THREAT ABATEMENT PLAN

for competition and land degradation by unmanaged goats

2008

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1. Introduction

This threat abatement plan (TAP) establishes a national framework to guide and coordinate Australia's response to the impacts of unmanaged goats (*Capra hircus*) on biodiversity. It identifies the research, management and other actions needed to ensure the long-term survival of native species and ecological communities affected by competition and land degradation caused by unmanaged goats. It replaces the TAP for competition and land degradation by feral goats published in 1999 (EA 1999a).

This plan should be read in conjunction with the publication *Background document for the threat abatement plan for competition and land degradation by unmanaged goats* (DEWHA 2008). The background document provides information on unmanaged goat characteristics, biology and distribution; impacts on environmental, economic, social and cultural values; and current management practices and measures.

1.1 Threat abatement plans

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the Australian Government develops TAPs and facilitates their implementation. To progress the main strategic development actions, the Department of the Environment, Water, Heritage and the Arts (DEWHA) assesses the potential for partnerships and co-investments with other government agencies, industry and other stakeholders. An important part of implementation of the TAP is ensuring that knowledge of improved abatement methods is disseminated to potential users.

Mitigating the threat of invasive species is not simply a matter of providing better technical solutions, such as improved baits for feral animal control. It also involves understanding and addressing social and economic factors; for example, through supporting the efforts of private landholders and leaseholders to manage invasive species on their lands for biodiversity conservation and primary production. In addition, research and development programs for controlling vertebrate pest species need to integrate interests of both primary production and environmental conservation.

Regional natural resource management plans and site-based plans provide the best scale and context for developing operational plans to control invasive species. They allow primary production and environmental considerations to be jointly addressed, and control to be integrated across the local priority vertebrate pests within the scope of other natural resource management priorities.

The national coordination of pest animal control activities occurs under the Australian Pest Animal Strategy, released in 2007 by the Natural Resource Management and Primary Industries Ministerial Councils. The Vertebrate Pests Committee, comprising representatives from all Australian, state and territory governments, has responsibility for implementation of the strategy. This TAP provides guidance for abating the impacts of unmanaged goats within that broader context.

1.2 Threat abatement plan for unmanaged goats

1.2.1 The threat

Goats are found across approximately 2 million square kilometres of Australia. They are present in all states, the Australian Capital Territory and some offshore islands, including islands that are part of the Northern Territory. However, unmanaged goats are not found on the mainland of the Northern Territory. Further details about distribution and abundance are in the accompanying background document (DEWHA 2008).

The intensity of goat management varies widely. In the agricultural zone, goats are typically more intensively farmed and tightly constrained by high fencing. In the pastoral zone, goats on leasehold or private property may be under varying levels of management.

The focus of this TAP is to minimise the impacts of goats wherever they affect biodiversity. Goats can be managed for productive purposes on private and leasehold lands in a total grazing pressure context, while still maintaining biodiversity values (Pearce et al. 1998). The focus of this plan is to abate the impacts of goats where they are not actively managed, while allowing for the responsible farming of goats. The plan therefore refers mainly to the impacts of 'unmanaged goats.'

Under this plan, 'unmanaged goats' are goats that are free-living and not subject to livestock husbandry but may be 'owned' in the sense that access for harvesting or control is determined by the owner or occupier of the land. This is in contrast to 'managed' goats, which are those held under some combination of animal husbandry (owned, identified, restrained, managed for population structure and density, and receive welfare). Some goats may have one or more of the characteristics of managed goats, but in all other respects can be indistinguishable from unmanaged animals with no husbandry (after Forsyth and Parkes 2004, who explains the distinction but uses the terms feral and domestic goats).

Unmanaged goats can be a serious pest because of their ability to severely affect native flora and fauna. They are recognised internationally as a serious pest, appearing in the World Conservation Union's list of the 100 worst invasive species (Lowe et al. 2000). Competition and land degradation by feral goats is listed as a key threatening process under the EPBC Act. Unmanaged goats are a threat to a number of native species (see Appendix A), although impacts from goat competition and land degradation are not restricted to these species.

This TAP has been put into place as a feasible, effective and efficient way to abate the threat of competition and land degradation by unmanaged goats.

1.2.2 The impacts

Characteristics of goats that help to explain their invasiveness and impacts are their diet and fecundity. As generalist herbivores, they can colonise a wide range of habitats. With two breeding seasons a year, and twins and triplets common, goat populations can increase by up to 50 per cent a year under favourable conditions (Mahood 1985, Maas and Choquenot 1995, Parkes et al. 1996, Fleming 2004).

Similarly to other grazing animals, unmanaged goats can affect native flora and fauna by grazing on native vegetation, thereby preventing regeneration (Harrington 1979, Harrington 1986, Greene et al. 1998); by overgrazing, which causes soil erosion (Bayne et al. 2004); by competing for food and shelter; by introducing weeds through seeds carried in their dung; and by fouling waterholes.

1.2.3 Managing the threat

Control of unmanaged goats relies on a range of approaches. The main techniques suitable for broadscale

control are mustering (mainly suitable in areas of flat terrain), trapping (mainly suitable in arid or semiarid areas where water sources are limited) and aerial shooting (useful in inaccessible terrain). Eradication from offshore islands (or from mainland areas that have similarly isolated populations) is feasible and has been achieved by various methods. Other pressures on goats, such as predation by dingoes, may also reduce their numbers.

In some areas of broadacre grazing it can be difficult to differentiate between managed and unmanaged herds. In these areas, the impacts from goats need to be considered as a component of the overall grazing pressure from both introduced livestock and from native species. Best practice management in these 'blended' situations (or where unmanaged goats alone are present) should involve reduction of the threat to native species that may be affected by competition and land degradation from goats. The varying contexts in which goats are found reinforces the need for governments, the goat industry and other key stakeholders to work together to abate the impact on biodiversity from goats.

1.2.4   The review of the 1999 TAP

In accordance with the requirements of the EPBC Act, the original TAP for feral goat competition and land degradation (EA 1999a) was reviewed in 2004–05 by the Bureau of Rural Sciences (BRS) (Hart 2005) as part of a broader review encompassing the original TAPs for cats (EA 1999b), foxes (EA 1999c) and rabbits (EA 1999d).

The BRS review found that it was difficult to accurately determine the extent to which the goat TAP had reduced the impacts of goats on biodiversity. This reflects the current paucity of nationally consistent data on the ranges and densities of goats and their impacts, and the difficulties of linking outcomes in goat population changes to the outputs of the TAP. The invasive species indicator data to be produced under the National Monitoring and Evaluation Framework (NRMMC) should improve the availability of continental overview data over the next year or so.

The BRS surveyed a broad range of stakeholders and assessed a range of projects commissioned by the Department of Environment and Heritage (now the Department of the Environment, Water, Heritage and the Arts) that were developed under the auspices of the existing TAPs. This has helped to identify actions that will need to be initiated or continued into the future. The review concluded, however, that the goat-related projects that were assessed had positively contributed to reducing the impacts of goats.

The BRS review proposed a number of changes to the actions found in the original TAP, but recommended that the objectives remain substantially unchanged. The review suggested that the implementation of the revised goat TAP should give priority to improved national engagement, integrated pest animal control, flexibility in implementation, setting priorities for research, follow-through with research and development, and establishment of a new advisory panel for vertebrate TAPs. The review also recommended that revised plans include measures to enhance existing processes through, for example, regional processes; control and monitoring techniques that support on-ground management; and monitoring of key projects according to national protocols.

This document replaces the 1999 TAP. It incorporates the knowledge gained in the intervening years and has been modified in line with recommendations from the review. The TAP aims to guide the responsible use of public resources and the best outcome for native species and ecological communities threatened by competition and land degradation by unmanaged goats. The plan seeks to achieve these outcomes by recognising the opportunities and limitations that exist, and ensuring that field experience and research are used in dealing with the impacts from unmanaged goats. The activities and priorities under the TAP will need to adapt to changes as they occur.

1.2.5   Involvement of stakeholders

The successful implementation of this TAP will depend on a high level of cooperation between landholders,

community groups, local government, state and territory conservation and pest management agencies, and the Australian Government and its agencies. Success will depend on all participants assessing the impact of unmanaged goats and allocating adequate resources to achieve effective on-ground control of unmanaged goats at critical sites, improve the effectiveness of control programs, and measure and assess outcomes. Various programs in natural resource management, at national, state and regional levels, will assist stakeholders to make significant contributions to implementing the plan.

2. Objectives and actions

The goal of this TAP is to minimise the impact of unmanaged goat competition and land degradation on biodiversity in Australia and its territories by:

- protecting affected native species and ecological communities, and
- preventing further species and ecological communities from becoming threatened.

To achieve this goal, the plan has five main objectives, developed through the review of the previous TAP (Hart 2005) and consultation with experts. These objectives are to:

1. prevent unmanaged goats occupying new areas in Australia and eradicate them from high-conservation-value 'islands'
2. promote the maintenance and recovery of native species and ecological communities that are affected by competition and land degradation by unmanaged goats
3. improve knowledge and understanding of unmanaged goat impacts and interactions with other species and other ecological processes
4. improve the effectiveness, target specificity and humaneness of control options for unmanaged goats, and
5. increase awareness of all stakeholders of the objectives and actions of the TAP, and of the need to control unmanaged goats.

Each objective is accompanied by a set of actions, which, when implemented, will help to achieve the goal of the plan. Performance indicators have been established for each objective. Progress will be assessed by determining the extent to which the conditions set in the performance indicators have been met.

The sections below provide background on each objective, followed by a table listing the actions required to meet the objective. Twenty actions have been developed to meet the five objectives.

Priorities for each action are given in the tables below, categorised as 'very high', 'high' or 'medium'. Each action has also been assigned a timeframe within which the outcome could be achieved once the action has commenced. Timeframes are categorised as short term (i.e. within three years), medium term (i.e. within three to five years) or long term (i.e. five years or beyond).

☐ **Objective 1**

Prevent unmanaged goats occupying new areas in Australia and eradicate them from high-conservation-value 'islands'

Key actions for Objective 1 include identifying 'islands' of high conservation value, ranking the risk to such areas posed by unmanaged goats, and developing and implementing management plans to protect such areas from them. The actions are designed to prevent unmanaged goats from extending their range in Australia, and to remove them from high-conservation-value 'islands' if eradication is feasible. The actions focus on off-shore islands and on mainland 'islands' that are isolated or currently do not have unmanaged goats. All the actions are of high to very high priority and could be achieved within three to five years.

Action 1.1 focuses on collating data on conservation values of island areas, the likelihood of significant biodiversity impacts from unmanaged goats, and the risk that competition and land degradation from them will become a threat in these areas. DEWHA is establishing a national database of introduced animals across Australian offshore islands that will complement this work.

Action 1.2 develops contingency plans for preventing, monitoring and, if an incursion occurs, containing and eradicating unmanaged goats in areas with high conservation values. Action 1.3 implements these plans. All planning and implementation work would recognise that unmanaged goats are one of many pests facing land managers, and therefore would be undertaken within the context of integrated management activities.

Action 1.4 involves eradicating established populations of unmanaged goats from those 'islands' considered to be of high conservation value, depending on feasibility and cost-effectiveness. The identification of any areas for eradication of goats should closely involve local communities and landholders, including those with an economic interest in those herds.

Although not included as an action, genetic characterisation of existing populations should be considered as it may help identify sources and/or mechanisms of invasion, and thus help to prevent new invasions in the future.

Performance indicators

- No further establishments of unmanaged goats in goat-free areas of high conservation value.
- Successful eradication of isolated populations of unmanaged goats where this is attempted.
- Increased populations of affected native species in areas from which unmanaged goats, and other invasive species, have been eradicated.

Action	Priority and timeframe
1.1 Collate data on offshore islands, and on isolated mainland 'islands', assess their conservation value, the likelihood of significant biodiversity impacts from unmanaged goats, and if there are no goats, rank the level of risk from them being introduced and establishing populations.	High priority, short term
1.2 Develop management plans to prevent, monitor and, if incursions occur, contain and eradicate any incursion by unmanaged goats, for 'islands' with high conservation values.	Very high priority, undertake in short term, monitor over long term
1.3 Implement management plans for high-conservation-value 'islands', including prevention and monitoring actions, and containment or eradication actions if incursions occur.	Very high priority, medium term
1.4 Eradicate established populations of unmanaged goats from 'islands' with high conservation values where this is cost-effective, feasible and a high conservation priority.	Very high priority, undertake in short term, monitor over medium term

☐ Objective 2

Promote the maintenance and recovery of native species and ecological communities that are affected by competition and land degradation by unmanaged goats

Key actions for Objective 2 include identifying priority areas for investment in controlling unmanaged goats; implementing and supporting regional control programs; and applying incentives for promoting and maintaining control programs adjacent to the priority areas. Actions 2.1–2.3 focus programs in goat control on the maintenance and recovery of native species and ecological communities affected by competition and land degradation from unmanaged goats. All these actions are of high or very high priority.

Broadscale control of unmanaged goats in Australia is not feasible using the methods currently available. Therefore, it is necessary to identify priority areas for control based on scientific evidence of the significance of the population of native species or the ecological community affected and the degree of impact posed by unmanaged goats relative to other impacts. In addition, the cost-effectiveness of a control program and the feasibility of effective remedial action must be considered. These activities are covered by Action 2.1. Identification of priority areas can involve mapping the distribution of susceptible species, high-risk habitats and unmanaged goats to produce a national overview of priority regions (e.g. using the approach outlined in Dickman [1996] and NSW NPWS [2003]).

Once priority areas for investment have been identified, the next step is to implement regional control programs, as described in Action 2.2. Organisations implementing control programs will be encouraged to focus on areas where the control of unmanaged goats will help to reduce the threat to native species. The success of control programs should be monitored, applying national monitoring protocols (see Action 3.1) as soon as they are available.

It is important to promote goat control in priority areas and in adjacent areas, to prevent reinvasion. Action 2.3 focuses on applying new and existing incentives for such actions on private and leasehold lands.

Performance indicators

- Priority areas, where goat control is required to protect important affected flora and fauna, have been identified and are a focus for unmanaged goat control programs.
- The effectiveness of programs to control unmanaged goats is measured through pre and post-control monitoring of unmanaged goat populations and of key native species.

Action	Priority and timeframe
2.1 Identify priority areas to control unmanaged goats based on: • the significance of the population of the affected native species or of the ecological community • the degree of threat posed by unmanaged goats to species and ecological communities relative to other threats • the cost-effectiveness of maintaining unmanaged goat populations below an identified 'damage threshold' in the region, and • the feasibility of effective remedial action	Very high priority, short term
2.2 Conduct and monitor regional goat control, through new or existing programs, in priority areas identified in Action 2.1.	High priority, short term

2.3 Apply incentives to promote and maintain on-ground control of unmanaged goats on private or leasehold lands within or adjacent to priority sites identified in Action 2.1.	High priority, long term

☐ Objective 3

Improve knowledge and understanding of unmanaged goat impacts and interactions with other species and other ecological processes

Key actions for Objective 3 include developing simple, cost-effective methods for monitoring impacts; improving knowledge of interactions between unmanaged goats and key native species, and between unmanaged goats, livestock, rabbits, macropods and wild dogs; and identifying unintended effects of controlling unmanaged goats in isolation from other activities. Actions 3.1–3.4 focus on ensuring that goat control programs do not lead to unintended impacts, and that control activities are targeted strategically through better understanding of the impacts of unmanaged goats and their interactions with other species. These actions are mainly of high to very high priority, and most should be achieved in the short to medium term.

To determine the effectiveness of goat control programs, Action 3.1 is to develop simple, cost-effective methods for monitoring the impact of this invasive species on affected species and ecological processes (e.g. nutrient cycles and fire regimes) relative to other sources of impact, such as wild rabbits and domestic livestock. Monitoring methods need to be reliable for different densities of both unmanaged goats and the native species they affect through competition and land degradation. Areas for investigation include the feasibility and practicality of individual identification of unmanaged goats by genotyping scats or hairs, to help estimate abundance, particularly at low densities.

Interactions between unmanaged goats and other species need to be considered when undertaking control programs. Action 3.2 is to investigate interactions between goats, livestock, rabbits, macropods and wild dogs. This will help determine optimal approaches to integrated management of these species in the rangelands. For example, certain fences used to contain goats can also exclude wild dogs. Action 3.3 is to identify any unintended effects that controlling unmanaged goats may have if it is not integrated with other management activities, such as weed outbreaks or increases in other grazers.

One of the most important actions is Action 3.4, which is to establish the relationship between density of unmanaged goats and damage and benefits in different ecosystems.

Performance indicators

- Reliable monitoring techniques have been developed for unmanaged goats.
- Control of unmanaged goats is better integrated with control of other vertebrate pests.
- The unintended effects of programs to control unmanaged goats are minimised.

Action	Priority and timeframe
3.1 Develop simple and cost-effective methods for assessing and monitoring the impact of unmanaged goats relative to other sources of impact, including reliable methods for monitoring their numbers and their effects at different densities on key native species.	High priority, short term
3.2 Investigate interactions between unmanaged goats, other livestock species, rabbits, macropods and wild dogs to determine optimal approaches to integrated management of these species in the rangelands.	High priority, medium to long term
3.3 Identify any unintended effects that controlling unmanaged goats may have if conducted in isolation from other management activities.	High priority, medium term
3.4 Investigate the relationship between unmanaged goat density and damage and benefits in different ecosystems.	High priority, medium term

☐ **Objective 4**

Improve the effectiveness, target specificity, integration and humaneness of control options for unmanaged goats

Key actions for Objective 4 include improving control methods, strategic use of exclusion fencing, increasing use of control methods by land managers, increasing adoption of standard control methods, promoting commercial use approaches that complement conservation objectives, and investigating the eradication of isolated populations through the use of integrated control methods. Actions 4.1–4.7 focus on improving options to control unmanaged goats through better use of existing techniques and development of new techniques, including those for monitoring success of control in the field. These actions are of medium to high priority; some are already partially achieved, and most could be achieved within the next three to five years.

Total grazing management systems incorporating self-mustering traps have, in some regions, played a useful role in controlling goat numbers. Trapping groups of goats around watering points can be an effective and efficient control technique (Harrington 1982), but in areas of high rainfall, trapping is effective only in dry times when goats are obliged to find water and there is no access to alternative water sources. Action 4.1 includes research into the potential of bore capping and new technologies, such as 'machine vision' species recognition, to improve the effectiveness of waterpoint trapping.

Action 4.2 is to research the potential drawbacks of toxins used to poison unmanaged goats; for example, their potential to affect non-target species.

Action 4.3 is to test and disseminate information on exclusion fencing, such as that contained in a recent review (Long and Robley 2004). The review authors were unable to locate any exclusion fences (except for small experimental exclosures) designed to exclude unmanaged goats from conservation areas. Goats will eventually breach most fences; therefore, fencing is often regarded as a tactical weapon to facilitate control of

unmanaged goats rather than a tool for achieving complete exclusion (Parkes et al. 1996).

To improve the effectiveness of control programs, Action 4.4 is to develop training programs to help land managers adopt and evaluate control methods appropriate for local conditions and determine in what circumstances and times they should be used.

To ensure that goat management follows best practice, Action 4.5 is to continue to promote the adoption and adaptation of the relevant model codes of practice and standard operating procedures for the humane management of goats (Sharp and Saunders 2004), including their recognition as a reference under the National Competency Standards for Vertebrate Pest Management (National Training Information Service 2007). This should be done in conjunction with the national feral livestock code of practice (CSIRO 1995).

Action 4.6 is to promote commercial approaches that complement conservation objectives. One possible option could be supporting landholders in key areas to reduce unmanaged goat densities to levels below those that are commercially viable for harvesting.

Various control techniques, such as trapping, aerial and ground shooting, and use of Judas goats can be effective in controlling unmanaged goats. Action 4.7 is to investigate the potential for integrating such techniques to eradicate unmanaged goats from offshore islands or areas of the mainland with isolated unmanaged goat populations.

Performance indicators

- Increased proportion of goat control programs use 'best-practice' techniques.
- Increased use of exclusion fencing in situations where it is considered to be more cost-effective than ongoing control of unmanaged goats and to protect critically endangered species.
- Increased adoption and adaptation of the model codes of practice and standard operating procedures for humane management of unmanaged goats, including their recognition as a reference under the National Competency Standards for Vertebrate Pest Management.

Action	Priority and timeframe
4.1 Investigate opportunities to improve self-mustering trap systems that operate within a scheme of total grazing management, as well as investigate the potential of bore capping and new technologies to increase the effectiveness of waterpoint trapping.	High priority, short term
4.2 Assess goat toxins for undesirable side-effects, such as off-target species impacts.	Medium priority, long term
4.3 Test and disseminate information on exclusion fence designs regarding their cost-effectiveness for particular habitats or topography.	High priority, short term
4.4 Develop training programs to help land managers identify locally appropriate control methods and the circumstances and times in which to apply them.	High priority, short term
4.5 Continue to promote the adoption and adaptation of the model codes of practice and standard operating procedures for humane management of goats, in	High priority, long term

Action	Priority and timeframe
conjunction with the national feral livestock code of practice.	
4.6 Promote commercial use approaches that complement conservation objectives.	Medium priority, long term
4.7 Investigate the potential to integrate a range of conventional control techniques to eradicate isolated or island populations of unmanaged goats.	High priority, medium term

☐ Objective 5

Increase awareness of all stakeholders of the objectives and actions of the TAP, and of the need to control unmanaged goats

Key actions for Objective 5 focus on ensuring that the TAP actions, and the need to manage goats, are communicated to interested parties by preparing and distributing extension materials. Working with primary producers of goats will be important to minimise the risk of recruitment of their goat stock into unmanaged populations, particularly outside the rangelands, and to finding approaches that take into account their economic interests in goat harvesting.

The promotion of extension materials as noted in Action 5.1 will help develop knowledge and understanding of the 18 actions listed in Objectives 1–4 of the TAP, of the techniques used in controlling unmanaged goats, and why competition by feral goats is listed as a key threatening process. Action 5.2 is to monitor the economic costs of control activities and compare these to the environmental benefits gained through control of unmanaged goats, using information from the actions under Objectives 2 and 3.

Performance indicators

- Widespread use of current 'best practice' techniques in control of unmanaged goats.
- Greater awareness in the rural community about issues surrounding unmanaged goats.
- Increased awareness of the TAP actions and objectives.

Action	Priority and timeframe
5.1 Promote: • broad understanding of the threat to biodiversity posed by unmanaged goats and support for their control • basic protocols for effective control of unmanaged goats in conservation areas and farmlands including, for example, with primary producers of goats • the importance of competition and land degradation by unmanaged goats as a key threatening process • understanding and adoption of the actions to be undertaken under this plan • the use of humane and cost-effective goat control methods, and • the involvement of the community in controlling unmanaged goats.	High priority, short term
5.2 Compare the economic costs and environmental benefits of control	Medium priority, medium term

activities.	

3. Duration, cost, implementation and evaluation of the plan

3.1 Duration and cost of the plan

This plan reflects the fact that the threat abatement process is likely to be ongoing, as unmanaged goats are established in Australia. In most cases, the ongoing costs of controlling unmanaged goats will be high. Current options for control in mainland areas are mustering, trapping and aerial shooting. All of these are expensive, time consuming and not suitable for broadscale implementation.

Investment in many of the TAP actions will be determined by the level of resources that stakeholders commit to management of the problem. The total cost of implementation therefore cannot be quantified at the time of writing. However, overall control costs for unmanaged goats have been estimated at $2 million per year in Australia (McLeod 2004), with labour costs of up to $0.9 million in the six-year period from 1998 to 2003 (Reddiex and Forsyth 2004).

This TAP provides a framework for undertaking targeted priority actions. Budgetary and other constraints may affect the achievement of the objectives of this plan, and as knowledge changes, proposed actions may be modified over the life of the plan. Australian Government funds may be available to implement key national environmental priorities, such as relevant actions listed in this plan and actions identified in regional natural resource management plans.

3.2 Implementing the plan

DEWHA will work with other Australian Government agencies, state and territory governments, and national and regional industry and community groups, to facilitate the implementation of the plan. There are many different stakeholder interests and perspectives to take into account in managing goats. For example, the views of Indigenous communities, pastoralists and environment groups need to be fully considered. It will be important to consult and involve the range of stakeholders in implementing the actions in this plan.

The Australian Government will implement the plan as it applies to Commonwealth land.

DEWHA will support a TAP implementation team to assist and advise on the implementation of the plan. The team will draw on expertise in vertebrate pest management from state and territory agencies, and non-government organisations.

This TAP will operate under the overarching framework of the Australian Biosecurity System for Primary Production and the Environment (AusBIOSEC) and in the context of the Australian Pest Animal Strategy, both of which aim to reduce the impacts of invasive species on native species and ecosystems.

3.3 Evaluating implementation of the plan

It will be difficult to assess directly the effectiveness of the plan in abating the impacts of unmanaged goats on Australia's biodiversity, given the broad range of stakeholders involved in their control. However, the Natural Resource Management Monitoring and Evaluation Framework (NRMMC 2003) established a program to provide national information about resource condition on a range of biophysical matters,

including threats from vertebrate species such as unmanaged goats. As part of this work, a range of indicators will provide information on the extent of the impact of priority vertebrate species on biodiversity, as well as national trends on their distribution and abundance.

Appendix A: Species affected by unmanaged goats

The species in the table below may be adversely affected by competition and land degradation from unmanaged goats (that is, there is scientific proof, anecdotal evidence or the potential for impact). The threatened species included are listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The list is indicative and not comprehensive.

Information for species listed under the EPBC Act is available from the Species Profile and Threats Database: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

Table A1:   Threatened species that may be adversely affected by unmanaged goats

Type/category	Scientific name	Common name	Current status
Listed threatened species that may be adversely affected by unmanaged goats			
Birds	*Amytornis barbatus barbatus*	Grey grasswren (bulloo)	Vulnerable
	Amytornis textilis modestus	Thick-billed grasswren (eastern)	Vulnerable
	Calyptorhynchus lathami halmaturinus	Glossy black-cockatoo (South Australian), glossy black-cockatoo (Kangaroo Island)	Endangered
	Gallirallus sylvestris (listed as *Tricholimnas sylvestris*)	Lord Howe woodhen	Vulnerable
	Leipoa ocellata	Malleefowl	Vulnerable
	Lagostrophus fasciatus fasciatus	Banded hare-wallaby, marnine, munning	Vulnerable
	Malurus leucopterus leucopterus	White-winged fairy-wren (Dirk Hartog Island), Dirk Hartog black-and-white fairy-wren	Vulnerable
	Pterodroma neglecta neglecta	Kermadec petrel (western)	Vulnerable
Mammals	*Petrogale lateralis lateralis*	Black-flanked rock-wallaby	Vulnerable

Type/category	Scientific name	Common name	Current status
	Petrogale penicillata	Brush-tailed rock-wallaby	Vulnerable
	Petrogale xanthopus xanthopus	Yellow-footed rock-wallaby (SA and NSW)	Vulnerable
Insects	*Paralucia spinifera*	Bathurst copper butterfly, purple copper butterfly, Bathurst copper, Bathurst copper wing, Bathurst-Lithgow copper, purple copper	Vulnerable
Plants	*Acacia ammophila*		Vulnerable
	Acacia araneosa	Spidery wattle, Balcanoona wattle	Vulnerable
	Acacia curranii	Curly-bark wattle	Vulnerable
	Acacia macnuttiana	McNutt's wattle	Vulnerable
	Acacia menzelii	Menzel's wattle	Vulnerable
	Acacia pycnostachya	Bolivia wattle	Vulnerable
	Acacia unguicula		Critically endangered
	Arachnorchis arenaria (listed as *Caledenia arenorchis*)		Endangered
	Arachnorchis lowanensis	Wimmera spider-orchid	Endangered
	Astrotricha roddii		Endangered
	Bertya opponens (listed as *Bertya* sp. Cobar-Coolabah; Cunningham & Milthorpe s.n. 2/8/73)		Vulnerable
	Boronia granitica	Granite boronia	Endangered
	Borya mirabilis	Grampians pincushion-lily	Endangered

Type/category	Scientific name	Common name	Current status
	Brachyscome muelleri		Endangered
	Calonema wanosa		Vulnerable
	Cynanchum elegans	White-flowered wax plant	Endangered
	Drakaea concolor	Kneeling hammer-orchid	Vulnerable
	Drakonorchis drakeoides	Hinged dragon orchid	Endangered
	Eremophila pinnatifida	Pinnate-leaf eremophila	Endangered
	Eriocaulon carsonii	Salt pipewort, button grass	Endangered
	Eucalyptus crucis subsp praecipua	Paynes find mallee	Endangered
	Grevillea beadleana	Beadle's grevillea	Endangered
	Grevillea iaspicula	Wee Jasper grevillea	Endangered
Plants (continued)	*Hakea maconochieana*		Vulnerable
	Homoranthus prolixus		Vulnerable
	Irenepharsus trypherus	Delicate cress, Illawarra Irene	Endangered
	Lachnagrostis limitanea	Spalding blown grass	Endangered
	Leionema ralstonii		Vulnerable
	Leucopogon confertus		Endangered
	Micromyrtus grandis		Endangered
	Pterostylis cucullata	Leafy greenhood	Vulnerable
	Pterostylis xerophila	Desert greenhood	Vulnerable

Type/category	Scientific name	Common name	Current status
	Pultenaea sp. Genowlan Point	Genowlan Point pultenaea	Critically endangered
	Sarcochilus hartmannii	Waxy sarcochilus, blue knob orchid	Vulnerable
	Senecio megaglossus	Superb groundsel	Vulnerable
	Stachystemon nematophorus	Three-flowered stachystemon	Vulnerable
	Swainsona murrayana	Slender Darling-pea, slender swainson, Murray swainson-pea	Vulnerable
	Westringia crassifolia	Whipstick westringia	Endangered
	Westringia davidii		Vulnerable
	Xerothamnella parvifolia		Vulnerable
	Zieria adenophora	Araluen zieria	Endangered
	Zieria buxijugum		Endangered
	Zieria floydii		Endangered
	Zieria parrisiae		Endangered
Unlisted species or taxa that could be adversely affected			
Plants	*Triodia bromoides*		

Glossary

Critically endangered

Under the EPBC Act, a native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.

Endangered

Under the EPBC Act, a native species is eligible to be included in the endangered category at a particular time if, at that time, (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.

Fecundity

Potential rate at which an organism reproduces.

Feral

An introduced animal, formerly in domestication, with an established self-supporting population in the wild.

Genotyping

The process of determining the genotype (i.e. the genetic makeup) of an individual with a biological assay.

Invasive species

A species occurring as a result of human activities beyond its accepted normal distribution and which threatens valued environmental, agricultural or personal resources by the damage it causes (Beeton et al. 2006).

Judas goat

The Judas goat method involves releasing a radio-collared goat into an area known to contain feral goats. Being social animals, the Judas goat will join any feral goats in the area. The goat can be relocated by means of directional radio-receiving equipment and hence the feral goat herd can be located and shot. The Judas goat can be allowed to escape and the process repeated until feral goats are no longer encountered. Hence, by using their sociability against them, goats can be eradicated.

Key threatening process

Under the EPBC Act, a process that threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community.

Performance indicator

A criterion or measure that provides information on the extent to which a policy, program or initiative is achieving its outcomes.

Pest animal or species	Any non-human species of animal that causes trouble locally or over a wide area, to one or more persons, either by being a health hazard, a general nuisance, or by causing damage to agriculture, wild ecosystems or natural resources.
Threat abatement plan	Under the EPBC Act, a plan providing for the research, management, and any other actions necessary to reduce the impact of a listed key threatening process on affected species and ecological communities.
Threatened species	A species under the EPBC Act listed as critically endangered, endangered, vulnerable or conservation dependent.
Unmanaged goats	Goats that are free-living and not subject to livestock husbandry, but may be 'owned' in the sense that access for harvesting or control is determined by the owner or occupier of the land. This is in contrast to 'managed' goats, which are those held under some combination of animal husbandry methods (such as being owned, identified, restrained, managed for population structure and density, and receive welfare). Some goats, however, have one or more of the characteristics of managed goats, but in all other respects are indistinguishable from unmanaged animals with no husbandry.
Vulnerable	Under the EPBC Act, a native species is eligible to be included in the vulnerable category at a particular time if, at that time, (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Acronyms and abbreviations

BRS	Bureau of Rural Sciences
DEWHA	Australian Government Department of the Environment, Water, Heritage and the Arts
EPBC Act	the Commonwealth Environment Protection and Biodiversity Conservation Act 1999
TAP	threat abatement plan

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