating trends in population growth and response to management actions. When assessing pest animal abundance it should be remembered that many populations are unevenly distributed across the landscape, as individuals favour locations with adequate food, water and shelter, or flock for safety or breeding purposes. Abundance assessments should account for this variation by sampling at an appropriate scale and location (eg, within the pest animal's habitat or home range), at a time of day or season relevant to the species' behaviour, and with greater replication of sampling units where distribution is patchy and unpredictable (Olsen 1998; Hone 2007). The distribution range of a pest animal can be assessed by mapping its occurrence at a suitable spatial scale, and its full potential range can be predicted based on climate and habitat preferences (NLWRA and IACRC 2008). Methods for measuring the abundance of vertebrate pest animals are described in the published series referred to in Section 4.3.1. Methods for assessing invertebrate pest animal abundance can be found in scientific publications and on primary industries (eg, http://www.dpi.nsw.gov.au/agriculture/pests-weeds/insects) and human health (eg, http://www.health.sa.gov.au/pehs/PDF-files/mozzie-resource-aug06.pdf) websites.

4.4 Choosing pest management options

4.4.1 Principles

Once the need for management of a pest animal has been established through assessment of the damage that it causes, and its abundance and/or distribution, desired management outcomes should be identified as the first step in developing a pest management program. Ideally, pest management programs should be effective and efficient in maximising damage reduction and the longevity of management effects at the minimum cost and human effort (Braysher 1993). An overall aim of the program should be to reduce the need for ongoing management, and outcomes should be consistent with:

- the principles of Ecologically Sustainable Development (Harding 2006) in maintaining and enhancing social, environmental and economic assets and dealing cautiously with risk, uncertainty and irreversibility, so that the needs of current and future generations are not compromised;
- knowledge of animal welfare requirements and legislation (Section 2.3.3);
- the expectations (where well-informed) of stakeholder and community groups (discussed in Chapter 6); and
- the beneficiary pays approach in which the full costs of management are identified and assigned to individuals or entities that benefit socially, environmentally or economically from the management program.

4.4.2 Management options

The main options for managing pest animals include (after Olsen 1998):

- exclusion of pest animals (eg, conventional or electric fencing, protecting high-value stock in sheds and house yards, bird netting, guard animals, fish exclusion screens);
- use of biological control agents (eg, myxoma virus, RHD virus, pathogen-based insecticides);
- habitat manipulation (eg, destruction of burrows, nests or warrens, removal of water sources and shelter, removal of alternate plant and animal hosts, encouraging pathogens and predators, planting decoy crops, creating pest-free islands);

- killing and/or removing animals (eg, poisoning with sprays, baits and fumigants, shooting, trapping, mustering, commercial harvesting);
- other techniques (eg, diversifying or switching enterprises, coordinated breeding, deep sowing of crop seed, use of noise deterrents for birds, use of anti-fertility agents for confined populations); and
- choosing to take no action where desired outcomes cannot be practically achieved.

Integrated pest management involving use of a combination of these options is usually the most effective means of achieving desired management outcomes. This is because individuals within a population can become immune or resistant to chemical or biological control agents, or can learn to avoid baits, traps or areas where mustering and shooting occur. For example, wild dogs are managed in the ACT using a combination of ground baiting, ejector baiting, trapping and opportunistic shooting because individual animals may avoid one or more of these techniques (Box 8).

Strategic application of management options at critical stages in the life cycle of a pest animal can improve the effectiveness and efficiency of pest management programs (Olsen 1998). Management efforts should also be targeted at areas where social, environmental or economic assets are of highest value and before significant damage has occurred. For example, techniques for reducing pest animal numbers may be most effective and efficient:

- before the pest animal, or its food source, reproduces;
- when pest animal densities are already low (eg, in drought, early in a cropping cycle);
- when there is strong competition for food (eg, greater bait uptake occurs when grass is scarce);
- before new generations of pest animals have reached maturity and dispersed;
- where populations are concentrated at breeding sites;
- when applied to high-value crops;
- in paddocks immediately adjacent to high-value livestock; and
- in areas where vulnerable or endangered native plants, animals and ecosystems occur.

Many of the options for managing pest animals will cause some degree of animal welfare concern. In accordance with animal welfare legislative requirements (Section 2.3.3), pest management programs should utilise options '*that avoid or minimise pain, suffering and distress to target and non-target animals*' (Humane Vertebrate Pest Control Working Group 2004). Non-target vertebrates include people, domestic stock, pets and native animals that may be killed, injured or distressed by management actions. Minimising the number of animals affected is a well respected pest animal management principle, meaning that management programs are more desirable if they rapidly reduce the target population then intervene frequently to keep numbers low. Intermittent management programs that result in population recovery between management events constitute poor animal welfare.

Box 8: Management options for wild dogs in the ACT

Managing wild dogs in the ACT

Dingoes (*Canis lupus dingo*) and domestic dogs (*Canis lupus familiaris*) are capable of interbreeding (Fleming *et al*. 2001). In the ACT dingoes are classified as native animals and domestic dogs are considered to be exotic. Genetic testing of a large number of animals has shown that there are no feral dogs (domestic dogs gone wild) in the ACT region (A. Wilton unpublished data). The DNA evidence suggests that wild dog populations can best be described as being dingoes with a small proportion of domesticated dog genes. Pure dingoes cannot be distinguished from part dingoes in the field so they are managed as a single entity (ie, as wild dogs).

Wild dogs may perform an important role as higher order predators in natural ecosystems (Glen *et al*. 2007), irrespective of their genetic makeup or coat colour. The ACT Government therefore aims to maintain viable populations of wild dogs in conservation areas. However, livestock are killed and severely injured by wild dogs where their habitat is adjacent to or overlaps with rural properties. Wild dogs from Namadgi National Park and privately owned adjacent bushland killed up to 200 sheep per year between 2002 and 2008, causing production losses of up to $15,000 per year as well as personal trauma to rural families (N. Webb personal communication). Wild dog management is therefore a high priority for the ACT Government.

Management options

Effective management of wild dogs requires an integrated management approach, and ground baiting, poison bait ejectors (M-44s), trapping and shooting (Fleming *et al.* 2001; Thomson 2003; Sharp and Saunders 2004b) are used to target all animals within control areas in the ACT. On public land deployment of these techniques is concentrated in a buffer zone between areas where wild dogs are conserved and adjacent rural properties (where attacks on stock occur).

Ground baiting (Sharp and Saunders 2004b,c) involves burying meat baits containing the poison 1080 (sodium monofluoroacetate) at the edge of management trails that dogs commonly use as movement corridors. Baits are buried to minimise damage to non-target species such as quolls and birds. Ground baiting is regarded as being most effective when applied intensively at times of year when dogs show the greatest movement within the landscape. This is in autumn when adult dogs are mating and spring when older pups are dispersing. Baits are available free to rural landholders that participate in cooperative baiting programs with the ACT Government.

M-44 ejectors are baited, spring-activated devices that propel 1080 poison into a dog or fox's mouth as it pulls upwards on the bait (NSW National Parks and Wildlife Service 2010). Ejectors are particularly effective in less accessible movement corridors such as ridgelines and gullies because the encapsulated 1080 poison does not degrade and the bait remains attractive and lethal when triggered as long as the bait head remains in place. Damage to non-target species is minimised because the pull force required to activate ejector devices excludes many smaller non-target species, and the bait cannot be moved and cached by foxes to areas where it could poison domestic dogs.

Trapping using padded jaw traps (Sharp and Saunders 2004b,d) is an effective technique for removing dogs that do not take poison baits. The technique is generally target-specific and, if non-target species such as sheep or wombats become trapped, they can generally be released unharmed. Trapping is particularly effective for targeting individual dogs that are responsible for attacks on stock in a given area.

Shooting (Sharp and Saunders 2004b), while generally inefficient for routine management of wild dogs because of their shyness, can be used to manage individuals that repeatedly visit or attack stock in a given paddock, or have become bait or trap shy.

The use of guard animals is also seen as a humane alternative or adjunct to other forms of wild dog control (Sharp and Saunders 2008, Tyrrell and Hunt 2008). Dogs, llamas and donkeys can be used to repel predators, alert owners to disturbances in the flock and reduce reliance on less humane forms of control.

The ACT Government participates in regional cooperative wild dog and fox management plans to ensure that its wild dog management is coordinated at the landscape scale with similar programs in adjacent areas of NSW.

Monitoring and assessment of wild dogs and management programs

All aspects of the wild dog management program are monitored to ensure that delivery is as efficient and cost effective as possible (Fleming *et al*. 2001). The primary indicator of program success is the number of stock losses reported in relation to the number of sheep being grazed, which provides an assessment of the economic and social damage to rural landholders.

The ACT Government also monitors wild dog abundance in core conservation areas of Namadgi National Park and in the buffer zone adjacent to rural properties to ensure that management programs do not compromise conservation goals. Dog abundance is assessed by sand-pads (that show footprints) in forested areas.

Pest management options may also cause damage to invertebrate species that are not the subject of animal welfare concerns (eg, the natural predators of insect pests) and on the wider environment (eg, contamination of water, soils and produce or damage to plants; Olsen 1998). Pest management programs should incorporate mitigation strategies (where available) to minimise this damage.

Management options for vertebrate pest species are documented in the Vertebrate Pest Control Manual (NSW DPI 2007) and in the Managing Vertebrate Pests series (ABARES; www.daff.gov.au/brs/ land/feral-animals/ species). National model Codes of Practice for the humane control of cats, goats, horses, pigs, foxes, rabbits and wild dogs based on NSW Codes of Practice and Standard Operating Procedures (NSW DPI 2005b) are being prepared for release through the VPC. Codes of Practice for the humane control of other vertebrate pest animals can be found on the NSW Department of Trade and Investment, Regional Infrastructure and Services website (http://www.dpi.nsw.gov.au/agriculture/pests-weeds/vertebrate-pests/codes/humane-pest-animal-control).

Agricultural invertebrate pests are usually managed according to industry-specific crop and livestock guidelines; the NSW Government provides a useful online resource (www.dpi.nsw.gov.au/agriculture/pests-weeds/insects). Land managers should be aware that pest management options are frequently reviewed, refined or replaced in response to research findings and to observations and outcomes from pest management programs (Braysher 1993) and should check regularly for changes to recommended practices.

4.5 Risk assessment

4.5.1 Pest animal risk assessment guide

The overall strategic approach to pest animal management (Section 1.2) and the more detailed considerations in Sections 4.2-4.4 provide the background knowledge that underpins the development of a pest animal management program. However, developing site-specific local or regional pest management programs in accordance with ACT land use management objectives (Section 2.2) requires a structured decision-making process. As most biological systems are complex and incompletely understood, pest management actions may fail to reduce damage or pest animal numbers in the manner expected (Part 1; Section 1.2.2). Setting pest management priorities to achieve desired outcomes requires a risk management approach to identify, assess and address often imprecise threats within acceptable risk levels.

A risk management approach is also essential for guiding the allocation of limited resources available for pest (and other) management priorities. No land management agency would ever have sufficient resources to comprehensively reduce all damage caused by pest animals in the ACT (Appendix 1) across all land tenures. A structured risk assessment process allows limited human and financial resources to be strategically allocated to managing the pest species that are causing the most damage and to protecting the social, environmental and economic assets of highest value. This is particularly important where there are a number of high-priority species causing damage or high-value assets at risk. A structured risk assessment process enhances transparency and accountability to stakeholders and the public in the delivery of pest animal management programs.

A pest animal risk assessment guide has been developed to assist ACT land managers in deciding whether a pest management program will be beneficial in reducing pest damage on their land management unit (Appendix 2; Harrison and Congdon 2002, Braysher and Saunders 2003). The guide is comprised of five steps, with each step providing a series of multiple choice statements or questions. The guide prompts land managers to consider:

- what is already known about the risks associated with a species including pest, public safety and disease risks (Step 1);
- whether the species is causing apparent damage to social, environmental or economic assets (Step 2) that warrants a more rigorous assessment of actual or potential damage (ie, using damage, species abundance and/or distribution assessment methods) (Step 3);
- where actual or potential damage levels are unacceptable (Step 3), whether pest management should be given priority relative to other management activities for primary production, conservation and/or urban land uses (Step 4); and
- whether there are effective, efficient and cost-effective pest management options available for the species that can be easily implemented without compromising the environment, public safety, animal welfare (including non-target species) or the ability to manage the pest in the future (Step 5).

Multiple choice statements and questions in the pest animal risk assessment guide may recommend that the land manager undertakes a cost benefit analysis. Cost benefit analyses are used to determine the economic viability of a pest management program, and for comparison of alternative pest management options (Hone 2007). To perform the analysis, the total economic benefits from undertaking pest management are divided by the total costs of the management program. If the benefits of pest management exceed the costs ie, the benefit to cost ratio is greater than one, then pest management is likely to be economically viable. Cost benefit analysis can be complex, for example, factors that need to be taken into account in performing a cost benefit analysis for rabbit control on rural land include (Williams *et al*. 1995):

- production losses;
- gross margins;
- commodity prices;
- rabbit density (and the cost of estimating it);
- relative pasture intake of rabbits and stock;
- cost, effectiveness, frequency of application and long-term benefits of different control methods;
- the potential for rabbit numbers to increase following management efforts (eg, varies in high and low rainfall years);
- expected improvements in pasture biomass (quantity) and/or composition (quality) after rabbit removal;
- agreed or legislated stocking rates; and
- the total carrying capacity of the property (for all grazing animals).

Where the costs and/or benefits of pest management are social or environmental rather than economic, then land managers make a judgement on the desirability or cost-effectiveness (Hone 2007) of a program based on 'acceptable' social and environmental asset value(s) and the availability of resources for undertaking management programs.

Data for performing risk assessments and cost benefit analyses may be difficult to obtain. For example, carp are believed to lower water quality and to damage aquatic habitats, affecting water suppliers, irrigated agriculture, commercial and recreational fisheries, and freshwater ecological communities (Koehn *et al*. 2000). However, there is limited knowledge on the biology, population dynamics and ecology of carp, and standardised indices of carp abundance are yet to be developed. There is also a lack of quantitative data available on the damage

carp cause, the economic and environmental costs of that damage, and the efficacy and cost effectiveness of a range of harvesting and management methods. Until such gaps in knowledge are addressed, the risk assessment process and the development of realistic management objectives (Section 4.5.2) may not be readily achieved. Where there are no reliable methods for damage assessment, it is difficult to demonstrate that effective damage reduction has been achieved as a result of intervention.

If the pest animal is migratory, or has a home range that overlaps with adjacent land management units, then long-term reduction of pest animal damage is most likely to be achieved through a coordinated management approach across land tenures. In this case, all relevant land managers and other stakeholders (Section 2.2.2) should participate in the risk assessment process which can be facilitated by organising one or more pest management workshops. The level of stakeholder interest in participating in pest management workshops will vary according to individual land management objectives (Section 2.2.1). Step 4 of the pest animal risk assessment guide (Appendix 2) allows land management priorities to be considered simultaneously for primary production, conservation and urban land uses. Guidelines for facilitating pest management workshops (Braysher and Saunders 2003) that were used in the development of the risk assessment guide should be referred to in conjunction with Appendix 2. The principles for ensuring good stakeholder communication and positive workshop outcomes are discussed in detail in Chapter 6 and Appendix 3.

4.5.2 Pest management plans

Where risk assessment indicates that pest management will be beneficial, the next step is to develop a pest management plan[1]. The purpose of a pest management plan is to convert the land management priorities, preferred management options and associated risks identified through the risk assessment process (Section 4.5.1) into a set of actions with specific management outcomes, the success of which can be determined using appropriate performance measures (Braysher and Saunders 2003). The pest management plan may be developed for a single land management unit or as an integral part of a broader urban, catchment, whole-farm or conservation management plan.

Pest management plans should be agreed by all land managers and typically include:

- the main aim of the pest management program with respect to damage reduction;
- the types and extent of damage present and how they are caused;
- a set of specific actions and desired management outcomes (eg, a given percentage reduction in pest damage, population numbers or public complaints; asset quality improved to a specified level);
- the management option(s) that will be used to achieve the outcomes (in accordance with animal welfare Codes of Practice; Section 4.4.2);
- criteria for failure (eg, targets to be achieved within a specified period) and associated contingency plans;
- the costs (per unit area or animal) of management actions and the breakdown of who will pay for them;
- any public/occupational health and safety, environmental or animal welfare risk mitigation measures;
- the strategy and methods for monitoring and assessing the success of the management program (Section 4.6);
- the names of the people responsible for achieving and reporting on outcomes;
- a timeframe and milestones for completing actions and achieving outcomes; and
- a comprehensive communication strategy to keep key stakeholders informed of progress and to foster long-term commitment to management program aims (Section 6.3).

1 'Pest management plan' is used here as a general term in contrast to the Pest Animal Management Plan that is a statutory instrument under the ACT Pest P&A Act (Section 2.3.1). Note that urban pest animals controlled as a duty of care to reduce social nuisance are not subject to the development of a pest management plan.

4.6 Operational and performance monitoring and assessment

Monitoring and assessment are essential steps for determining whether pest management programs have been as efficient and cost-effective as possible (operational monitoring) and whether they have reduced pest animal damage or numbers to acceptable levels (performance monitoring). Monitoring involves taking systematic and repeated measurements that are relevant to the outcomes, techniques and costs defined in the pest management plan (Section 4.5.2). Assessment is the objective review of pest management programs based on the monitoring information. Without appropriate monitoring and assessment, it is difficult to accurately report on program outcomes, respond to changes in pest animal status or stakeholder priorities, or compare new management options with those already in use (Braysher and Saunders 2003). The methods and resources required for monitoring and assessment should be agreed by all stakeholders before a pest management program commences and should be clearly stated in the pest management plan (Section 4.5.2).

Monitoring during the operational phase of pest management programs involves recording expenditure on items such as chemicals, equipment, labour and transport, and the time taken for holding stakeholder meetings, delivering management techniques and monitoring their success. If more than one technique is used, or the amount or delivery of a technique is varied, then monitoring and assessment methods should allow individual treatments to be compared.

Performance monitoring is achieved using the same damage, species abundance and/or distribution measures described previously to determine the need for pest management programs (Section 4.3). Performance monitoring aims to assess the longevity of management effects as well as the absolute reduction in pest animal damage or numbers. The monitoring program should be conducted in a manner that allows the effects of management on the pest animal to be distinguished from the effects of other external factors (eg, rainfall, feed availability, changes in competition/predation and changes in pest management operator). Information from monitoring programs should be stored in databases to facilitate reporting and the assessment of long-term trends in pest animal damage, abundance, distribution and management costs.

Performance monitoring can also assist in setting or refining 'acceptable' or threshold pest damage levels, above which management action is required. Below threshold levels, social, environmental or economic assets may be improved by pest management action, but the benefits are outweighed by the costs and/or effort required (Olsen 1998). Where pest management action has been successful, ongoing monitoring is often necessary as pest animal populations recover and damage and density thresholds are again exceeded. Practically, a safety margin needs to be built into threshold levels for management action, because of the delay between detection of increased damage or population density and the initiation of a management response.

Summaries of the operational plans for, and outcomes of, ACT Government vertebrate pest animal management programs, including the expenditure on each program, are produced annually (Section 2.5). From 2012, the Vertebrate Pest Management Operations Plan and Vertebrate Pest Management Annual Report will be publically available on the TAMSD website (p. 8; Strategic Action 4.3 performance indicator).

4.7 Adaptation to change

When undertaking a risk assessment, stakeholders consider the degree of risk that the species represents, the level of damage caused, and the suitability, feasibility and cost effectiveness of available management options for achieving desired damage reduction outcomes (Section 4.5). All of these factors are subject to change. For example, disease risks may be lessened by access to an effective vaccine, seasonal weather patterns may reduce expected damage levels, new research may produce a more cost-effective or humane management option, or the land use may change so that the species no longer causes damage.

For these reasons, management programs need to remain adaptive to change and mechanisms should be built in at the planning stage to allow for strategic review and modification by stakeholders (Braysher and Saunders 2003). It may be necessary periodically to repeat the risk assessment process and cost benefit analyses, and to refine the specific actions, desired management outcomes and the criteria for success and failure originally agreed by stakeholders (Section 4.5.1; Appendix 2). Data generated during operational and performance monitoring and assessment may also indicate the need for a modified management program (Section 4.6). These are the elements of an adaptive management approach which ensures that insights gained during the management program, particularly in areas where prior knowledge is limited, are incorporated into future program activities to maximise the chance of success, benefits to stakeholders and efficiency of resource use.

A common problem in natural resource management programs is that monitoring and assessment is undertaken simply to meet regulatory or agreed reporting requirements, and that the outcomes do not contribute to improved stakeholder understanding or ongoing modification of management goals (Allen *et al.* 2001). Mechanisms that may improve the adaptive management process include (Allen *et al*. 2001; Braysher and Saunders 2003):

- centralised, internet-based access by all stakeholders to monitoring data (ensuring anonymity of data from individual land managers), workshop minutes and reference materials;
- external auditing of the monitoring and assessment process when data are collected by multiple stakeholders; and
- stakeholder workshops, including participants with appropriate knowledge and experience, to share and understand new information such as collaborative research results (Section 6.3).

MANAGEMENT OF NATIVE ANIMALS FOR DAMAGE REDUCTION

Key Principles

Native animals are a natural and integral part of urban, rural and conserved ecosystems but **may require management for damage reduction** where adverse impacts on social, environmental or economic assets are unacceptable. Management programs for damage reduction should **take into account the value and vulnerability of affected assets and the expected benefits from intervention.** Desired outcomes from native animal management programs may vary according to land use, but should always be developed **with reference to the overall conservation status of the species in the ACT.** Consideration should be given to managing and regulating native animals under nature conservation and animal welfare legislation.

Objective	Strategic Action
3. Manage native animals appropriately to achieve damage reduction and conservation.	3.1 Investigate amending legislation so that management of native animals for all purposes is specified exclusively under the NC Act and the Animal Welfare Act. 3.2 Determine overall population viability thresholds for high-impact native animal species requiring management for damage reduction in the ACT. 3.3 Support research and development of humane management options for high-impact native animal species requiring management for damage reduction.

5.1 Introduction

Native animals are similar to pest animals (Chapters 3 and 4) in that they can cause unacceptable damage to valued social, environmental and economic assets. Damage by native animals is most likely to occur when their population numbers have increased or their behaviour has changed in response to humans or their alteration of the natural environment (eg, magpie attacks in the ACT; Box 9). Native animals may also cause damage when they are translocated to areas where they do not naturally occur (Olsen 1998).

The key principles for managing native animals that cause damage are similar to those described for exotic pest animals (Part 1; Section 1.2.2) except that native animals are primarily managed under different legislation (Section 2.3.2) and to achieve different outcomes (Conover 2002). Native animals are generally accepted as a natural and integral part of urban, rural and conserved ecosystems but they may be managed for specific conservation purposes or to maintain a valued resource (eg, bag and size limits for fishing of Murray cod and golden perch). Management of native animals to alleviate damage occurs when they pose a health and safety risk or public nuisance, or compromise a particular land use objective such as primary production or conservation. For example, heavy grazing pressure from kangaroos (and other grazers) can affect the habitat and abundance of threatened plant and animal species inhabiting modified lowland grassy ecosystems in the ACT, particularly during drought (ACT Government 2010). In cases such as these, the management objective should be to minimise the risk of damage or the actual damage associated with the native animal to 'acceptable' levels (Section 4.3; Conover 2002). Management of a native animal is most appropriate where the viability of a high-value asset is threatened and where the threshold for unacceptable damage has been identified.

Management of native animals can polarise community views, particularly when lethal control (culling) is proposed. Management programs for native animals may require a longer consultative phase than those for exotic pest animals, and may need strong political support and evidence of the extent of damage, the effectiveness of damage mitigation, consideration of all alternatives to lethal control and a valid licence to proceed. The principles for educating and engaging with stakeholders and the community on pest and native animal management issues are addressed in Chapter 6.

Box 9: Swooping by Australian magpies *(Cracticus tibicen)* in urban Canberra

Introduction

The Australian magpie is the most frequently recorded bird species in surveys of Canberra gardens, with average abundance increasing since the 1980s (COG 2009). Magpies are ground feeders with a diet consisting of a wide range of invertebrates (eg, earthworms, crickets, beetles, grasshoppers, ants, spiders), small vertebrates (eg, frogs, lizards, mice), carrion, seed, grain, tubers and fruits (Kaplan 2004). Their increased abundance may be due to their broad, generalist diet, including an ability to exploit urban resources (food scraps in schoolyards and parks, insects in watered lawns and playing fields, road kill), the suburban 'open woodland' habitat structure, and their high tolerance for the presence of humans and their activities (Jones 2002, Warne *et al.* 2010). Magpies are generally popular with urban dwellers because of their song, intriguing behaviour, willingness to interact with people, and capacity to remove invertebrate pests such as lawn scarab beetle larvae (Kaplan 2004; ACT Government 2006).

Nesting

Magpies are territorial, seeking and defending areas (2-24 hectares) that provide adequate food all year round and trees for roosting and nesting (Kaplan 2004). Only socially cohesive groups (typically 2-10 individuals) with an established territory successfully nest and produce viable young. Female magpies build nests of twigs, vines, sticks and man-made materials lined with grass, bark, wool and other fibres (Kaplan 2004). Nest building is most active in July and August, and ends in October (COG 2009). Nests containing eggs and young peak in frequency during September and are usually empty by November. Young birds remain dependent on adults for food until around March of the following year.

Swooping

In the breeding season, a small proportion of magpies (mostly male) swoop to attack humans and their pets, predators such as snakes, goannas, raptors, crows and currawongs, and non-predators such as possums (Jones 2002, Kaplan 2004). The reason for the swooping is most likely to be brood defence rather than general defence of the territory or a response to increased testosterone levels in males (Warne *et al*. 2010). This is consistent with the observation that most attacks occur near nest trees when chicks are present (Jones 2002). Swooping of people is particularly prevalent in public places (Kaplan 2004) with individual birds often attacking only one type of intruder, eg, pedestrians, cyclists or mail deliverers (Jones 2002). Swooping magpies may cause indirect injuries, eg, cyclists losing control of their bikes (Kaplan 2004), minor scratches and abrasions, or, infrequently, serious damage to eyes (Warne *et al*. 2010). However, most alarm calls, swooping and beak-claps are warning signals to perceived intruders that do not result in injury (Jones 2002, Kaplan 2004).

Managing swooping magpies

While magpies are protected as native birds, it is recognised that their interaction with the community sometimes needs to be managed. Consequently, the ACT Government has developed management guidelines for living with swooping magpies (ACT Government 2006). Individuals should:

- walk through the magpie's territory quickly (don't run or ride a bike);
- avoid chasing or otherwise harassing the magpie, eg, picking up fledglings;
- take a different route until the magpie stops swooping;
- protect eyes with glasses and the head with an umbrella, hat or helmet;
- watch the magpie while walking away from it;
- attach flags, streamers etc. to bikes and backpacks;
- secure pets in the house, garage, kennel or hutch;
- prevent pets attacking magpies (walk dogs on a lead); and
- avoid leaving dog or cat food out in the yard.

An online education package has also been developed for primary schools, which gives guidance on what to do if swooped (J. Keogh; http://www.pestales.org.au/lessonplans/magpiemadness.htm).

Particularly aggressive magpies should be reported to Canberra Connect (13 22 81). The ACT Government may erect warning signs or, in extreme cases, remove problem birds. Nests and chicks should not be removed as breeding pairs are likely to raise a second brood and may become more aggressive (Jones 2002). Removal of birds is only considered as a last resort in cases of extreme risk to humans. This is because of problems with translocation (Section 5.4) including the potentially poor survival of translocated males, adverse consequences for the remaining nestlings and female partner, and the possibility that males will return home, the female partner will become aggressive, or that a new male bird will be just as aggressive as the bird that has been removed (Jones 2002). Note that only people who have received appropriate permits under the *Nature Conservation Act 1980* are authorised to trap and remove magpies.

In this chapter, 'native animals' are defined (Section 5.2) and their management for damage reduction is discussed (Section 5.3) with reference to ACT legislation. Principles and objectives specific to managing native animals are identified (Section 5.4) and sources of social and political conflict are considered (Section 5.5).

5.2 What is a native animal?

Native animals are commonly considered to be those that are '*indigenous to a particular region or country*' (Delbridge and Bernard 1998). However, native animal populations are not static in their distribution and may migrate to new regions and countries in response to natural and human-induced changes to their environment. For example, a number of bird species (long-billed corella, crested pigeon, galah) that were rare visitors in the ACT historically have more recently become breeding residents (Pizzey and Knight 2007, Olsen 2008, COG 2009, COG 2010a,b).

In this strategy, a native animal is defined as '*an animal of a kind indigenous to Australia*' in accordance with the definition proposed under the current review of the NC Act (Section 2.3.2). This definition is broader than the definition for a native animal provided in the APAS (NRMMC 2007a), ie, '*a species within its natural range (past or present), including any area which it can reach and occupy by its own legs, wings, wind/waterborne or other dispersal systems, even if it is seldom found there*'. The NC Act definition includes species indigenous to other regions of Australia that have been accidentally or deliberately introduced via human agents or transport routes and have become established in the ACT. Should these species require management for damage reduction, the ACT Flora and Fauna Committee will be consulted on appropriate management objectives, with reference to the conservation status of the species in other regions of Australia.

One native animal, the dingo, is currently declared as a pest animal under the Pest P&A Act (Section 2.3.1). Many dingoes in the ACT contain a small proportion of domestic dog genes but are indistinguishable in the field from genetically pure dingoes. Together with pure dingoes these animals are termed collectively 'wild dogs' (Box 8; Section 4.4.2). Wild dogs are managed as native animals for conservation purposes in core conservation zones and as pest animals to reduce damage to stock in other areas such as on rural leases and areas of adjoining public land.

5.3 Management of native animals to reduce damage under ACT legislation

Options for managing native animals for damage reduction currently include killing and taking of animals by licence provided by the ACT Conservator of Flora and Fauna under the NC Act. There is provision for applying conditions to these licences that can be used to specify management actions that need to be either taken or avoided in accordance with licence use. However, the NC Act does not have a provision equivalent to a Pest Animal Management Plan (PAMP; Section 2.3.2) for specifying and enforcing a range of non-lethal management requirements for native animals. Native animals could be declared as pest animals (as for wild dogs), which would allow the development of a PAMP under the Pest P&A Act (Section 2.3.2). In this case, land managers wishing to cull native animals on their own land would no longer be required to obtain a licence. This would require the development of an alternative mechanism for specifying the number of native animals that can be killed in relation to the overall conservation status of the species in the ACT.

The ACT Government will investigate amending legislation so that all management of native animals, for both damage reduction and conservation purposes, would occur under the NC Act and the Animal Welfare Act. This may include provision for the development of Native Animal Management Plans (NAMPs) that would be equivalent to PAMPs and would specify management methods and stakeholder responsibilities, and provide the statutory basis for compliance and enforcement. For this to occur, the NC Act (and subordinate legislation) would need to be amended, with the removal of native animal species from the provisions of the Pest P&A Act. Key stakeholders would be invited to provide input during the amendment process, which would include a

review of the licensing arrangements for culling native animals. Requirements for managing native animals may also be specified in a Code of Practice under the Animal Welfare Act, which can now be approved as mandatory (Section 2.3.3).

5.4 Principles and objectives for managing native animals for damage reduction

The principles for managing native animals for damage reduction are largely the same as those for managing exotic pest animals (Part 1; Section 1.2.2.). For example, it is important to maximise the welfare of both native and pest animals during management programs, with adherence to agreed Codes of Practice (eg, the Code of Practice for the Humane Destruction of Kangaroos in the ACT; ACT Government 1994). However, there are additional management principles and objectives associated with the native status of the animals. For land uses that have conservation as a management objective, an important principle will be to maintain a viable population of the native animal being managed. The level of culling permitted to reduce damage to an acceptable level in conservation areas should be determined in accordance with this principle. For kangaroo conservation in the ACT, viable population densities have been determined using '*the best available scientific knowledge of [the species'] biology, ecology and population dynamics*' (ACT Government 2010). For land uses where conservation is not the primary management objective, population reduction thresholds for native animals should take into account the overall conservation status of the species throughout the ACT (ie, across all land tenures) and reflect the damage caused by these populations to specific stakeholders. A management program should also take into account the availability and viability of alternative methods to culling to achieve damage reduction, and the level of damage (ie, loss of value and viability of assets) that will be prevented through a culling program.

While management of native animals for damage reduction has been undertaken for eastern grey kangaroos, wild dogs, possums, magpies and venomous snakes in the ACT, other jurisdictions manage a wider range of species. In 2008, the Victorian Department of Sustainability and Environment (DSE) issued Authorities to Control Wildlife (ATCWs) through dispersal, trapping and destruction for 43 native animal species, most of which were birds (DSE 2009). A management principle advocated by the DSE is the use of non-lethal techniques wherever possible (eg, fencing, netting, chemical, visual or auditory deterrents, decoy feeding, habitat modification, changing human behaviour and perceptions; Conover 2002, DSE 2009). Lethal methods for managing native animals (which are specified in ATCWs) are used only as a last resort, ie, where non-lethal methods are ineffective or inappropriate (as for eastern grey kangaroos in the ACT; ACT Government 2010). Queensland has similar provisions to Victoria (www.derm.qld.gov.au/register/p00928aa.pdf). Issuing of ATCWs in Victoria is contingent on the provision of sufficient evidence of damage, or high population numbers of species known to cause damage, by the land manager (DSE 2009).

ACT licence applications for killing and taking native animals could also require provision by land managers of sufficient evidence of damage, or of expected damage taking into account observed population numbers and available knowledge on the population dynamics of the species and its relationship to damage levels (Section 4.3.1). Inclusion of approximate damage and population thresholds for different land uses in culling licence application guidelines would assist land managers in planning to maintain population numbers at acceptable levels, thereby reducing the total number of animals that need to be culled over successive seasons. The number of animals culled annually in a district should match population replacement numbers due to breeding once desired population levels have been attained.

Translocation is the deliberate transfer of species or regenerative material from one place to another (NRMMC 2007a). As a non-lethal method for managing native animals, translocation has been proposed by concerned community groups as an alternative to culling. Translocation has been used to manage magpies representing a public nuisance in urban areas of the ACT. However, if the habitat to which the animal is translocated is fully occupied, then released animals may find insufficient food and shelter, be subject to aggression and predation, displace members of the resident population, cause genetic contamination and disease, or immediately migrate (Conover 2002, DSE 2009). If native animals are translocated to a habitat with different food species,

then starvation may occur. Depopulated areas may also be rapidly recolonised by the problem species, in which case moving existing populations is futile. Translocation of native animals can also simply transfer management problems to a different land user. Destruction of native animals and the use of alternative non-lethal methods may be more humane or socially acceptable options than translocation under these circumstances. The ACT Kangaroo Management Plan (ACT Government 2010) presents a detailed analysis of translocation as a tool for management of wildlife.

5.5 Social and political conflicts in native animal management programs

Management of native animals that are causing damage can result in conflict because of divergent community viewpoints, particularly when culling is the proposed management option. Most stakeholders accept that management of native animals is required under certain circumstances, as long as the need for management has been adequately demonstrated and the welfare of the animals has been given high priority in the choice of management options. However, different stakeholder groups do not always agree on the justification for undertaking or restricting management programs, or on the adequacy of proposed animal welfare measures. Conflict typically arises where (Conover 2002):

- national or regional native animal management policy and legislation reflects majority views (eg, not to cull native animals) but not those of key stakeholders at risk or affected by the damage;
- the native species is being managed for both conservation purposes and as a resource (eg, for hunting or fishing);
- the species is highly valued by some stakeholders for moral, aesthetic, emotional or cultural reasons; and
- the species' home or migratory range spans multiple land uses with different management objectives.

The management of flying foxes, which are important species in native ecosystems but can represent a health and safety risk, a public nuisance and a threat to horticultural crops, illustrates how stakeholders with legitimate but differing land management objectives can come into conflict (Box 10). Where stakeholder tolerances for the risk and damage caused by native animals overlap, then collaborative management programs can be developed using the risk management approach described for pest animal management programs (Section 4.5.1) and effective stakeholder communication (Section 6.3; Appendix 3). Where conflicts of interest cannot be resolved, then one or more stakeholders are likely to be disadvantaged by final management decisions, even where the greatest good is obtained for the greatest number of people (Conover 2002). In these cases, greater equity can be achieved if there are assistance measures in place for disadvantaged groups.

Social conflict can arise in urban areas of the ACT when residents with an interest in wildlife feed native birds and other native animals to attract them onto their properties. For example, a few native birds can quickly build into a large flock where an artificial food source is provided. Flocks of birds can become aggressive and frightening in their demands for food, and can damage neighbouring gardens and buildings (eg, chewing trees, cedar houses and roof fittings), cause excessive noise, and foul cars and properties with their droppings.

Feeding native animals is discouraged because they can:

- become dependent on the artificial food source;
- fall ill through inadequate nutrition;
- have their breeding cycles affected;
- become less resistant to disease (which is readily transmitted in large populations); and
- be less able to escape predators.

Feeding native animals may also attract pest animals such as foxes and cats (which prey on native wildlife) and introduced birds such as the Common Starling and Indian Myna (which aggressively compete for food and nesting sites, forcing native birds out of the area). Development of an education campaign for ACT urban residents to discourage feeding of wildlife could be considered to reduce this source of conflict and improve the welfare of urban wildlife.

Box 10: Social and political conflict in the management of flying foxes in Australia

Conservation and heritage value

Flying foxes have an important ecological role in Australian native forests as they feed on nectar, pollen and fruits thereby dispersing seed and pollen (DECC NSW 2007). There are four species of large flying fox (*Pteropus* spp.) in Australia: the black, little red, spectacled and grey-headed species (Tidemann 2003). Spectacled and grey-headed flying foxes are listed as threatened species under the *Environment Protection and Biodiversity Conservation Act 1999* (*Cwlth*), and black and little red flying foxes are protected under various state and territory legislation (Tidemann 2003, DECC NSW 2007). Flying fox populations have declined in some areas due to land clearing for primary industries and urban encroachment. Flying foxes are valued by communities of Indigenous, Pacific Islander and South-East Asian origin due to their totemic and kinship significance and as a traditional food source (DECC NSW 2007).

Behaviour causing damage

Flying foxes form large, communal camps in trees, which may be either transient or occupied all year round (DECC NSW 2007). Camps provide sites for roosting, mating, raising young, accessing food and migratory stop-overs, and often comprise many thousands of individuals. Camps situated close to urban developments are smelly and noisy, and cause soiling of cars and houses from droppings, damage to backyard fruit crops and fear of disease among residents. Flying foxes can transmit a range of diseases including the Australian bat lyssavirus (can cause death through respiratory paralysis) and the Hendra virus (has recently caused death in horses, and in humans and dogs following transmission from horses) (Queensland Health 2009; http://www.dpi.qld.gov.au/4790_20741.htm). At night, animals leave camps in search of fruit, blossoms and nectar, often from horticultural crops such as stone, pome and tropical fruits (DEC NSW 2002). Tree limbs, foliage and fruiting branches can be damaged as well as flowers, buds and fruit, with most damage being attributed by farmers to the grey-headed flying fox. Recently, grey-headed flying fox populations have become more prevalent in the ACT, with members of the public sustaining bites and scratches requiring medical attention after trying to release trapped animals from fruit tree netting and fences (ACT Health 2010). Pre-exposure vaccination against Australian bat lyssavirus is recommended for regular handlers of flying foxes and insectivorous bats (ACT Health 2009).

Management options

Flying foxes need to be managed so that their conservation and heritage values are protected while minimising public nuisance and disease risks, and losses to the horticultural industries. In NSW, the most widespread practice employed by farmers to control flying foxes is shooting, which has been regulated under licence since 1986 when flying foxes became protected under NSW legislation (DEC NSW 2002). An Independent Review Panel for Licensed Culling (Woodhead *et al*. 2009) found that shooting is contributing to population decline, is unacceptable on animal welfare grounds (legally and ethically), is ineffective where larger numbers of flying foxes visit orchards, and should be replaced by full exclusion netting (with appropriate financial support from government grants). However, NSW Farmers Association members have concerns about the costs and logistics associated with full exclusion netting (up to $40,000 per hectare; NSW Farmers Association 2009a) and have been lobbying the NSW Government to ensure the best outcomes for orchardists (NSW Farmers Association 2009b). Shooting of flying foxes is no longer legal in Queensland (QDPI&F no date) and concerned community groups are lobbying for NSW farmers and the NSW Government to follow Queensland's example (eg, Humane Society International Australia http://www.hsi.org.au/index.php?catID=263).

A wide range of alternative management options have been trialled, including taste, smell, sound and light deterrents, electric wires, protective bags on fruit and poisons (QDPI&F no date). While there has been some success with noise deterrents in urban areas (eg, Tidemann 2003), flying foxes often become accustomed to deterrents. Other methods are either impractical or, in the case of poisoning, illegal (QDPI&F no date). Until practical, affordable and acceptable management options are identified, it is likely that the social and political conflict over flying fox management will continue.

AWARENESS, UNDERSTANDING, COORDINATION AND CAPACITY BUILDING

Key Principles

- When developing programs to manage the damage due to pests, it is essential to **seek and understand the attitudes, concerns and capacity of the various key individuals and groups that have a significant interest in the pest animals**, their adverse impacts and the actions undertaken to manage them. These attitudes and concerns need to be fully understood and valued, and considered in the design and implementation of the management program. This includes engendering appropriate ownership of the program by key individuals and groups.
- Effective management of pest animal damage requires **coordination among all levels of government in partnership with industry, land and water managers and the community,** regardless of land tenure. Active engagement and consultation with key stakeholders is required to promote a clear understanding of roles and responsibilities among government, industry and/or community partners.
- **Effective management requires capacity building across all stakeholder groups** to provide the education and training necessary to address pest and native animal management problems and to increase awareness and understanding in the broader community.

Objective	Strategic Action
3. Increase awareness, understanding, coordination and capacity building.	4.1 Establish an ongoing pest animal management group for ACT stakeholder communication. 4.2 Engage in operational, regional management groups and forums to improve cross-border pest and native animal management, and engage in the VPC. 4.3 Maintain regular communication and pathways for information exchange between key stakeholders and the community. 4.4 Encourage education and training in pest and native animal management to promote awareness and address skills shortages through linkages with appropriate institutions. 4.5 Identify gaps in knowledge and initiate, or link with, relevant research projects. 4.6 Review the strategy after five years (brief review) and ten years (major review) to incorporate changes to legislation, policy and management frameworks, advances in pest and native animal management, and the impacts of climate change.

6.1 Introduction

ACT stakeholders with an interest in pest animal management, including the key land managers for different land uses, were identified in Chapter 2 (Section 2.2; Table 1). As native animals can cause damage to valued social, environmental and economic assets (Chapter 5), their management for damage reduction is also of interest to these stakeholders. Many pest and native animals have home or migratory ranges extending over multiple land uses in the ACT (Section 2.2.1) and into NSW. These species require coordinated management programs to achieve desired levels of damage reduction.

The success of coordinated management programs will depend partly on the willingness of key stakeholders to communicate and cooperate, and will be greatest where all involved have a full understanding of the management issues (Braysher and Saunders 2003). Ideally, there should be broad public and political acceptance of the need for management programs, particularly where native animals (Section 5.5) or pest animals that are valued by some sectors of the community (eg, horses in Namadgi National Park; see also Olsen 1998) are the target species. Strategies to increase awareness and understanding of pest and native animal management issues should aim to inform all of these interest groups.

The success of management programs also depends on the availability of effective, efficient, economic and humane management options (Section 4.4) for reducing pest or native animal damage. If these are unavailable, or the suitability of different options is unknown, research will be needed either before, or as an integral part of, a management program to identify appropriate management options. Research projects are reliant on participation by, or access to, stakeholders or collaborators with adequate research capacity. Where suitable management options are available, there needs to be sufficient local technical expertise to apply them and to undertake the operational and performance monitoring and assessment (Section 4.6) necessary to evaluate their success. The maintenance of adequate research capacity and technical expertise to support management programs depends on regional access to effective education and training programs.

This chapter explores the benefits of having a high level of awareness and understanding of pest and native animal management issues amongst stakeholders (Section 6.2) and of fostering good communication and collaboration in coordinated management programs (Section 6.3). Regional education, training (Section 6.4) and research (Section 6.5) programs in pest and native animal management are identified. The strategy concludes with a timeline for review to incorporate changes to legislation, policy and management frameworks and advances in pest and native animal management that occur over the next decade (Section 6.6).

6.2 Awareness and understanding

6.2.1 Promoting awareness and understanding

The principles and practices underpinning pest and native animal management are complex (Chapters 1-5) and are usually only well understood by a few key stakeholders or other interest groups. Improving awareness and understanding of pest and native animal management issues facilitates the development and appropriate ownership of management programs (Sections 4.5.2 and 6.3) and may reduce public opposition that can arise through misunderstanding.

In the ACT, awareness and understanding of pest and native animal management issues have been promoted through:

- web-based information (http://www.tams.act.gov.au/play/pcl);
- provision of information to plant nurseries and pet retailers on notifiable pest animals and the importation of high-risk materials (Section 3.3.1);
- media releases (eg, the red-eared slider turtle communication strategy; Section 3.3.2; Box 5);
- brochures and signs in parks and reserves;
- research programs involving ACT residents (eg, opinion polls on kangaroo management); and
- meetings with stakeholders affected by pest and native animal damage (eg, land managers affected by wild dogs; Section 4.4.2; Box 8).

Stakeholders and the public may also contact the ACT Government directly to seek advice on pest and native management animal issues (eg, European wasps; Box 11).

Box 11: The European wasp hotline

What are European wasps?

European wasps (*Vespula germanica*) are an invasive insect pest that is now found in the cooler regions of all Australian states and the ACT, as well as in New Zealand, South Africa, Canada and North and South America (TAMS 2006a; Museum Victoria 2010). European wasps are similar in size to the European honey bee, but have distinctive yellow and black markings (see below) and yellow (rather than black) legs. Their nests are commonly built underground, but they also nest in wall and roof cavities. European wasps are attracted by sweet drinks, food (including fruit and pet food), insects (on which they prey) and road kill. They may have adverse impacts on biodiversity because of their capacity for insect predation. European wasps were probably introduced into Australia accidentally as stowaways in a boat or plane (Museum Victoria 2010).

Photograph by P. Spradbury

Public health risk

European wasps are commonly found in and around suburban homes, picnic and barbecue areas, school playgrounds, shops and food factories (TAMS 2006a, Museum Victoria 2010). Nests may contain thousands of wasps and they can be highly aggressive if disturbed by people or their pets. Individual wasps can sting repeatedly and may release a pheromone that incites other wasps to sting. Wasp stings are typically painful and cause swelling, which can be dangerous when the mouth or throat is targeted and breathing becomes obstructed. Wasp stings may also cause an allergic reaction leading to itching or, in extreme cases, heart failure. Allergic reactions are more prevalent in people who have been stung previously by European wasps.

European wasp hotline

The ACT Government has established a European wasp hotline to provide general advice on their identification and control, and to facilitate their removal from public land. The ACT Government also provides advice to the public on seasonal behaviour of European wasps through media releases and conducts baiting programs in high-use public areas such as picnic and barbecue facilities. Advice can be obtained from the hotline (6162 1914), Canberra Connect (13 22 81) (TAMS 2006a) and the ACT Government website. When a nest is found on private property, the owner is responsible for organising its treatment and removal by a qualified pest control operator. Nest treatment and removal is the most effective form of control because it kills the egg-laying queen (Museum Victoria 2010).

6.2.2 *Benefits of community engagement in management programs*

Engagement of community groups in pest and native animal management programs can help to (Braysher 1993):

- mobilise local knowledge, skills and resources;
- target local concerns;
- facilitate ownership of management issues where appropriate;
- disseminate information to landholders and the public;
- provide feedback to government; and
- provide a host organisation for stakeholder workshops (see Section 6.3).

The ACT is fortunate in having a high level of community engagement, with around 22 per cent of residents undertaking voluntary, unpaid work for organisations (ACT NRM Council 2009). ACT community groups have played a prominent role in increasing public and stakeholder awareness and understanding of pest and native animal management issues, and in undertaking, or contributing to, pest animal management programs. For example, there has been successful community engagement in the rabbit management program in the Canberra Nature Park (Box 12).

Another notable success is the Canberra Indian Myna Action Group Incorporated (CIMAG) that provides a network for key community groups, the ACT Government, the RSPCA and university researchers (Handke 2009). The Indian Myna is an introduced pest bird species that poses a considerable threat to native wildlife. It evicts native birds from their nests (including eggs and nestlings) and competes with birds and other native animals such as sugar gliders for food and tree nesting hollows (TAMS 2006b). Indian Mynas are considered to be a threat to these native species, particularly in urban habitats where they have become common. Also, the general community regards these birds as a major urban nuisance because of their noisy roosting sites, their fouling of backyard patios and barbeque areas, and their aggression towards other birds.

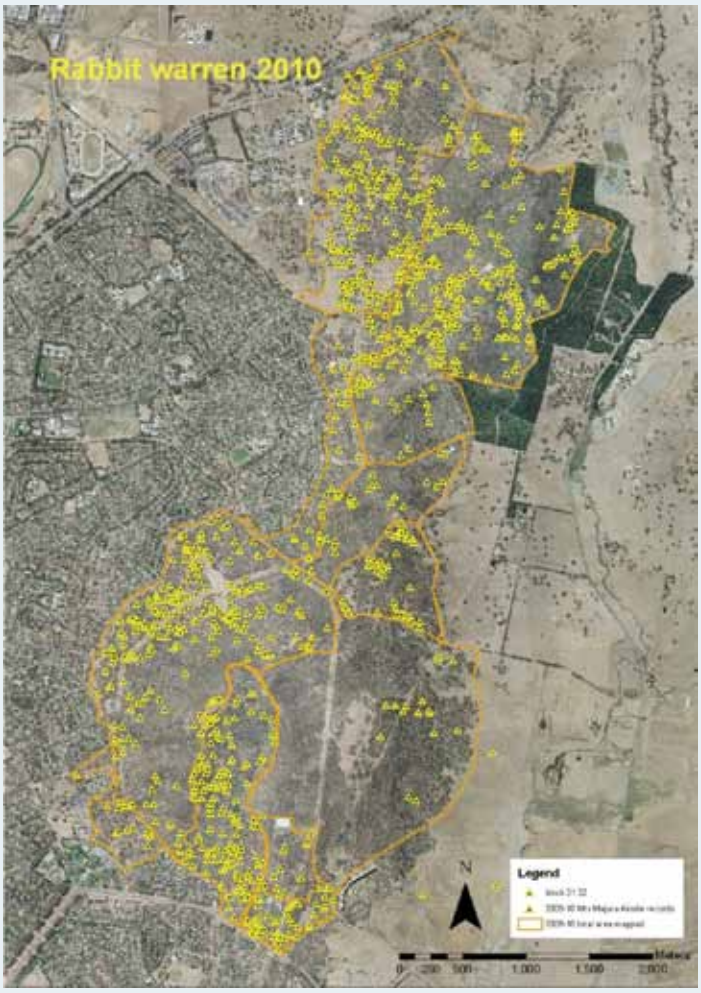
CIMAG was formed in 2006 to increase public awareness of the environmental threat posed by the Indian Myna, educate the public about limiting its spread through limiting feeding and breeding opportunities, and conduct a humane reduction program in the Canberra area (www.indianmynaaction.org.au). Since its formation, CIMAG has adopted an animal welfare protocol, designed and built backyard trapping equipment and removed at least 39,500 Indian Mynas from suburban Canberra and Queanbeyan (B. Handke personal communication). The Indian Myna has decreased from being the third most abundant bird species in the Canberra area prior to the formation of CIMAG to being the fourteenth most abundant bird species in 2011. Research currently being conducted at the Australian National University on the impact of Indian Mynas on native birds in Canberra suburbs and on the effectiveness of their removal is near completion.

The ACT Government is committed to continue working with ACT community groups to increase their involvement in pest animal management programs, taking into account risks to human health and safety, and animal welfare requirements (for target and non-target species).

Box 12: Community ParkCare groups map rabbit warrens on Mt Ainslie and Mt Majura

Canberra ParkCare groups (Friends of Mt Majura, Mount Ainslie Weeders, Watson Woodland Working Group) have been instrumental in mapping and marking rabbit warrens in the Mt Ainslie and Mt Majura Canberra Nature Parks. Between 2008 and 2010, ParkCare members, volunteers and ACT Government staff located warrens using a Global Positioning System and collected data on the topography, number and accessibility of burrows, and rockiness of the sites (http://majura.org/rabbits). The warren mapping and marking was an essential step in integrated rabbit management programs conducted by contractors and ACT Government staff using a combination of poisoned baiting, warren fumigation and ripping. Spotlight monitoring has shown that the combined 2009 and 2010 programs have achieved around 90 per cent reduction in the rabbit population present before management began. Ongoing monitoring and management is required to protect against reinvasion of warrens and to maintain rabbit populations below densities that cause unacceptable damage to native vegetation (Section 4.3.1; Box 7).

Rabbit warrens on Mt Ainslie and Mt Majura



6.3 Stakeholder communication

6.3.1 Principles of stakeholder communication

Coordinated pest and native animal management programs are most effective when key stakeholders and other groups or individuals that are responsible for, benefit from, or have an interest in, the program are intimately involved in its development and implementation and share in its objectives (Braysher 1993, Olsen 1998, Conover 2002). In the absence of ownership of the problem and a coordinated management program, there are risks that:

- conflicting management approaches will be adopted by different stakeholders;
- there will be inefficient use of available resources;
- individual stakeholders will have less leverage to secure additional resources; and
- the pest or native animal will rapidly recolonise managed areas from unmanaged areas.

Coordinated management programs may be developed using stakeholder workshops. These are beneficial when stakeholder understanding of the issues is low, the stakeholders are willing participants in the process, and development of a management program is a likely outcome. PESTPLAN (Braysher and Saunders 2003; Section 4.5) provides one example of a staged guide for initiating workshops and for helping stakeholders to understand issues, perform risk assessments, set priorities and develop management programs. PESTPLAN also provides guidance on facilitating good communication and cooperation between stakeholders, the principles of which (Braysher 1993, Olsen 1998, Conover 2002, Braysher and Saunders 2003) have been summarised in Appendix 3.

6.3.2 Improving stakeholder communication and coordination in the ACT

A number of effective stakeholder groups and coordinated management programs have been implemented in the ACT to address specific management issues; examples of these have been given in other sections of the strategy (eg, wild dogs - Section 4.4.2 - Box 8; rabbits - Section 6.2.2 - Box 12). The ACT Government is also represented on the VPC, which provides a strategic forum for all jurisdictions to develop nationally consistent vertebrate pest management policies and programs, including implementation of the APAS (NRMMC 2007a; Section 2.4.1).

Although specific stakeholder groups and VPC membership enhance communication and coordination of pest and native animal management in the ACT, there is no regular, ongoing forum for key stakeholders to address issues such as:

- strategic coordination, risk assessment and resource allocation for multiple management programs;
- invertebrate pest management;
- the development, implementation and review of ACT legislative, policy and planning instruments in accordance with the APAS;
- input by ACT stakeholders into the national VPC agenda;
- coordination of surveillance to prevent and detect new incursions (Chapter 3);
- assisting the ACT Government biosecurity team in the event of an emergency response to an animal (or animal-borne) disease (Section 3.2.4); and
- review of the declaration status of pest animals under the Pest P&A Act (Section 2.3.1).

To address this deficiency, a stakeholder working group for pest and native animal management will be established and coordinated by the ACT Government (Strategic Action 4.1; Part 1). The working group will have provision to invite participation by community group representatives where they are identified as key stakeholders in particular management issues. The ACT pest animal management group will complement the current roles and functions of the ACT Weeds Advisory Group and the ACT Weeds Working Group (ACT DECCEW 2009).

ACT and NSW stakeholders currently liaise on a number of cross-border pest animal issues through:

- three regional wild dog and fox cooperative management programs;
- the Australian Alps Natural Resource Management Reference Group;
- the Australian Alps Feral Horse and Wild Dog Working Groups;
- annual pig management programs in the Namadgi and Brindabella National Parks; and
- fruit fly monitoring with the NSW Department of Trade and Investment, Regional Infrastructure and Services.

Coordinated management of pest and native animals by ACT and NSW stakeholders is appropriate for all animals that cause damage and have home and migratory ranges that overlap these jurisdictions. The NSW Pest Animal Council and NSW South East and Tablelands Livestock Health and Pest Authorities (former Rural Lands Protection Boards; http://www.lhpa.org.au) provide other forums through which cross-border pest and native animal management programs could be coordinated.

6.4 Education and training

Education and training programs are required to underpin many of the aspects of pest and native animal management covered in this strategy. While it is not essential for all stakeholders to understand every aspect of a management issue, policy advisors, key stakeholders in coordinated management programs, individual land managers, and operational staff and contractors need access to expert advice and information to:

- develop and implement legislation, policy and management frameworks (Chapter 2);
- identify high-risk animal species and undertake surveillance of invasion pathways to prevent their incursion (Chapter 3);
- assess the damage caused by existing pest and native animals, develop management programs based on risk assessment, assign priority to high-risk species and high-value assets, and identify and apply suitable management options and monitor and assess their effectiveness (Chapters 4 and 5); and
- improve the awareness, understanding and coordination of all stakeholders and maintain the capacity for research on target species and on the development and application of management options (Chapter 6).

The Training Working Group of the VPC is currently auditing vertebrate pest management training opportunities in Australia to identify gaps in training that need to be addressed (see scoping study at http://www.feral.org.au/scoping-study-training). In the Canberra region, education and training programs in pest and native animal management (Table 3) are provided by the University of Canberra (UC), Australian National University (ANU) and the NSW Department of Trade and Investment, Regional Infrastructure and Services (or accredited providers of their PROfarm and SMARTtrain® courses).

PROfarm and SMARTtrain® courses (Table 3) are run intermittently in NSW in response to registration of interest by potential participants and occasionally in the ACT under special arrangement with the ACT Government. Limitations to training for operational staff and commercial contractors are competition with other work programs including other training requirements and the cost of travel and accommodation for trainees to go to NSW or for trainers to come to Canberra. Local provision of all courses that are a mandatory requirement for operators, contractors and volunteers would be beneficial. However, currently the ACT Government does not have the knowledge, capacity and resources to develop and deliver all mandatory training in the ACT and surrounding districts. Should this become necessary, significant investment would be required.

6.5 Research and collaboration

Pest and native animal management programs are most successful when the biology, population dynamics, behaviour and ecology of the target species are well understood, and when management options, and monitoring and assessment protocols, have been thoroughly researched. Outcomes from research programs are readily adopted when key stakeholders, operational staff and contractors are collaborators in the research process, particularly when the research is undertaken as an integral part of management programs.

The ACT has significant research strengths in pest and native animals and their management, with several organisations conducting the postgraduate training that maintains research capacity (Table 3) and active research programs. These organisations include the Institute for Applied Ecology (IAE; UC; http://iae.canberra.edu.au), the Invasive Animals Cooperative Research Centre (IACRC; http://www.invasiveanimals.com), CSIRO Ecosystem Sciences (http://www.csiro.au/org/entomology) and the ANU Research School of Biology (http://biology.anu.edu.au).

The ACT Government (Conservation, Planning and Research, Nature Conservation Policy, ESDD) also conducts research on pest and native animals and their management, and provides support for research partnerships with a range of institutions and agencies. Research projects have included:

- feral pig management (Box 13);
- wild dog and dingo tracking (with NSW Office of Environment and Heritage);
- kangaroo fertility control (with University of Newcastle, CSIRO and IACRC);
- habitat and movement of urban populations of eastern grey kangaroos (with IAE);
- modelling of eastern grey kangaroo population dynamics in the ACT temperate environment (with IAE);
- kangaroo density in relation to food supply at a range of sites;
- damage due to overgrazing by kangaroos (and other species) on grassland ecosystems and threatened flora and fauna (with IAE and ANU);
- woodland management effects on small fauna (kangaroo grazing; fox and cat control) (with ANU); and
- regular surveys of introduced and native (including threatened) fish species in urban lakes.

The ACT Government recognises the importance of collaborative research programs for informing pest and native animal management in the ACT and will actively initiate and support such programs into the future.

Table 3 Training opportunities in pest and native animal management in the Canberra region

Institution and course	Course description
University of Canberra	
Diploma of Conservation Land Management – Pest Animals: New Solutions to Old Problems	A Vocational Education and Training diploma course specialising in vertebrate pest management. The course has been developed in consultation with state government agencies and aims to provide field officers with the skills needed to develop and implement strategic vertebrate pest management plans. The course is delivered primarily online, supported by three residentials at the University of Canberra.
Graduate Certificate in Wildlife Management in Invasive Species	This course is available online and aims to provide mid and upper level land managers with the skills to identify pest animal problems and to develop and implement effective pest management strategies that are part of a strategic approach to sustainable resource management. Land managers will have the ability to adapt and respond to changing land use practices.
Master of Science (MSc) and Doctor of Philosophy (PhD) by Research	Current and past research includes projects on kangaroos, flying foxes, rabbits, feral goats, sheep, donkeys, horses, ferrets, foxes, domestic cats and dogs, birds and coyotes.
Note: a course work Graduate Diploma/MSc on strategic pest animal and weed management will be offered in 2012.	
Australian National University	
MSc and PhD by Research	Current research includes projects on Indian Mynas and feral pigs.
NSW Department of Trade and Investment, Regional Infrastructure and Services, PROfarm Courses	
Vertebrate Pest Management	Provides training for those implementing vertebrate pest management for agricultural production and conservation.
Planning for Pest Management	Assists participants to develop skills in developing a regional plan of management for vertebrate and invertebrate pest and weed control.
SMARTtrain® courses	
Chemical Application (Level 3)	Trains people that use pesticides with powered and hand-held application equipment.
Chemical Risk Management (Level 4)	Trains supervisors and managers in risk management skills to manage the transportation, storage, application and record keeping of agricultural chemicals including biological pesticides.
Fumigation on Farms	The relevant section of this course trains people to work effectively with fumigants for vertebrate pest management.
Other courses (Goulburn)	
Sodium monofluoroacetate (1080) training	Measurement, application and use of 1080 and other, restricted vertebrate pest poisons.

Box 13: HOGGONE® trial to manage feral pigs in Namadgi National Park

Distribution and damage

Feral pigs have become widespread in northern and eastern Australia (NLWRA and IACRC 2008) because they are habitat generalists with omnivorous and adaptive feeding habits, a large body size and high reproductive capacity (Sharp and Saunders 2004a). They cause damage to native plants, animals and ecosystems (Section 4.2.2) and prey on new-born lambs, eat and destroy grain crops and pasture, and damage fences and water sources (Sharp and Saunders 2004a). The areas most suitable for pigs have permanent water bodies, shade (NLWRA and IACRC 2008) and cover (Sharp and Saunders 2004a). Feral pigs are most commonly found in the western ranges of the ACT in conservation areas such as Namadgi National Park and adjoining leased bushland.

Management

An annual pig management program has been undertaken in Namadgi National Park since the mid 1980s and has been successful in reducing pig population levels (Hone 2002). Originally, wheat baits containing warfarin (an anticoagulant poison) were used to bait pigs. However, warfarin is no longer considered to be an acceptable management option because of the risk of poisoning in non-target animals and the disability and pain that feral pigs experience during the several days it takes them to die (Sharp and Saunders 2004a). The 2009 and 2010 pig management programs in Namadgi National Park have therefore used 1080 (sodium fluoroacetate) incorporated in a poison bait (PIGOUT®) (TAMS 2010).

Collaborative research

The ACT Government (ACT Parks and Conservation Service, TAMSD) has been working with the IACRC and Animal Control Technologies to assess the efficacy of a new pig toxin, sodium nitrite, in a bait known as HOGGONE® (Lapidge 2009). Field trials have been conducted in Namadgi National Park on free-living pig populations within their naturalised environment, which represents the main end-use of the product. The data collected will be incorporated into the HOGGONE® registration package, with the aim (once registered) of providing a highly pig-specific, humane and reliable tool to assist land managers with the management of feral pigs. HOGGONE® will provide a safer alternative for non-target species compared to current baiting practices. The research team is developing an antidote to HOGGONE® to protect working dogs in case of accidental poisoning.

Photograph by M. Clarke

6.6 Review of the ACT Pest Animal Management Strategy 2012-2022

Changes in pest animal legislation, policy and management frameworks occur regularly at the local, regional and national levels (Section 2.1.2). It is proposed that this ACT Pest Animal Management Strategy 2012-2022 undergoes an interim review in 2016 to incorporate minor changes to these frameworks that occur over the first five years. It is also envisaged that the strategy will be thoroughly reviewed in 2022 by the ACT pest animal management group (Section 6.3.2). The final review should assess progress in the implementation of the strategic actions based on the performance indicators detailed in Part 1. The final review should also modify the strategic goals, key principles and objectives in accordance with advances in pest and native animal management that occur over the next decade.

SUMMARY OF MANAGEMENT ACTIVITIES AND ISSUES FOR PEST ANIMALS AND NATIVE ANIMALS THAT CAUSE DAMAGE

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Species	Risks	Management options and issues	Current management and monitoring practices	Outlook
European Rabbit	• Reduced seedling recruitment by browsing • Soil disturbance at warrens promotes erosion and weed invasion • Grazing competition with livestock and macropods • Grazing of private gardens and public landscaping in urban areas • Unwelcome aesthetic impact from presence of warrens, scrapes and large populations in natural and landscaped areas • Burrows and scrapes are a trip-hazard concern for managers of high use public areas eg, playing fields, lawns around public buildings • Supports elevated populations of feral cats and foxes that in turn can pose a threat to native species of concern	• Warren destruction by ripping or explosives provides long-term management due to removal of rabbit harbour • Baiting with 1080 is effective in reducing rabbit populations prior to warren destruction • Baiting with pindone requires multiple poisoned feeds but is useful in peri-urban areas where 1080 cannot be used • Warren fumigation using phosphine is labour intensive and does not remove harbour as rabbits may re-open warrens • Shooting only suitable for small-scale, follow-up operations as it is labour intensive • Myxomatosis and RHD are responsible for localised reductions in rabbit numbers through periodic natural outbreaks • RHD virus baiting can be used as part of an integrated control program but should not be used as a stand-alone method • Ferreting of rabbits is not permitted on public land as ferrets are a declared pest species • Exclusion fencing is useful to protect high-value assets eg, threatened plants, plant nurseries • Interactions with fox, wild dog (and possibly feral cat) predation are an important consideration in control programs • Removal of rabbit harbour, eg, blackberry and boxthorn thickets, assists control programs	• Primary rabbit management programs are conducted at the landscape scale, involving all adjoining land managers • Pre- and post-management rabbit monitoring conducted to assess effectiveness of control programs • Long-term spotlight monitoring of rabbit populations conducted in Namadgi National Park (NNP), Tidbinbilla Nature Reserve (Tidbinbilla) and Googong Foreshores • Cooperative, targeted community involvement in mapping and/or monitoring of rabbit populations eg, through ParkCare groups • Where terrain limits physical control actions the objective will be to reduce abundance to the 'low equilibrium range' where predators will tend to keep rabbit numbers low	• Continuing participation in the national RHD program by supply of RHD-infected carcasses and testing of new RHD strains as they are developed • Maintain community participation in mapping/monitoring of rabbit populations • Stay aware of new and emerging technologies eg, carbon monoxide pressure fumigator being developed by the IACRC

Species	Risks	Management options and issues	Current management and monitoring practices	Outlook
European Red Fox	• Predation of medium-sized native mammals • Predation of bird populations and some threatened species • Urban nuisance • Potential rabies reservoir • Agent for spread of weed seeds • Reduction in lambing success	• Baiting with 1080 is the most cost-effective technique available but is not permitted in peri-urban areas • M-44 1080 ejectors are an effective technique (currently only available for use on non-urban public land) • Shooting is labour intensive and therefore only suited to small-scale operations • Padded-jaw and cage traps are inefficient for general control but may be useful for problem animals • Den fumigation with carbon monoxide is useful for localised problems where baiting or shooting is not possible but is not effective for broad-scale control • Exclusion fencing is useful for protecting poultry and vulnerable captive wildlife populations • Livestock guardian animals eg, Maremma dogs, alpacas, donkeys are effective for small- to medium-sized enterprises • Sustained control programs over adjoining land tenures are required to achieve long-term effective results • Control action can promote elevated rabbit populations; a concurrent or advance rabbit management program may be necessary • Control effectiveness is difficult to assess in terms of reduction in the loss of biodiversity • Effect of reduced numbers on feral cat population is an unknown consideration	• 1080 baiting programs undertaken in high-conservation, non-urban parks and reserves to reduce loss of native species and damage to neighbouring sheep-breeding enterprises • Baiting programs on some rural leases to improve lambing success • Mulligans Flat Sanctuary maintained as fox-free area	• Participate in site-based research programs on fox biology or new control methods, particularly methods applicable for safe use in peri-urban areas • Ecological research, eg, predator-prey relationships may point to changes in strategic directions • Improved coordination of control programs across differing land tenures • Implications for Brush-tailed Rock Wallabies need to be evaluated if their re-introduction is contemplated

Species	Risks	Management options and issues	Current management and monitoring practices	Outlook
Dingo/Wild Dog	• Production losses from sheep kills, injury and harassment • Potential threat to new-born calves • Social cost of emotional distress experienced by land holders who experience on-going wild dog attacks on livestock • Reservoir for hydatid parasites • Social impacts of wild dog sightings or howlings on recreational users of remote areas • Social impact of wild dog presence in campgrounds	• 1080 ground baiting is the most cost-effective technique available • 1080 aerial baiting is effective for baiting in remote areas • 1080 M-44 ejector devices are effective especially in remote areas where access for regular ground baiting is restricted • Trapping is particularly effective for targeting bait-shy problem dogs but is inefficient for broad-scale control • Shooting is labour intensive and is not effective for broad-scale control • Exclusion fencing is effective but expensive and labour intensive to maintain, especially in large or remote areas • Livestock guard animals eg, llamas, guardian dogs, donkeys are only effective for small- to medium-sized paddocks • Wild dog control in reserves may reduce predation pressure on pest species including rabbits, pigs and goats • Escape/release of domestic dogs - especially escape of pig hunting dogs in reserves - may further erode dingo genetics by interbreeding • Pure dingoes and their hybrids (collectively called wild dogs; Section 4.4.2 Box 8) cannot be distinguished in the field; both come in a variety of colours • Wild dogs perform the same role as a top-order predator in the ecosystem	• Wild dog management using 1080 baiting, 1080 ejectors and trapping occurs in a control area of several kilometres between sheep-growing areas and parks and reserves • Wild dog management is coordinated with programs in NSW through cooperative cross-border dog/fox management plans • Sand-pad monitoring is used to assess effectiveness of dog management in buffer zone areas in southern NNP • Information signs about wild dog biology and behaviour erected at locations where park visitors are most likely to encounter wild dogs • Australian Alps wild dog fact sheet available at visitor centres and on display boards at camp sites/toilets • Promotion and education of wild dogs as performing function of top-order predator in protected area landscapes	• Wider use of 1080 ejectors to improve cost effectiveness of baiting • Seek further opportunities for collaborative research on movement patterns, the dingo's role in ecosystems, genetic integrity and control techniques • Improve effectiveness of wild dog management by seeking further landholder participation in cooperative wild dog management programs and on-farm stock protection via fencing and guardian animals • Investigate use of remote cameras for monitoring of wild dogs • Interpretive pamphlets explaining presence and function of wild dogs in protected areas

Species	Risks	Management options and issues	Current management and monitoring practices	Outlook
Feral Pig	• Ground rooting of treeless flats and bogs in sub-alpine areas with presumed adverse impacts on wetland hydrology and abundance of plants and animals, including threatened species • Ground rooting creates disturbed soil which promotes weed invasion • Reduced abundance of favoured tuberous native plants • Ground-rooting damage and sightings of mobs of pigs are disliked by visitors to parks and reserves • Predation of lambs • Damage to fences and pastures • Potential reservoir for exotic stock diseases • Degradation of water quality in catchments and wetlands	• Warfarin grain baiting (used in NNP since the mid-1980s) is no longer considered humane for pig control and is due to be phased out nationally by 2013 • 1080 poisoned baiting is currently the most cost-effective technique for pig management • Trapping is not practical for large-scale control but is useful when poison cannot be used • Shooting is labour intensive and only suitable for small-scale operations • Pig populations attract illegal access by pig hunters in parks and reserves • Augmentation of hunting resource by release of pigs may be reducing control effectiveness • Control of pigs in remote areas, especially sensitive sub-alpine bogs, is problematic due to difficulty of access • Aerial shooting could potentially be used to control pigs in some situations	• 1080 poisoned baiting has now replaced warfarin for the annual control program in southern parks and reserves used to keep pig damage to acceptable levels • Targeted trapping is used to remove pigs that cause damage to specific sensitive or public areas, or where poisoned baiting is not possible • ACT PCS, TAMSD are exploring options for alternative monitoring protocols following cessation of University of Canberra monitoring of pig abundance plots in NNP • Free poisoned bait offered to rural landholders who participate in cooperative baiting programs • Baiting of ACT parks and reserves is coordinated with parallel programs in neighbouring NSW parks	• Continue to participate in trials of new feral pig toxins • Continue to test new delivery systems for pig bait, particularly those suitable for use in remote areas • Important to maintain some form of monitoring of feral pig abundance and damage in NNP to assess the effectiveness of the annual program, new baiting regimes and toxins
Feral Goat	• Grazing competition with livestock and macropods • Selective browsing of native shrubs • Alteration of screes • Damage to fences • Potential reservoir of stock disease • May help support wild dog populations in bushland adjacent to sheep enterprises	• Shooting is labour intensive and only suitable for small-scale operations although radio-collared 'Judas' goats can improve efficiency • Aerial shooting can be used effectively in rugged terrain but is expensive • Trapping can be effective when food/water is scarce; cost effective when goat prices are high • Mustering into yards with livestock working dogs • Escapes of farmed goats from rural leases in ACT and neighbouring NSW have occurred • Fox and dog control may remove predation pressures and promote goat population increase	• Goat populations currently at acceptable levels following aerial shooting and the 2003 fires • Continued monitoring of mob locations and size • Ground-based shooting where practicable • Mustering of goat mobs in collaboration with rural landholders • Trial trapping on reserves, and rural land in collaboration with rural landholders	• Joint control programs with NSW for border areas • Re-visit radio-collaring 'Judas' goat technique when necessary

Species	Risks	Management options and issues	Current management and monitoring practices	Outlook
Feral Horse	• Alteration of sub-alpine habitat, particularly sphagnum bogs and associated grassy flats/ woodlands which are critical to sub-alpine species of very limited distribution • Potential to reduce the quality of Canberra's water supply if horse numbers permitted to increase in the Cotter Catchment	• Aerial shooting is the most effective method of culling, particularly in inaccessible country • Ground shooting is labour intensive and should not be used in rugged country where any injured animals cannot be rapidly located and euthanased • Trapping can be effective but is difficult and expensive in remote locations • Mustering is only suitable for accessible locations • Exclusion fencing is expensive and difficult to maintain in remote, timbered locations • Eradicated from NNP in 1986 but numbers gradually increasing from 2001 to 2007 before control re-initiated • Significant community sensitivities regarding control techniques • Important for animal welfare to control horses while numbers are low to minimise the numbers of animals affected	• Feral horses in remote areas of the Bimberi Range in NNP managed by trapping, sedation and euthanasia • NNP Feral Horse Management Plan also allows for aerial shooting of trap-shy animals • Photo-point monitoring of sub-alpine bogs damaged by feral horses	• Continual re-infestation likely from Kosciuszko National Park requiring continuation of regional collaboration to facilitate cross-border control programs • Continue partnership with Australian Alps National Parks agencies to support feral horse research in the region
Fallow Deer **Red Deer** **Sambar Deer**	• Tracking, and wallowing • Selective browsing of preferred species – native vegetation and plantations • Damage to young trees and shrubs from antler rubbing • Grazing competition with livestock and macropods • Reservoir of stock disease • Vehicle accident hazard • Public safety in rut • Public risk from illegal hunting in protected areas	• Shooting is labour intensive due to the secretive and dispersed nature of the animals • Trapping is possible but there are animal welfare concerns with such flighty animals in traps • Potential to attract illegal hunters onto reserves and rural land with related public safety and vandalism concerns should deer numbers continue to increase • Concern that irresponsible hunters may introduce other deer species • Damage caused by wallowing behaviour of increasing numbers of Sambar Deer is of particular concern for sub-alpine wetland areas • Aerial shooting could potentially be used to control deer in some situations	• General monitoring of occurrence via a sightings database and opportunistic shooting • Rural lessees advised to shoot any deer that occur on rural land • Education on damage caused by deer and seasonal behaviour	• Maintain regional liaison and surveillance • Participate in research projects on deer ecology and management • Management implications of further escapes/ releases of animals from deer farms in the ACT region • Effective and humane deer management techniques are under development in NSW

Species	Risks	Management options and issues	Current management and monitoring practices	Outlook
Feral Cat	• Predation of small mammals, reptiles and birds • Potential reservoir of feline diseases and consequent implications from interactions with domestic animals	• Cats do not take baits readily • Trapping and shooting are labour intensive due to widespread and dispersed distribution of feral cats • Ecological role as a predator/competitor needs to be determined if a broad-acre control program is contemplated • Feral cat management issues are different to those arising from stray/wandering domestic cats, but can overlap near urban areas • Escape/release of domestic cats may enhance stray and feral cat populations	• Targeted, intensive programs using trapping and shooting for sites of significance eg, bird-breeding enclosures at Tidbinbilla • Continuing control and fence maintenance in sites of significance eg, Mulligans Flat Sanctuary • Domestic cat containment requirement in new suburbs adjacent to high-value conservation areas	• Maintenance of a watching brief on new management developments • Participation in research on ecological significance of cat predation on native species
Brown Hare	• Browsing destroys planted seedlings in revegetation or landscape projects, arboreta and tree nurseries • May limit natural regeneration	• Exclusion fencing around high-value assets or guards on individual trees • Chemical deterrents around high-value assets • Shooting is labour intensive	• Fencing, tree guards, chemical deterrents or shooting in response to damage	• Likely to be continuation of current practices
Indian Myna	• Aggressively competes with native species for tree hollows • Production losses in horticultural industries – grapes, berries, olives, fruit, vegetables and cereal crops • Urban nuisance from roosts • Reservoir for diseases • Urban nuisance from fouling of backyards and patios, noisy calls and aggressive behaviour	• No cost-effective, broad-scale control available • Trapping is labour intensive but effective at the small scale if effort maintained • Potential for increased infestation of rural areas parks and reserves • Adds to horticultural production costs through control measures such as netting • Canberra Indian Myna Action Group (CIMAG) assist members with trapping of mynas in back yards • Potential use of surface poisons at roost sites by licensed pest controllers	• No cost-effective control method available for use on public land • Protective measures undertaken on an individual basis by producers • Public referred to CIMAG for advice on trapping in back yard situations • Traps are produced by residents at the Alexander Maconochie Centre	• Continue to support research on new control techniques and on quantification of damage caused by Indian Mynas • There is continuing CIMAG support for the adoption of the trapping program by the Canberra community
Common Starling	• Competes with native species for tree hollows • Production losses in horticultural industries • Urban nuisance from roosts • Reservoir for diseases • Spread environmental weeds eg, olives	• No cost-effective, broad-scale control available • Adds to horticultural production costs through control measures such as netting • Potential use of surface poisons at roost sites by licensed pest controllers	• No cost-effective control method available for use on public land • Protective measures undertaken on an individual basis by producers	• Continuing industry investigation of cost-effective and environmentally benign control measures

Species	Risks	Management options and issues	Current management and monitoring practices	Outlook
Feral Pigeon (Rock Dove)	• Urban nuisance at roosting and feeding sites due to fouling from droppings • Potential human health hazard from some diseases carried by pigeons • Potential vector of bird diseases such as avian paramyxovirus • Potential flying hazard to motorists where large numbers roost on underpass structures	• No cost-effective, broad-scale control available • Shooting effective for small-scale situations • Trapping may be effective for small-scale situations • Physical barriers such as netting, spikes/wires or a deterrent gel used to exclude or deter birds from roosting on building ledges • Vandalism of physical barriers and birds building up debris/material behind the barriers makes them less effective • Poison-treated grain bait can be used to remove birds in specific situations • Potential use of surface poisons on structures or platforms at key roost sites may be a control option	• No cost-effective method available for use on public land • Licensed pest controllers may be authorised to use poisoned bait for specific, small-scale situations	• Maintenance of a watching brief on new management developments • Consider poisoning trial at suitable roost site(s)
Spotted Dove	• Pest risk assessed as moderate using the Bomford 2003 and 2008 models • Potential to compete with native birds for food resources and nesting areas • Known to disperse olive seeds and may spread weeds (seed eater known to eat weed seeds) • Known carrier of H5N1 avian influenza and the stickfast flea (a chicken parasite), potential carrier of other avian diseases • Minor public nuisance caused by fouling of cars, roofs and rainwater tanks, and cooing	• A trapping and shooting program has reduced populations in Alice Springs • Remove food sources (seed, petfood) from gardens, cover chicken houses and aviaries • Destroy eggs and nests • Better prospect for control if action taken while population is at very low level • Birds have become established in Queanbeyan, so cross-border approach needed	• No organised control program in place • COG has provided data on sightings and locations	• Explore the possibility of a community-based control program • This could include a community awareness and reporting campaign, pilot trapping program and destruction of nests
Non-local aviary escapees	• Potential to establish in the wild and compete with local native species	• Contingency arrangement for management of potential ecological threats • Lack of appreciation by aviculturists of issues and risks involved	• Maintenance of licensing system to reduce risk of escape of problem species	• Community education regarding species of concern and responsible bird keeping
Carp	• Dominant species in many local waters • Concern that feeding behaviour increases turbidity and undermines stream banks, contributing to habitat degradation and consequent pressures on welfare of native species • Source of parasites that potentially harm native species	• Prevention of spread to currently uninfested catchments eg, those of the Tidbinbilla, Gudgenby, Cotter and upper Queanbeyan rivers • Translocation to uninfested streams through use of carp as live bait or escape from farm dams	• Participation in the Murray Darling Basin Authority ACT Regional Carp Control Plan • Programmed fish monitoring program • Angler education • Eradication of farm dam populations in otherwise uninfested catchments	• Maintenance of a watching brief on emerging management and control measures • Opportunistic continuing eradication of new farm dam populations • Community education

Species	Risks	Management options and issues	Current management and monitoring practices	Outlook
Feral Goldfish	• Source of disease/parasites that potentially harm native species	• Prevention of spread to currently uninfested catchments eg, those of the Tidbinbilla, Naas, Gudgenby and Orroral rivers • Translocation to uninfested waterways through use as live bait by anglers	• Programmed fish monitoring program • Angler education	• Community education • Continuation of fish monitoring program
Redfin Perch	• Source of virus that harms native fish, particularly the threatened species Macquarie Perch and Silver Perch • Predation of native species • Resource competition with native species	• Prevention of spread to currently uninfested catchments eg, those of the Naas, Gudgenby, Cotter, upper Queanbeyan and Orroral rivers • Translocation to uninfested waterways by anglers	• Programmed fish monitoring program • Angler education	• Community education • Continuation of fish monitoring program
Oriental Weather-loach	• Competition with native fish such as Mountain Galaxias and Western Carp Gudgeon • Potential egg predator of native species, including amphibia	• Hardy species popular in aquariums, presumed to be the original source of infestation in the ACT • Translocation to uninfested catchments eg, those of the Naas, Gudgenby and Orroral rivers, through their illegal use by anglers as live bait	• Programmed fish monitoring program • Angler education	• Community education • Continuation of fish monitoring program • Maintenance of a watching brief on research to determine ecological damage caused by the species
Brown Trout **Rainbow Trout**	• Predation of native species • Competition with native species • Source/vector of virus that harms native fish	• Expansion of range at the expense of native species • Damage to already reduced populations of threatened species • Lack of appreciation in the fishing community of pest attributes	• Programmed fish monitoring program • Stocking of selected impoundments, ie, at Googong • Ban on stocking streams	• Improved angler appreciation of issues involved • Increased alignment with regional fish stocking policies
Eastern Gambusia Fish	• Predation of native fish and amphibia • Competition and aggression with native species	• Prevention of spread to currently uninfested catchments eg, those of the Tidbinbilla, Naas, Gudgenby, Orroral and Cotter rivers	• Angler education	• Community education • Continuation of fish monitoring program • Maintenance of a watching brief on research on the damage caused by and control of the species
Discarded aquarium fish	• Potential to establish in the wild • Potential source or vector of virus that harms native fish	• Inappropriate disposal of unwanted aquarium fish • Inadequate keeping arrangements so that escaped fish have access to waterways	• Education of aquarium keepers • Participation in the VPC Freshwater Fish Working Group	• Community education • Continuation of fish monitoring program • Increase control on importation of pest species

Species	Risks	Management options and issues	Current management and monitoring practices	Outlook
Various native species eg, Eastern Grey Kangaroo, White Cockatoo, Wombat, Pied Currawong	• Undue damage to conservation and/or production values when populations become excessive or damage concentrated eg, fence damage (kangaroo and wombat), spread of weeds, predation of nestlings (currawong) and crop damage (kangaroo, cockatoo) • Social nuisance in urban areas (cockatoos, possums)	• May be site-specific in response to inappropriate or new practices eg, vineyards, cropping, feeding of native birds and animals in urban areas • Seed-spreading pests counter weed control efforts • Determining an appropriate threshold for damage changing from 'environmental factor to be accommodated routinely in management' to 'unacceptable damage that warrants management intervention'	• Procedure for kangaroo culling on rural properties in place • Response to other issues on a case-by-case basis • 'Living with nature' ethos promoted	• Continuing investigation of management options in response to issues arising • Community education regarding management alternatives • Improved monitoring of population and distribution trends with support for related research
Non-local crustaceans (Marron etc.) **[treated as fish for legislative purposes]**	• If released/escape to waterways • Potential source of diseases or parasites of native species already under pressure • Potential competition with local crayfish species	• Periodic expressions of interest in establishing aquaculture enterprises • Potential for illegal/accidental introduction • Lack of import/keeping controls because of invertebrate status	• Surveillance of potential sources of introduction • Education of aquarium keepers	• Community education • Continuation of fish monitoring program • Compliance with National Policy for the Translocation of Live Aquatic Organisms
European Wasp	• During the breeding season, European Wasps will defend their nests and not hesitate to attack and sting both animals and humans • European Wasps have spread rapidly into remote conservation areas since 2006 and have been reported in the southern-most extremes of NNP. The wasps are adapting to survive and spread in these areas	• European Wasps are capable of denuding an area of insect life and hence impact on bird and plant life	• A contract consultant will provide an identification service and advice to the ACT community on European Wasps • All phone calls on European Wasps are forwarded to the European Wasp Hotline on (02) 6162 1914 • All confirmed nests on Territory land will be treated • In high-use barbecue/picnic areas where a nest cannot be located, a baiting program may be implemented during the breeding season when wasps are particularly aggressive	• Adequate stocks of European Wasp brochures are to be available at Visitor Information Centres • It is critical that media coverage is provided to remind residents to be aware of European Wasps and to eencourage people to report nests on public land and to control nests on private property

Species	Risks	Management options and issues	Current management and monitoring practices	Outlook
European Honey Bee	• The establishment of new colonies of honey bees in tree hollows reduces the number of nesting sites for native hollow-dependent fauna, eg, the Brown Treecreeper and Sugar Glider. In addition, feral honey bees can remove nectar from wildflowers without pollinating them • Bee swarms are not normally aggressive as they are engorged with honey and are homeless, which reduces their defensive behaviour. However if they are attacked or threatened then there can be a high risk of serious injury from multiple stings, with the highest risk being areas where young children play	• If increasing numbers of bee swarms setting up in tree hollows becomes threatening, then direct control would be required to free up the limited tree hollows • Swarming is part of the natural reproductive lifecycle of honey bees • Swarming, whilst not necessarily threatening or harmful, is a common concern of the general public	• Will only treat bee swarms if they pose a high risk to the public eg, a swarm in a high-use shopping centre or adjacent to a child-care centre or school • Swarm collection from private land may be available through the Beekeepers Association of the ACT	• Will only treat bee swarms for nature conservation purposes if increasing numbers of bee swarms setting up in tree hollows become a key threatening process
Termite	• Termites nesting on territory land sometimes attack and infest adjacent buildings • Termites can cause significant damage to buildings and private leaseholders may face major expense for repairs and for treatment to prevent further attack • Termites enter buildings from underground tunnels that originate from a nest which may be up to 50 metres away	• The two species that cause the most damage in the Canberra region are *Nasutitermes exitiosus* and *Coptotermes frenchi*. *N. exitiosus* nests are almost invariably mounds located within 30-50 metres of the infested areas, often in adjacent bushland. *C. frenchi* usually nest in old eucalyptus trees. Their nests may sometimes be found in eucalyptus regrowth and landscaped gardens, particularly in sleepers or woodchips, in damp areas in and around housing	• Nests will be considered as a possible source of termite attack if they are located within 60 metres of structures under attack and the termites in the nest are of the same species as those identified in the infested area • Nests must be destroyed within fourteen days of ACT PCS being notified in writing by the pest control firm	• Where a termite nest is not located, private leaseholders may consider the installation of a chemical soil barrier to prevent possible future termite attack of their residence from the soil • Installation of chemical barriers needs to be performed by a commercial pest operator at the cost of the resident or leaseholder
Meat Ant & Sugar Ant	• Many requests to treat ant nests on public parkland and nature strips, chiefly between October and March of each year • At these times of the year ant nests can become very large and their foraging habits may bring them in close contact with humans	• Ants are an integral part of the environment. As natural scavengers, they quickly recycle nutrients from organic material back into the soil. They are also eaten by a wide range of native animals and spiders	• Only treat Meat Ant nests if they occur at bus stops, barbecue areas or playgrounds • In exceptional circumstances, where ants are genuinely invading a private property and making it uninhabitable to residents, ie, residents or children are being bitten by ants	• Residents are strongly urged to consider alternative ant control methods if ants are foraging in backyards eg, removal of food sources which may attract ants

RISK ASSESSMENT GUIDE

(modified from Harrison and Congdon 2002 and Braysher and Saunders 2003).

The purpose of this risk assessment guide is to provide a framework of questions and statements that assist land managers in deciding whether pest or native animal management should be given high priority amongst other management activities, and, in some cases, to suggest likely consequences or an appropriate course of action. Note that indicative scores have been provided with each question or statement to indicate potential low (-2 to 1), moderate (2) or high (3 to 6) management priority. Land managers should use these scores as a guide only as they have not been weighted according to their relative importance. Land managers may modify the scores to develop their own, appropriately-weighted scoring system.

Step 1. What are the known risks associated with the pest species?

1A Pest risk has been assessed as low (0), moderate (1), serious (2) or extreme (3) (refer to Sections 3.1.3 and 3.2.1; Bomford 2008) or, if unknown, go to Question 1D.

1B Public safety risk has been assessed as not dangerous (0), moderately dangerous (1) or highly dangerous (2) (refer to Sections 3.1.3 and 3.2.1; Bomford 2008) or, if unknown, go to Question 1D.

1C The pest animal carries no disease risk (0), is a vector or carrier of a notifiable or reportable disease (1) or is recognised as a major disease risk with a national emergency response plan (2) (refer to Section 3.2.4) or, if unknown, go to Question 1D.

1D If there has been no formal assessment of pest, public safety or disease risk, is there any evidence for potential risks in these categories? No evidence (0), evidence in one risk category (1), evidence in two risk categories (2), evidence in three risk categories (3).

1E Is there published evidence that pest, public safety and/or disease risk will be either reduced (-1), unchanged (0), increased (1) or greatly increased (2) in response to climate change, or is the likely response unknown (1)?

Step 2. Is the species causing apparent damage to social, environmental or economic assets in one or more Land Management Units (LMUs)?

2A For pest animals that are migratory, or have a home range larger than one LMU, is there no (0), variable/ moderate (1) or strong (2) support for coordinated pest management by adjacent land managers?

0 = Pest management activities are unlikely to have long term benefits due to incursions from adjacent LMUs.

1 = Convene a stakeholder workshop according to PESTPLAN (Braysher and Saunders 2003) to establish whether there is sufficient support for coordinated pest management.

2 = Land managers and other stakeholders arrange to meet to develop a coordinated pest management plan.

2B Within each LMU, is the pest animal causing no apparent damage (0), damage is present but there is no apparent reduction in the value of social, environmental or economic assets (1), or is reduction in value of social (2), environmental (2) and/or economic (2) assets apparent?

0 = No further action is required.

1 = Ongoing visual checks of the LMU should be performed to check that there is no apparent reduction in asset value.

2-6 = An assessment of damage and/or species abundance and/or distribution is required for the LMU.

2C Has the pest animal been present on the LMU for more than ten years (0), up to ten years (1) or has it been recently sighted (2)?

0 = Pest animal populations have had time to become established and the dynamics of population density, distribution and damage levels are unlikely to change rapidly unless there is rapid environmental change. The need to consider pest management should be based on apparent damage to assets (Question 2B).

1 = Pest animal populations are still becoming established and population densities and damage levels may still be increasing. Early damage assessment (Step 3) and pest management action may be the most cost-effective management option, particularly for species that scored highly in Step 1.

2 = The pest animal has recently arrived on the LMU and population density, distribution and damage are unlikely to have reached full potential. Take management action as soon as possible for moderate to extreme risk species (Step 1) to eradicate, contain or maintain populations at low density even if damage levels are low.

Step 3. Damage assessment

3A Valid damage, species abundance and/or distribution assessments (refer to Section 4.3) demonstrate no (0), low (1), moderate to high (2) or extreme (3) levels of damage (or potential for damage) to social, environmental and/or economic assets.

0 = No further action is required.

1 = The species is causing minimal damage that is not reducing asset value and no immediate management response is required. Damage should be reassessed periodically to check that asset value is not being reduced.

2 = Asset value is either being substantially reduced, or pest animal abundance and/or distribution indicate the potential for a substantial reduction. Pest management action should be considered based on land management priorities - Go to Step 4.

3 = Asset viability is threatened and damage may be irreversible unless immediate management action is taken - Go directly to Step 5.

Step 4. Determine land management priorities for 1. Primary Production, 2. Conservation or 3. Urban, Suburban and Recreational Areas – to be completed for one or more land uses or LMUs.

1. Primary Production

Note that questions 4A-4E are intended to assist landholders in making decisions relating to their production and economic management objectives. However, pest management action may be required to support social and environmental management objectives where increased production or economic gain is unlikely.

4A Is the LMU poorly productive (0), moderately productive (1) or highly productive (2)?

0 = Pest animal management alone is unlikely to improve production and may be uneconomical.

1 = Pest animal management may improve production (perform a cost benefit analysis; refer to Section 4.5.1) where production is not limited by other constraints.

2 = Pest animal management is likely to increase both production and net return (perform a cost benefit analysis; refer to Section 4.5.1) where production is not limited by other constraints.

4B Is pest animal damage a minor (0), moderate (1) or major (2) component of production loss?

0 = Managing other factors such as salinity, weeds or commodity choice is likely to increase production more than pest animal management.

1 = Priority for pest management should be ranked with respect to all farm management activities (PESTPLAN; Braysher and Saunders 2003).

2 = Production losses are unlikely to be recouped without pest animal management.

4C Do production losses from pest animal damage have no effect on the profit margin (0), reduce the profit margin (1), remove the profit margin or result in net loss (2)?

0 = There are no production losses and no management action is required.

1 = The enterprise is less profitable but remains viable and pest management action should be based on a cost benefit analysis and ranking of whole-farm management priorities.

2 = The enterprise will be non-viable without pest management action which may or may not be economical (perform a cost benefit analysis). If pest management is uneconomical, assess alternative enterprises.

4D Is the density of Eastern Grey Kangaroos (EGKs) less than or equal to 0.1 EGK per hectare (0) or above 0.1 EGK per hectare?

0 = As an approximate guide, a density of 0.1 EGK per hectare is unlikely to cause significant economic loss.

1 = Densities above 0.1 EGK per hectare may require culling depending on individual landholder tolerances of damage and on adverse economic and environmental impacts (perform a cost benefit analysis). A density of 4.5 EGK per hectare, which may be reached in the absence of culling or grazing competition from domestic stock, is unlikely to be acceptable to any land manager. Ideally, the annual cull in a district should be no greater than the annual increase in the EGK population and coordinated culling by adjacent landholders may help to achieve this. A property of 500 hectares with a density of 0.1 EGK per hectare may need to shoot up to 30 EGK a year to offset annual recovery of the population through breeding. The same property with a density of 0.5 EGK per hectare may need to shoot up to 150 EGK annually.

4E In addition to production losses, is the pest animal causing no damage (0), minor damage (1), moderate damage (2) or major damage (3) to fences, dam walls and/or other infrastructure?

0 = Only production losses need to be considered in assessing pest management options.

1 = Costs for remediation of damage can be absorbed with little reduction in profit.

Step 4. continued

2 = Costs for remediation of damage substantially reduce the profit margin and pest management should be considered (perform a cost benefit analysis and rank management priorities).

3 = Costs for remediation of damage may remove the profit margin or result in a net loss, with the enterprise becoming non-viable. Prepare a pest management plan or consider an alternative enterprise.

4F For sites or assets of significant environmental value, are current pest animal management actions enhancing (-1), maintaining (0), causing a minor reduction (1) or causing a major reduction (2) in environmental value?

-1 = No change is required to the current pest animal management program.

0 = Pest animal management requires no change unless the value of environmental assets is to be enhanced.

1 = Increase the frequency and/or intensity of current pest animal management actions to maintain or enhance environmental values.

2 = Consider whether alternative pest management options or integrated pest management will be more effective in maintaining and enhancing environmental values than the current pest management program.

2. Conservation

4G Is there no habitat overlap between the pest animal and vulnerable or threatened native plant or animal species or ecological communities (0), or is there overlap with at least one vulnerable (1) and/or threatened native species (2) and/or at least one threatened ecological community (2) for which the pest animal is recognised as a threatening process (refer to the ACT *Nature Conservation Act 1980*)? Note that the overlap between the pest animal and other native plant and animal species, and ecological communities, should also be considered where conservation is a recognised land management objective.

0 = Pest animal management is unlikely to improve the conservation status of vulnerable or threatened species or ecological communities in the ACT.

1-5 = The capacity for pest animal management to maintain or improve the conservation status of vulnerable or threatened native species or ecological communities should be assessed. The benefits of pest animal management are likely to increase as the number of native species and/or ecological communities increase.

4H If the LMU contains native woody vegetation, is it in low (0) or better (1) condition?

0 = There is <25% of the lower value for the over-storey foliage cover benchmark for the vegetation type and <50% of groundcover perennial vegetation species is indigenous or >90% is ploughed or fallow. Native vegetation in low condition has a high likelihood of not being viable under the current management regime and pest management alone is unlikely to improve its conservation value.

1 = Vegetation cover values exceed those defined for low condition. Vegetation is likely to remain viable under current land management and pest management may maintain or improve its conservation value.

4I If the LMU contains native grassland or herbland (native perennial groundcover vegetation is dominant with trees absent or providing <1% cover), is it in low (0) or better (1) condition?

0 = There are five or less native herbs within the most diverse 20 x 20 m plot within the area of investigation or >90% of the ground is ploughed or fallow. Native vegetation in low condition has a high likelihood of not being viable under the current management regime and pest management alone is unlikely to improve its conservation value.

1 = Vegetation biodiversity and ground cover values exceed those defined for low condition. Vegetation is likely to remain viable under current land management and pest management may maintain or improve its conservation value.

4J Do areas of native vegetation have low (0), moderate (1), high (2) or very high (3) landscape function and connectivity?

0 = Native vegetation areas are small and poorly connected and pest management alone is unlikely to improve their conservation value.

1 to 3 = The benefits of pest management increase as the function and connectivity of native vegetation increases.

Step 4. continued

4K Does the pest animal nest or shelter in tree hollows or fallen logs (1) or are these habitats unaffected (0)?

0 = The pest animal is unlikely to displace native animals dependent on tree hollows and/or fallen logs.

1 = The pest animal may displace native animals dependent on tree hollows and/or fallen logs and pest management is likely to be beneficial.

4L Does the pest animal have no (0), minor (1) or major (2) adverse impacts on the environment in addition to biodiversity impacts (eg, soil compaction/erosion, wetland/stream bank/bog damage, reduced water quality).

0 = Only pest animal damage to biodiversity needs to be considered.

1 = Assess whether pest animal management and/or remediation of environmental damage are effective management options for maintaining or enhancing environmental value.

2 = Both pest animal management and remediation of environmental damage are likely to be required to restore and then maintain environmental value.

3. Urban, Suburban and Recreational Areas

4M If the pest animal species presents a moderate to highly dangerous public safety risk (refer to Question 1B), is that risk unlikely (0), likely (1) or highly likely (2) to be realised in the LMU?

0 = Pest animal management is not required to maintain public safety in the LMU.

1 = Pest animal management should be considered and the public made aware of the safety risk and available protection measures through an education campaign.

2 = Pest management has high priority and public contact with the animal should be minimised. The public should be informed immediately of the safety risk and protection measures with an ongoing education campaign.

4N Does the pest animal present no (0), moderate (1) or high (2) risk to domestic poultry or companion animals (causing death, injury, stress, disturbance, disease, cross-breeding etc.)?

0 = Pest management is not required to maintain poultry or pet health and welfare.

1 = Pest animal management should be considered to improve and then maintain poultry and pet health and welfare at acceptable levels in conjunction with a public education campaign.

2 = Pest animal management has high priority, interaction between the pest animals, poultry and pets should be minimised and the public informed immediately of safety risk and protection measures with an ongoing education campaign.

4O Are costs and labour associated with repairing pest animal damage to residential or other urban infrastructure negligible (0), low to moderate (1) or excessive (2)?

0 = Pest animal damage is easily repaired and pest animal management is not required.

1 = Repairing pest animal damage may or may not be more cost effective than pest animal management (perform a cost benefit analysis).

2 = Pest animal management is required.

4P Does the pest animal create no (0), other minor (1) or other major (2) public disruption (eg, noise, faeces, nesting in gutters, garden damage, spreading rubbish)?

0 = No pest animal management is required.

1 = Pest animal management should be considered based on the level of public discontent and costs and labour.

2 = Costs and labour of pest animal management are likely to be lower than managing ongoing public discontent.

Step 5 Is pest management feasible?

1. Are effective and efficient pest management options available?

5A Are there no options (0), one or more options under development (1), one well established option (2) or multiple well established options (3) available for managing the pest animal?

0 = The pest animal cannot be managed.

1 = Defer pest animal management until the management option is well established.

2 = Consider whether the established management option is suitable for application in the LMU.

3 = Choose the most suitable pest management option(s) for implementation in the LMU.

5B Are available management options poorly effective (0), moderately effective (1) or highly effective (2)?

0 = Desired pest management outcomes may not be achievable using the pest management option.

1 = Establish a trial to determine whether pest management outcomes can be achieved and/or perform a cost benefit analysis.

2 = Implement the pest management option.

5C Are all individuals of the species susceptible to the pest management option equally at all times (0), or can the pest management option be targeted at a particular life cycle stage, population subgroup or season (1), or can effective management be achieved by targeting a few rogue individuals, a single life cycle stage, or a critical time within a season (2)?

0 = Implementation of the pest management option can be carried out any time in response to measured damage levels or population density.

1 = Pest management should be targeted at susceptible life cycle stages, population subgroups or seasonally to achieve desired pest management outcomes efficiently and cost effectively.

2 = The pest management option is likely to be highly efficient and cost effective.

5D Are pest management outcomes achieved through repeated application of multiple management options (0), a single application of multiple management options (1), repeated application of a single management option (2) or single application of a single management option (3)?

0 = Pest animal management is unlikely to be feasible or cost effective except for protecting high value assets.

1-2 = Perform a cost benefit analysis to determine management option feasibility.

3 = Pest management outcomes are likely to be achieved efficiently and cost effectively using the management option.

5E Is local eradication in the LMU impossible (0) or possible (1) using the management option?

0 = Pests replace themselves at a faster rate than they can be killed and/or recolonisation cannot be prevented and/or some reproductive individuals are not susceptible to the management option, thus reducing the chance of successful local eradication. The pest animal may also be difficult to monitor at low densities. Ongoing management is likely to be more successful than local eradication.

1 = Pests cannot replace themselves at a faster rate than they are killed and/or recolonisation can be prevented and/or all reproductive individuals are susceptible to the management option. Monitoring of the pest animal can be achieved even at low population densities. Local eradication may be possible and more cost effective than ongoing management in the long term (perform a cost benefit analysis).

5F Is the efficacy of the management option in reducing pest animal damage or population density difficult to monitor and assess (0), readily assessed when adequate monitoring resources are available (1) or always readily monitored and assessed (2)?

0 = It will be difficult to assess the effectiveness of the management option through monitoring activities and to perform cost benefit analyses and practice adaptive management.

Step 5 continued

1 = Adequate resourcing should be secured to conduct a monitoring program before pest management activities commence.

2 = Monitoring for reduction of pest animal damage should be a standard component of the pest management plan.

2. Can the pest management option(s) be easily implemented?

5G Is implementation of the management option highly difficult (0), moderately difficult (1) or easy (2)?

0 = The pest management option should only be considered for the protection of high value assets.

1 = Determine whether pest management outcomes can be achieved (trial the management option and/or perform a cost benefit analysis).

2 = Implement the pest management option.

5H Is the 'acceptable' level of damage or population density threshold for managing the pest animal unknown (0), or has it been estimated (1) or thoroughly assessed and quantified (2)?

0 = Assessment of pest animal damage and density should be undertaken in conjunction with pest management to determine 'acceptable' thresholds.

1 = Assessment of pest animal damage and density should be undertaken in conjunction with pest management to confirm estimates.

2 = Implement the pest management option to achieve pest animal damage levels and densities that are below 'acceptable' thresholds.

5I Is there little or no information (0), a product label (1), established management guidelines (2) or a Code of Practice and Standard Operating Procedures (3) for applying the pest management option?

0 = Adopt a precautionary approach with respect to the level, timing and frequency of application, monitor damage to non-target species and public safety, and assess damage and density before and after implementation of the pest management option.

1 = Follow product label instructions (as required under the ACT *Environment Protection Act 1997* and *Medicines, Poisons and Therapeutic Goods Act 2008*) and adopt a precautionary approach with respect to the factors itemised for 0.

2 = Follow established management guidelines for the pest management option.

3 = Adhere to the Code of Practice and Standard Operating Procedures for the pest management option.

5J Is the pest animal highly likely (0), likely (1) or unlikely (2) to develop resistance to, or avoidance of, the management option?

0 = Consider alternative pest management options.

1 = Adopt strategies that minimise the development of resistance or avoidance by the pest animal (eg, integrated pest management).

2 = Implement the management option.

5K Are adequate funds and technical expertise for undertaking the management option difficult to secure (0), available on a limited or periodic basis (1) or always readily available (2) for immediate and/or follow-up management action?

0-1 = Ensure that resources are secured before the management program commences, particularly where follow-up management action may be required.

2 = Implement the management option as convenient.

5L Do timing and resource requirements for the pest management option clash with (0) or complement (1) those of other land management activities (consider for one or more LMUs)?

Step 5 continued

0 = Rank LMU management priorities and implement pest management option if high priority (refer to Step 4).

1 = Implement the pest management option.

5M If pest management activities need to be communicated to managers of neighbouring LMUs and/or the general public in advance of implementation, is there no network (0), a partial network (1) or a well established network (2) available for that communication?

0 = Design communication strategies to ensure that all relevant parties receive notification before pest management programs commence.

1 = Use partial networks and other effective means for notifying relevant parties.

2 = Communicate pest management activities through established networks.

5N Is there community and/or political opposition (-1) or indifference (0) to use of the management option for control of the pest species, or is there variable/moderate (1) or strong (2) community and/or political support?

-1 = Implementation of the management option may not be feasible for the LMU, or its scope may be restricted to levels and frequencies of application or locations negotiated with community and/or political groups.

0 = Pest animal management plans should be developed in consultation with community and/or political groups to avoid delays in implementation.

1 = Pest animal management plans can be developed and implemented based on land management priorities and the feasibility of the management option with minimal community consultation.

2 = Pest management outcomes may be enhanced by community involvement and/or increased resource allocation from funding sources.

3. Adverse impacts of pest management implementation.

5O Is the management option likely to have adverse impacts on a large number of individuals of many non-target species (0), a moderate number of individuals of several non-target species (1), a few individuals of a few non-target species (2) or no non-target species (3), or are impacts on non-target species unknown (1)?

0 = Consider other management options or take no management action.

1 to 2 = Adopt mitigation strategies to limit adverse impacts on non-target species such as restricting the amount, location and timing of application of the pest management option. Where impacts on non-target species are unknown, adopt a precautionary approach.

3 = Implement the management option.

5P Is there major (0), minor (1) or no (2) environmental damage associated with use of the management option? Refer to examples of environmental damage for primary production (Question 4E), conservation (Question 4L) and urban (Questions 4O and 4P) land uses.

0 = Consider other management options or take no management action.

1 = Evaluate the threshold for 'acceptable' environmental damage and whether modification of the pest management option and/or environmental remediation can limit environmental damage to threshold levels.

2 = Implement the management option.

5Q Will management of the target pest animal alter the population density or behaviour of other pest animal species, resulting in major (-2), moderate (-1), or little or no (0) increase in the damage they cause? Alternatively, will management of the target pest animal simultaneously reduce the population density and/or damage caused by other pest animal species (1)?

Step 5 continued

-2 = Management of the target pest may cause an increase in the level of management required for one or more other pest animal species.

-1 = Assess whether the benefits from managing the target animal outweigh increased population density and damage risks associated with other pest animal species.

0 = Implement the management option.

1 = Assign high priority to implementation of the management option to reduce damage caused by multiple pest animal species.

5R Will adverse impacts caused by the management option be long term (ie, more than one year or reproductive cycle/or causing permanent modification of habitat) (0), medium term (one season or reproductive cycle) (1) or short term (up to several weeks) (2)?

0 = Consider other management options or take no management action.

1 = Evaluate the threshold for 'acceptable' damage and whether modification of pest management action and/or remediation can limit damage to threshold levels.

2 = Implement the management option and adopt strategies to minimise short term damage.

5S If the species causing damage is a native animal, is it vulnerable, threatened or endangered (0), rare (1) or abundant (2) under the ACT *Nature Conservation Act 1980*, the NSW *Threatened Species Conservation Act 1995* and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*?

0 = No management action should be taken.

1 = Management action should only be taken if there is sufficient evidence to predict its effect on population density and/or behaviour. Management action should only be considered where 'acceptable' damage and density thresholds for the species have been identified and where assets are of high value and their viability is threatened.

2 = Management action may be taken to conserve asset value.

PRINCIPLES FOR FACILITATING GOOD COMMUNICATION AND COOPERATION BETWEEN STAKEHOLDERS IN PEST AND NATIVE ANIMAL MANAGEMENT WORKSHOPS

(Braysher 1993, Olsen 1998, Conover 2002, Braysher and Saunders 2003).

Preliminary assessment – Pest and native animal management workshops are beneficial when stakeholder understanding of issues is low (or the issues are contentious) and the stakeholders are willing participants in the process. The first workshop contact for potential stakeholders should be a positive experience, underpinned by a genuine possibility that a coordinated management program can be progressed. Before initiating the workshop, the facilitator(s) or key stakeholder(s) should make a preliminary assessment to determine:

- that damage is being caused and that it is due to the pest or native animal;
- the extent and impact of the damage;
- whether management options are available for damage reduction;
- the key land managers that are affected and their likely land management priorities; and
- all other stakeholders with an interest in the issue, including those likely to oppose a management program.

Workshop planning - Where there is sufficient evidence that a coordinated management program is warranted and feasible, and that it is likely to reduce pest or native animal damage and be supported by most stakeholders:

- choose a venue that is suited to the number, diversity, level of acquaintance and preferences of the stakeholders;
- choose dates and times for workshops that avoid peak periods of stakeholder commitment (eg, shearing or harvest time for farmers; annual reporting and budgeting deadlines in government agencies);
- issue personal invitations to encourage stakeholder attendance;
- schedule 'mixers' before and during workshops (eg, barbecues, tea breaks), particularly when stakeholders originate from different social groups;
- prepare relevant and concise background material that will support stakeholder understanding and assessment of management issues; and
- prepare a structured series of questions as a framework for decision-making on available management options and program goals.

Facilitation - Engage an independent and impartial professional facilitator, or select a key stakeholder with good facilitation and communication skills, who can:

- present issues to stakeholders without pre-empting or dictating management decisions,
- initially adopt a broad geographical perspective rather than focussing on individual land management units;
- encourage all stakeholders to voice their opinions and to explain their key priorities in relation to their land management objectives (or other areas of interest) so that all participants are aware of the full range of issues;
- challenge stakeholders to consider new management options or those not normally practised, including higher risk options with greater potential benefits;
- assist stakeholders, particularly those unfamiliar with risk assessment, to weigh the costs and benefits of multiple risks and to maximise the benefit of the management program;
- encourage open debate to overcome disputes and guide debates with strategic questions if they become dominated by more vocal stakeholders;
- obtain cooperative agreement on desired outcomes, goals and performance indicators that support the key stakeholders affected by the damage and promote ownership of the management program;
- obtain agreement that the costs of the coordinated management program will fall proportionately to the stakeholders that derive the most benefit;
- ensure that social and ethical values, such as indigenous beliefs and animal welfare, are considered in addition to damage reduction, efficiency and economy in the development of the management program; and
- obtain agreement from individual stakeholders to take responsibility for follow–up actions, such as ongoing communication, finalising management programs, and making detailed estimates of resource requirements.

After the workshop - Ensure that further planning and implementation of the coordinated management program occurs with regular communication to all stakeholders. Plan to:

- summarise agreed outcomes and circulate them to all stakeholders immediately after the workshop;
- schedule follow-up meetings or workshops required to finalise management programs or adapt them in response to new information; and
- institute mechanisms such as a website or regular newsletter for stakeholders to report progress (eg, monitoring and assessment data, budgeting and resource use, research outcomes).

GLOSSARY

Note: Terms and definitions have been adapted from the glossaries of the APAS, the NSW ISP and the IGAB unless otherwise indicated.

Adaptive management
A management approach that involves monitoring the outcomes of a program or issue and, on the basis of the monitoring, improving the way the program is managed (http://www.environment.nsw.gov.au/salinity/glossary.htm).

Aquatic
In the ACT, aquatic refers to any organism that lives or grows in or on fresh water.

Biodiversity
The variety of life forms, the different plants, animals, microorganisms, the genes they contain and the ecosystems they form.

Biosecurity
The management of the risks to the economy, the environment, and the community, of pests and diseases entering, emerging, establishing or spreading.

Carrier
An individual animal harbouring specific organisms, which, though often immune to the agent harboured, may transmit the disease to others (Delbridge and Bernard 1998).

Commercial harvesting
Managing a pest or native animal species for financial gain.

Containment
Restricting the spread of an invasive species incursion.

Coordinated management program
A management program for pest or native animals that cause damage and whose home or migratory range extends over more than one land management unit. These species generally require coordinated management by multiple stakeholders to achieve effective and enduring damage reduction (Sections 4.5, 6.1 and 6.3).

Cost benefit analysis
A commonly used technique that estimates the monetary value of the benefits and costs of a particular activity (Hone 2007). If the benefits exceed the costs then the ratio of benefits to costs is greater than one and the activity will be economically profitable.

Declared pest animal
A species declared as a pest animal under the Pest P&A Act (http://www.legislation.act.gov.au/di/2005-255/default.asp).

Distribution
A measure of the spatial pattern or dispersion of a pest or native animal throughout a defined area (NLWRA and IACRC 2008).

Emergency response
The actions taken in anticipation of, during, and immediately after, a pest or disease outbreak to ensure the adverse impacts are minimised. These may include:

i) actions constituting an initial response to an outbreak; and

ii) actions that form part of a national biosecurity incident response.

Emerging species
A newly established pest animal species whose distribution, abundance and adverse impacts are expanding.

Endemic
Indigenous to a particular area and found nowhere else.

Eradication
Removal of the entire population of an invasive animal from a managed area, resulting in elimination of the species.

Established pest animal
A pest animal that can reproduce at a sufficient level to ensure continued survival in a new habitat without new genetic input from outside the system.

Evaluation
The process or results of an assessment or appraisal in relation to stated objectives, standards or criteria.

Exotic
Refers to a pest animal, or an animal (or animal-borne) disease, that is not native to Australia.

Feral animal
An animal that has reverted to the wild from domestication.

Generalist
An animal species with a broad diet of many food types (Bomford 2008).

Impacts
The (usually negative) social, environmental or economic effects of pest or native animal species.

Import risk analysis
Assessment of the level of biosecurity risk associated with the entry, emergence, establishment and spread of pests and diseases, and the identification of options to limit the level of biosecurity risk.

Incursion
An isolated population of an invasive species detected in an area where it has not been previously established.

Indigenous
Originating in and characterising a particular region or country (Delbridge and Bernard 1998).

Integrated pest management
Integrated pest management combines several management options to provide effective, economical control of pests while minimising damage to the environment (http://www.dpi.qld.gov.au/4790_4910.htm).

Introduced species
An exotic animal species that has been intentionally or accidentally brought into an area by humans (NLWRA and IACRC 2008).

Invasive species
A species occurring, as a result of human activities, beyond its acceptable normal distribution and which threatens valuable environmental, agricultural or other social resources by the damage it causes (http://www.environment.gov.au/biodiversity/invasive/index.html).

Invertebrate
An animal without a backbone (Delbridge and Bernard 1998).

Management option
Any method or approach available for managing pest or native animals that cause damage (Section 4.4).

Monitoring
Activities to investigate the presence or prevalence of a pest or disease in a given plant or animal population and its environment.

Native animal
An animal species indigenous to Australia (NC Act; Section 5.2).

Operational monitoring
Recording the costs of planning, labour and materials used in the operational phase of a pest or native animal management program with the aim of evaluating and improving the efficiency of subsequent operations (Braysher 1993).

Non-target species
Any animal or other species that is accidentally killed or damaged (Fleming *et al*. 2001) by a pest or native animal management program.

Notifiable pest animal
A declared pest animal under the Pest P&A Act (Section 2.3.1; http://www.legislation.act.gov.au/di/2005-255/default.asp), whose presence in the ACT must be notified to the Director-General of TAMSD.

Pathway
The means by which invasive species move. Possible pathways include air, surface water, groundwater, plants, animals, humans and human transport routes.

Performance monitoring
Monitoring changes in the damage caused by pest or native animals, or in their abundance or distribution (Section 4.3), with the aim of evaluating management program success against established performance criteria and criteria for failure (Braysher 1993; Section 4.5.2).

Pest animal
Any exotic animal causing, or with potential to cause, unacceptable damage to social, environmental or economic assets.

Prohibited pest animal
A declared pest animal under the Pest P&A Act (Section 2.3.1; http://www.legislation.act.gov.au/di/2005-255/default.asp), whose supply or keeping is prohibited in the ACT.

Quarantine
Legal restrictions imposed on a place, plant, animal, vehicle, or other things limiting movement.

Risk assessment
An evaluation of the social, environmental and economic risks associated with a particular pest or native animal, or with the management options available for reducing the damage that they cause (Section 4.5; Appendix 2). The aim of the risk assessment is to determine whether a management program is desirable and feasible in the context of the land management priorities of the affected stakeholder(s) (Braysher and Saunders 2003).

Risk management
The process of identifying, selecting and implementing measures that can be applied to reduce the level of risks.

Sleeper
Exotic animal species that have established, but are believed to have not yet reached their potential to form large and widespread populations in Australia, despite being established for some years. They are regarded as having the potential to assume major significance as invasive pest animal species.

Specialist
An animal species that is dependent on a restricted range of foods (Bomford 2008).

Species abundance
A measure (in numbers or relative value) of the density of a species in a defined area (NLWRA and IACRC 2008).

Stakeholders
Those people and organisations who may affect, be affected by, or perceive themselves to be affected by a pest or native animal management decision, activity or risk. Key stakeholders are those that have primary responsibility for managing pest or native animals that cause, or have the potential to cause, damage.

Surveillance
An official process which collects and records data on pest animal occurrence or absence by survey, monitoring or other procedures.

Translocation
The deliberate transfer of an animal species or its regenerative material from one place to another.

Vector
Anything capable of carrying or transmitting pests, diseases or infections.

Vertebrate
An animal with a backbone.

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