



**Australian Government**

**Department of the Environment and Energy**

# Threat abatement plan for competition and land degradation by rabbits



2016

The Department acknowledges the traditional owners of country throughout Australia and their continuing connection to land, sea and community. We pay our respects to them and their cultures and to their elders both past and present.

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## Introduction

This *Threat abatement plan for competition and land degradation by rabbits* establishes a national framework to guide and coordinate Australia's response to the impacts of European rabbits (*Oryctolagus cuniculus*) 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 rabbits. It builds on the achievements to date and replaces the previous threat abatement plan for rabbits published in 2008 (DEWHA 2008).

While this threat abatement plan aims primarily to abate the threat to key environmental assets (threatened species and ecological communities listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and other matters of national environmental significance), it also recognises that rabbits have wider environmental impacts as well as social, cultural and economic impacts.

This plan should be read in conjunction with the publication *Background document for the threat abatement plan for competition and land degradation by rabbits* (Department of the Environment and Energy 2016a). The background document provides information on:

- rabbit characteristics, biology and distribution
- impacts on environmental, economic, social and cultural values, and
- current management practices and research.

## Threat abatement plans

The EPBC Act provides for the identification and listing of key threatening processes. At the commencement of the EPBC Act, competition and land degradation by rabbits was listed as a key threatening process and a threat abatement plan was developed.

The Australian Government develops threat abatement plans with assistance from other Australian, state and territory government agencies, natural resource managers and scientific experts, and facilitates their implementation. To progress the main strategic actions within the threat abatement plan, the Department of the Environment and Energy relies on partnerships and co-investment with other government agencies, industry and other stakeholders. An important part of implementation of the threat abatement plan is ensuring that knowledge of improved abatement methods is disseminated to, and adopted by, potential users.

Mitigating the threat and impact of invasive species is a matter of developing, applying and integrating a number of control methods, not relying on one method. It also requires understanding and addressing social and economic factors; for example, through supporting the efforts of private landholders, leaseholders and volunteers to manage invasive species on their lands to achieve the desired outcomes for biodiversity conservation and primary production. In addition, research and development programs for managing pest species need to integrate the 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 allow management to

be integrated across the local priority vertebrate pests within the scope of other natural resource management priorities.

## **Review of the 2008 TAP**

The EPBC Act requires that a threat abatement plan be reviewed by the Minister at intervals of no longer than five years. The 2008 *Threat Abatement Plan for the competition and land degradation by rabbits* was reviewed by the Department of the Environment in 2013. The review assessed the progress and effectiveness of the threat abatement plan in: reducing the impacts of rabbits on biodiversity, specifically nationally listed threatened species and ecological communities; and preventing further species and communities from becoming threatened, through research, management and other actions. The review can be accessed at: <http://www.environment.gov.au/biodiversity/threatened/publications/tap/competition-and-land-degradation-rabbits>. In summary, the review found that:

- the issues and objectives outlined in the 2008 TAP were still valid and are likely to remain so into the future
- rabbits have reached their ecological limit within Australia; threat abatement should therefore focus on minimising their impact rather than preventing further spread
- there have been several successful eradications of rabbits on offshore islands in the last five years, most notably the eradication from Macquarie Island
- exclosures have been useful in quantifying the impacts of rabbits on native flora and fauna
- rabbits inhibit the regeneration of plants at densities as low as 0.5 rabbits per hectare
- rabbit control programs have often been ad hoc, lacked strategic prioritisation, and have rarely been initiated in order to promote threatened species or ecological community recovery
- information on the effects of rabbit abundance on pest predators, including prey switching, is limited
- rabbit control research over the last five years has predominantly focussed on increasing the effectiveness of Rabbit Haemorrhagic Disease, with several new strains identified, and
- new approaches and educational tools e.g. online manuals, guidelines, factsheets and economic decision models, have been produced to assist land managers implement integrated control programs.

This new TAP incorporates the knowledge gained since the 2008 TAP and the new objectives and actions have been written in line with the recommendations of the review.

## Involvement of stakeholders

The successful implementation of this TAP will depend on a high level of cooperation between landholders, community groups, non-government conservation organisations, local government, state and territory conservation and pest management agencies, and the Australian Government. Success will depend on all participants allocating adequate resources to achieve effective on-ground control of rabbits at critical sites, improving the effectiveness of control programs, and measuring and assessing outcomes. It is acknowledged that there have been declines in the number of people working on rabbit issues at a various levels of government, and this may add to the challenge of allocating adequate resources. However, programs in natural resource management, at national, state and regional levels, can make significant contributions to implementing the plan.

## Threat abatement plan for rabbits

This section provides an overview of the threat and management of competition and land degradation by rabbits. The background document (Department of the Environment and Energy 2016a) should be referred to for further information.

### The threat

The European rabbit (*Oryctolagus cuniculus*) was deliberately released onto the Australian mainland in the mid to late 1800s. Rabbits dominated two-thirds or 70% of the continent within 70 years (equivalent to approximately 5.3 million square kilometres) (Cox *et al.* 2013; Bengsen & Cox 2014). With the exception of the feral cat in Australia, this is considered to be the fastest rate of any colonizing mammal anywhere in the world (cited in Williams *et al.* 1995; McLeod 2004) — with colonisation greatly aided by the use of warrens (which protect them against predators and climatic extremes), their high reproductive rates, and their ability to survive in a wide range of habitats (Williams *et al.* 1995). They are now one of the most widely distributed and abundant mammals in Australia (Williams *et al.* 1995); found in all states and territories and many offshore islands, with only the most northerly regions of the mainland being rabbit free. Their exact abundance is unknown and cannot be readily quantified as population sizes frequently fluctuate through factors such as breeding events, mortality caused from biocontrol agents or drought, and availability of resources.

Rabbits inflict substantial damage upon both agricultural and environmental assets (e.g. native flora and fauna, vegetation communities, landforms, geomorphic processes and sensitive sites, and crops) and have been described as Australia's most costly vertebrate pest (Cooke *et al.* 2013). For agricultural commodities, this damage has been estimated at exceeding \$200 million annually (Gong *et al.* 2009); for environmental commodities, the value of the damage has not been quantified. The introduction of rabbit biocontrol agents (myxoma and rabbit haemorrhagic disease virus) have helped to reduce environmental impacts of rabbits in Australia and provided an economic benefit, although even at lower densities (e.g. more than 0.5 rabbits per hectare), their impact still continues to be severe (Bird *et al.* 2012; Cooke *et al.* 2010; Cooke 2012b; cited in Cooke *et al.* 2013). Direct impacts of rabbits include:

- competition with native wildlife for resources (food and shelter)

- preventing plant regeneration
- overgrazing and general damage to plant species
- reversing the normal processes of plant succession
- altering ecological communities and changing soil structure and nutrient cycling, leading to significant erosion, and
- removal of critical habitat for arboreal mammals and birds, leading to increased predation and reduced reproduction.

Rabbits also have indirect impacts on native flora and fauna, including:

- supporting elevated population densities of pest predators such as foxes and feral cats. They can also support wild dogs (wild dogs are not a problem across all parts of Australia, and indeed can play an important ecological role), and
- promoting growth of introduced and unpalatable species such as weeds.

Rabbits impact over 300 EPBC Act listed threatened species and nine ecological communities. This includes 44 species of fauna (15 birds, 20 mammals, 6 reptiles, 1 invertebrate, 1 fish and 1 amphibian) and 260 listed plant species (Department of the Environment 2015b). A full list of these species is at [Appendix A](#).

## Managing the threat

Rabbits are widely established and abundant in Australia and, with any current or foreseeable techniques, are not able to be eradicated. Given the current resources and techniques available, the focus of management is generally on abating their impacts rather than eradication. However, eradication may be achievable in isolated areas such as small reserves, exclosures, and offshore islands.

Sustained control of rabbits is feasible and has been achieved in some large areas using well planned and timely integrated control measures, particularly after rabbits have been reduced by drought or disease (Cooke 1993; Cooke 2012a). Integrated control measures must seek to: use a range of control techniques (e.g. poisoning and warren destruction); target a range of pest species (e.g. rabbit control activities should also focus on the reduction in foxes, feral cats and weeds); and seek to control rabbits across neighbouring land tenures.

In order to effectively manage rabbits and maximise control efforts, control efforts should be:

- targeted to protect sites where rabbits pose the greatest threat to biodiversity
- undertaken in a strategic manner to take advantage of the environmental conditions and other complementary activities, and
- monitored to ensure that objectives are met, and allow management options to be adapted to changing circumstances.

There are a range of control measures available for the management of rabbits. These include poison baiting, biological control agents, warren ripping and fumigation, fencing, harbour removal, and shooting. None of these techniques should be relied upon in isolation.

Research is continuing into improved control measures including biocontrol technology, particularly through three projects run by the Invasive Animals Cooperative Research Centre

(Invasive Animals CRC) — the RHD Boost, RHD Accelerator and Bioprospecting projects (Cox *et al.* 2013). Further information on control measures and the Invasive Animals CRC projects can be found in the supporting Background document (Department of the Environment and Energy 2016a).

## Objectives and actions

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

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

To achieve this goal, the plan has four main objectives:

1. Strategically manage rabbits at the landscape scale and suppress rabbit populations to densities below threshold levels in identified priority areas
2. Improve knowledge and understanding of the impact of rabbits and their interactions with other species and ecological processes
3. Improve the effectiveness of rabbit control programs, and
4. Increase engagement of, and awareness by, the community of the environmental impacts of rabbits and the need for integrated control.

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 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. Nineteen actions have been developed to meet the four objectives.

Priorities for each action are categorised as ‘very high’, ‘high’ or ‘medium’. Also, each action has 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 – Strategically manage rabbits at the landscape scale and suppress rabbit populations to densities below threshold levels in identified priority areas**

As the eradication of rabbits from all of mainland Australia and Tasmania is not feasible, attention needs to be directed to the management and control of populations to reduce their impact on biodiversity. However, in order to efficiently and effectively manage rabbits, control programs need to be strategically designed and implemented. This includes the consideration of



a number of different factors which can influence the success or failure, the effort required, and costs of control programs. The factors may include (among others):

- identification of threatened species and habitats for which rabbit control activities can provide the most benefit
- wider, community-based coordination of actions, including on-ground control on private properties, public land and in urban areas to provide control across wider areas to slow re-invasion. Noting that, for the purposes of this threat abatement plan, a greater focus should be on sites of higher conservation value
- incorporation of economic decision-model analyses to maximise cost-benefit outcomes of control programs
- identification of other land management activities such as pest animal control and weed management programs for integrated control and to reduce unintended consequences, and
- environmental site conditions including topography, land type, vegetation and climatic conditions; and their potential influence on control activities.

Control programs also need to take into account the number of rabbits per hectare. Several studies have found that if there are more than 0.5 rabbits per hectare, native species can be severely impacted (Mutze *et al.* 2008; Bird *et al.* 2012; Cooke 2012a). For example, when rabbit numbers are greater than 0.5 rabbits per hectare, the recruitment and regeneration of plants are inhibited, causing many of these species to become locally extinct (Mutze *et al.* 2008; Bird *et al.* 2012; Cooke 2012a).

The identification and consideration of threatened species and habitats is another critical consideration to ensure the survival of the species in that area. Removal of invasive species such as rabbits has been found to have significant benefits for native species such as reversing local population declines (Mutze *et al.* 2008; Bird *et al.* 2012; Pedler *et al.* 2016). Management actions for invasive species should therefore focus on removing these threats, as well as other threats to the threatened species or ecosystems, to enable the persistence of threatened native species and to support well-functioning ecosystems. Species identified (as at 2016) as being impacted by rabbits are outlined in [Appendix A](#).

In addition to the above factors, prioritisation of control for pest species such as rabbits has been found to be more useful at regional scales e.g. catchment or national resource management levels. Planning at this level enables a more holistic approach to rabbit management across regions, particularly in dividing and allocating resources (Murray *et al.* 2014). Regional areas are also likely to share the same or similar threatened species and ecological communities.

The actions under this objective therefore seek to assist land managers with information to support strategic rabbit management programs and to focus abatement on priority areas. The actions are envisaged to not only lead to better environmental outcomes such as species and ecological community protection, but to a more efficient and effective use of limited resources.

Key actions for Objective 1 include identifying priority areas for rabbit control on a regional scale, implementing and supporting regional control programs, and promoting and maintaining control programs in areas adjacent to priority areas. In particular, actions will seek to support control of rabbits to threshold levels of less than 0.5 rabbits per hectare.

Action 1.1 seeks to determine regional priority areas for rabbit control by focussing effort on areas where rabbits have the greatest impact on threatened species and/or ecological communities. This includes identifying priority islands for eradication efforts in each state. It also focuses on determining areas where the regeneration capacity of plants and the recovery of threatened species show the greatest potential. This will help obtain the greatest benefit for the amount of effort and resources put in. Aerial surveying using videos and GPS can be a cost-effective method for surveying and mapping regional areas to assist with prioritisation of management activities across a landscape. Economic decision models will also be useful to help determine how these efforts can be prioritised and the best combination of control methods (see background document for further information on economic decision models (Department of the Environment and Energy 2016a)). Control programs need to be implemented or continued in the identified priority areas.

Action 1.2 follows on from action 1.1 by ensuring that control efforts are focused on a wider and more holistic landscape-scale, rather than on small patches of land and including all land tenures such as private land and urban areas. By focusing efforts in this way, control activities can be planned in a strategic manner to take advantage of environmental conditions and other complementary activities in the area.

Action 1.3 relates to action 1.2, by using incentives for land managers to undertake more strategic and landscape-scale approaches to control programs. This should include coordination of control activities across neighbouring properties, including adjacent public and private land. It should be noted that incentives can include non-cash benefits such as training or community facilitation.

Both action 1.3 and 1.2 help to maximise effectiveness and minimise costs by avoiding a piecemeal approach to rabbit control which facilitates immigration from adjoining or adjacent land where no control has been undertaken.

Action 1.4 focuses on assessing the implementation of regional and state and territory based control programs via regular and coordinated monitoring and reporting mechanisms. Monitoring rabbit control programs is critical to assist in determining whether a management program has been successful or not and what the failure points might be. This is particularly important at the regional and state/territory level where funding and effort are put into very similar activities and under similar environmental conditions, but by a range of different groups and individuals. By making program reports readily available, this will help ensure that any future control activities are as effective as possible by allowing management programs to be adapted and avoiding duplication or the implementation of actions that are unlikely to succeed. Where possible, a common and best practice approach to rabbit monitoring should be undertaken to enable comparisons to be made between control activities. Further information on monitoring approaches for rabbits can be found in the background document (Department of the Environment and Energy 2016a).

Action 1.5 focuses on targeted eradication efforts on high priority islands identified through action 1.1. Eradications of rabbits from islands may be feasible, particularly if the risk of new arrivals can be mitigated against. The use of integrated and well-thought out management plans will be critical in such eradication programs to avoid unexpected consequences and to ensure their success.

### Performance indicators

- Regional priority areas for rabbit control are determined.
- Rabbits maintained at or below threshold (0.5 rabbits per hectare) levels in identified priority areas.
- Landscape scale control programs are implemented and monitored at regional levels.
- Eradication of rabbits on islands is successful where this is attempted.

Action	Priority and timeframe	Outcome	Output	Responsibility
<p>1.1. Prioritise areas on a regional scale (NRM, catchment level), including islands, for:</p> <p>a) their conservation value</p> <p>b) the potential for successful regeneration or rehabilitation of the species, and</p> <p>c) the degree of threat from rabbits.</p> <p>Undertake management action in these areas.</p> <p><i>*Prioritisation should consider a range of factors (examples in the text above), including economic decision models.</i></p>	High priority, short term	<p>Key species and ecological communities are prioritised and protected from the impacts of rabbits.</p> <p>Linkages made to recovery plans (where available).</p>	<p>List of priority areas.</p> <p>Management actions undertaken with a measured reduction in the impact of rabbits on key species and ecological communities.</p>	<p>State governments, NRM and catchment groups.</p> <p>Consultation should include local land managers and friends groups.</p>
1.2. Continue to develop and implement cost effective and coordinated management programs across all land tenures, including urban areas.	High priority, medium term	<p>Coordinated and targeted action by land managers.</p> <p>Measurable recovery in threatened species and ecological communities.</p>	<p>Landscape scale management plans are adopted and implemented.</p> <p>Rabbit numbers are reduced to less than 0.5 rabbits per hectare in priority areas.</p>	State governments, NRM and catchment groups, land managers and friends groups
1.3. Create incentives for coordinated and strategic control across adjacent	Medium priority, long term	Coordinated and strategic rabbit control	Rabbit control is shared amongst adjoining land managers. Strategic	State/territory governments and local

Action	Priority and timeframe	Outcome	Output	Responsibility
properties in all areas occupied by rabbits.		resulting in slower reinvasion and more effective control.	control is undertaken across all adjoining land tenures.	councils
1.4. Develop regular and coordinated monitoring and reporting mechanisms at a regional and state scale to assess progress and apply adaptive management.	High priority, short, medium and long term (this will be an ongoing activity)	Land managers apply the most effective management actions to control rabbits.	Adaptive management practices are adopted and information is shared.	State governments, NRM and catchment groups, and land managers
1.5. Eradicate rabbits from identified islands	Very high priority, long term	Measurable recovery in threatened species and ecological communities on identified islands.	Rabbits are eradicated or under sustained control on high priority islands.	State/territory governments and land managers

## **Objective 2 – Improve knowledge and understanding of the impact of rabbits and their interactions with other species and ecological processes**

The biology and ecology of rabbits has been extensively studied throughout Australia, but the interactions between rabbits and other fauna, as well as their contribution to a range of environmental processes, is still not well understood. Many studies describe economic losses to agriculture, but for the environment, very little information on the value and extent of these losses has been quantified. Further, many land managers consider rabbits to be under control through the use of biocontrol agents, but there generally is a poor understanding by some managers of how even one rabbit can significantly impact native vegetation and how integrated control measures can enhance outcomes.

There is a paucity of research about the exact contribution of rabbits to the diet of native or introduced predators and the potential trophic-cascade effect that rabbit control, or even introduced predator control, may cause (e.g. increase in rabbit numbers, augmentation in resource competition with native herbivores, increase of predation on native prey species). For example, in semi-arid Australia, rabbits have been reported as a staple (and in some cases,

primary) prey species for introduced species such as feral cats and foxes, and are thought to directly influence the abundance of these predators (Read & Bowen 2001; Holden & Mutze 2002; Glen & Dickman 2005). The abundance, survival and breeding of eagles, such as the wedge-tailed eagle (*Aquila audax*), had been thought to be directly related to rabbit abundance, but some recent research is proving otherwise (see Olsen *et al.* 2014). It is therefore imperative that more conclusive information on potential impacts is garnered.

Key actions for Objective 2 focus on improving our understanding of the impacts of rabbits and the interaction of rabbits with other species, in order to use this information to optimise integrated rabbit control measures.

Action 2.1 seeks to further investigate the interactions between rabbits, feral cats, foxes and wild dogs to enable more effective integration of control activities for these species. Research is envisaged to focus on how predator abundance fluctuates in response to rabbit control, the nature of the shift in predation to native species in response to rabbit control, and any variability in these interactions with different habitats across Australia. This research is expected to help land managers to determine and anticipate any unexpected consequences (direct and/or indirect) of proposed control actions. Such assessments may save land managers considerable flow-on remedial management costs, and help to ensure the previous control actions have a positive outcome (Bergstrom *et al.* 2009).

Action 2.2 seeks to further investigate the correlation between rabbits and weed species and increase our understanding of the benefits of integrated management. Previous research has suggested that high levels of grazing and soil disturbance by rabbits around warrens is likely to promote the growth of introduced plant species, especially invasive weeds (Williams *et al.* 1995; Cooke 2012b). By understanding the correlation of rabbits and weeds, land managers should be able to respond more cost-effectively and efficiently.

Action 2.3 aims to continue research into whether or not rabbits sustain populations of native species (i.e. act as a main component of their diet), and whether rabbit control has any implications for the survival of these populations. In particular, research should aim to create a greater understanding of how native predators respond to a sudden and widespread reduction in rabbit numbers.

#### *Performance indicators*

- Control program planning demonstrates consideration of unintended consequences of proposed actions.
- Control programs demonstrate use of integrated control measures for pest species that interact with rabbits and for weed species promoted by rabbits.
- Research papers are published that inform whether rabbit control is detrimental or beneficial to the survival of native species.

Action	Priority and timeframe	Outcome	Output	Responsibility
2.1 Continue research into understanding the contribution of rabbits to the	High priority, medium	A clear and greater understanding	Research papers and reports on the interaction between	Researchers, Government and



Action	Priority and timeframe	Outcome	Output	Responsibility
diet and abundance of feral cats, foxes and wild dogs in different landscapes, and any potential effects of modifying pest predator populations (e.g. prey switching, decline in native species)	term	<p>of how management programs can influence rabbit and pest predator populations.</p> <p>Land managers are able to implement more integrated management programs for rabbits and other pest species which don't deliver perverse environmental outcomes.</p>	rabbits and pest predators are published.	land managers
2.2 Increase understanding of the correlation between rabbits and weed species and the benefits of integrating their management	Medium priority, medium term	<p>A greater understanding of correlations between rabbit and weed control.</p> <p>Land managers are able to implement more effective pest management.</p>	Research papers and reports on correlations between rabbits and weeds are published.	Researchers, Government and land managers
2.3 Continue research into understanding the contribution of rabbits to the diet and abundance of native species.	High priority, medium term	A clear and greater understanding of whether rabbit management programs	Research papers and reports on the role or rabbits in maintaining populations of native species, including predators, are	Researchers, Government and land managers

Action	Priority and timeframe	Outcome	Output	Responsibility
		<p>affect the abundance of native species – predators and herbivores.</p> <p>Land managers are able to implement more effective pest management.</p>	published.	

### Objective 3 – Improve the effectiveness of rabbit control programs

In order to reduce the impact of rabbits on native biodiversity and ecosystems, the use, improvement and development of control tools and programs is of high importance. However, as improving the effectiveness of control programs and control methods (particularly biocontrol agents) or developing new tools can take many years, it is imperative that strategic research and development of more effective and efficient or new techniques is begun prior to any significant increases in rabbit numbers (Saunders *et al.* 2010; Cox *et al.* 2013).

In order to improve the effectiveness of rabbit control programs, we also need to understand the impact that control activities are having in the field. As such, surveillance and monitoring of control activities and their effect on rabbits, including abundance, will be critical in providing information for future management actions. This will include research into, and the development of, additional control measures and use of new biocontrol agents. The research should include the goal of improving the animal welfare of the rabbits with the control tools.

Key actions for Objective 3 therefore include: improving conventional control options and tools for land managers; improving the coordination of monitoring and surveillance of rabbit control programs; continuing research into new biocontrol and other novel control options; and increasing the adoption of standard operating procedures.

Action 3.1 seeks to support ongoing research to ensure conventional management options are effective, target specific and humane. This includes supporting the development of more humane baits and conventional control methods — for example, the development of a humane carbon monoxide warren fumigator by the Invasive Animals Cooperative Research Centre. The development of further control tools is expected to enhance the effectiveness, efficiency and humaneness of control programs. It may also reduce potential impacts on both the environment and non-target species.

Actions 3.2 to 3.5 focus on maximising the effectiveness of rabbit biocontrol programs through understanding interactions and evolutions of rabbit viruses, their optimal use, investigating the use of new viruses, and developing and registering new biocontrol agents/products. This

includes increasing our understanding of how, and under what circumstances, the endemic RHD virus (RCV-A1) — which is found in cool and wet areas of Australia — interacts with the current RHDV strains and helps provide immunity. Given the effectiveness of biocontrol agents in reducing rabbit numbers and in helping to protect threatened species, these actions are considered of high priority and will require a long-term and ongoing commitment. Through developing a greater understanding of the rabbit biocontrol viruses, including behaviours and evolutions, and increasing their effectiveness in the field, Australia will be better placed to respond to any future increase in rabbit numbers. It will also allow land managers to counteract any decrease in the effectiveness of existing strains by having new and effective biocontrol tools. Research being undertaken through Invasive Animals CRC programs such as the RHD Boost and Acceleration programs (see background document for further information on these programs (Department of the Environment and Energy 2016a)) will be of benefit to these actions. Other research institutes including universities and the CSIRO are also well placed to conduct novel research programs into control of rabbits based on their genetics, neurology and other physiological processes.

Actions 3.6 focuses on ensuring there is adequate monitoring and surveillance throughout Australia to determine whether or not rabbit pathogens continue to be effective in reducing rabbit numbers. Monitoring and surveillance is also critical to understanding the prevalence, seasonal fluctuations and interactions with the current biocontrol agents (Cox *et al.* 2013) and contributes to the outcomes of actions 3.3 to 3.5. Research under this action should include pre and post monitoring for any new release of a pathogen to track its performance and to better estimate the return on investment. This will help inform and define how successful future releases of biocontrol agents in the field might be and how they might complement or reduce the effects of existing measures (Saunders *et al.* 2010; Cox *et al.* 2013).

Action 3.7 aims to provide further tools for land managers to improve their ability to predict and forecast optimal rabbit control methods in order to effectively reduce the number of rabbits and their impact on various landscapes. At present, very few tools exist to estimate the various costs of using different control measures and how inaction may affect numbers of rabbits, impacts on the environment, and costs over time. In addition, existing tools are limited to certain regions and habitat types and have not yet been extrapolated for use in all habitat types. Expanding the applicability of these tools would assist land managers to design more effective control programs and gain a better understanding of the potential impact of their choice of control activities.

Action 3.8 follows on from action 3.7 by aiming to develop further economic assessment methods to determine the environmental benefits of rabbit control. At present, a model has been developed by Cooke *et al.* (2010) for the control of rabbits across south-eastern Australia with values assigned to native vegetation. Further native vegetation models need to be developed for use across all areas of Australia. Also of importance, values need to be assigned to the protection of native fauna, particularly those that are listed as threatened under the EPBC Act. Such values are likely to support management actions for native species and ecological communities, rather than only for agriculture where monetary values (and hence losses) can be more readily quantified.

For all of these actions, the outputs need to be made readily available and understandable for land managers so that they are able to translate the findings into improved control of rabbits.

*Performance indicators*



- Current control tools are refined (where possible) to improve effectiveness and humaneness.
- Additional effective and humane control tools, including biological control agents, are developed. Research papers are published on the biology of rabbit viruses, including their behaviour, evolution and impediments.
- Research papers and general information is published on the interactions of RHDV strains, their long term evolution and the development of genetic resistance by rabbits.
- Forecasting tools to predict the impact of changes in rabbit numbers and effectiveness of control methods in different landscapes developed and promoted.
- Monetary values are able to be assigned to the impact of rabbits on environmental assets.
- Pre and post monitoring is undertaken for the release of any new biocontrol agents.

Action	Priority and timeframe	Outcome	Output	Responsibility
3.1 Develop new methods and refine current methods for rabbit control that are effective, target specific and humane.	High priority, long term and ongoing	New humane and effective tools for control of rabbits are available to land managers	Measurable reduction in the number of rabbits.  Reduced impacts on non-target species and the environment.	Researchers and product manufacturers
3.2 Continue research to maximise the effectiveness of existing biocontrol tools and investigate new biocontrol agents or other novel control tools.	High priority, long term and ongoing	Biocontrol agents improved or new agents identified to ultimately deliver more effective rabbit control	Research papers and reports on biocontrols are published.  More effective or new biocontrol agents developed/identified.	Researchers
3.3 Develop and register new biocontrol agents and products, and other novel control tools identified.	High priority, long term and ongoing	Measurable and continued reduction in the number and impacts of rabbits through use of biocontrol agents.	Additional biocontrol agents are available to registered land managers.	Government and product manufacturers.
3.4 Increase understanding of the seasonal patterns of RCV-A1 and its interaction with RHDV strains.	High priority, long term	A clear understanding of the interaction	Research papers and reports on RCV-A1 and its interaction with RHDV strains are	Researchers and Government

Action	Priority and timeframe	Outcome	Output	Responsibility
		between all the strains of RHDV. Land managers able to time releases of RHDV strains for maximum impact.	published. Future biocontrol research takes into account, and aims to reduce interactions of RCV-A1 with RHDV strains.	
3.5 Increase understanding of the long term effect of evolution and genetic resistance to biocontrol agents.	Medium priority, long term	A clear understanding of the virus' evolution and role in genetic resistance. Future biocontrol programs are strengthened by taking account of the rate of evolution and development of genetic resistance.	Research papers and reports on virus evolution and its role in genetic resistance are published.	Researchers
3.6 Conduct pre and post monitoring to determine success of biocontrol releases across a range of landscapes	High priority, medium term	A clear understanding of the effectiveness, or otherwise, of each biocontrol agent release, and its environmental impacts.	Monitoring results for biocontrol reported of the reduction in rabbit numbers and environmental outcomes.	Government, researchers, community groups and land managers
3.7 Further develop user-friendly models to predict	Medium priority,	Land managers are	Forecasting tools are developed for use by	Researchers and Government

Action	Priority and timeframe	Outcome	Output	Responsibility
and forecast the impact of changes in rabbit numbers and effectiveness of control methods in a range of different landscapes	medium term	able to implement the most cost effective and optimal rabbit control activities.	land managers. Training provided to land managers in the use of the models.	
3.8 Further develop economic assessment methods to determine the environmental benefits of rabbit control	Medium priority, medium term	Land managers are able to apply an economic assessment to the value of managing environmental assets.	Economic assessment tools are available to land managers	Researchers and Government

#### **Objective 4 – Increase engagement of, and awareness by, the community of the impacts caused by rabbits, and the need for integrated control**

The success of previous rabbit control, predominantly due to the effectiveness of biocontrol agents, has resulted in rabbits losing some of their profile in the community as a major pest species (Williams *et al.* 1995; Cox *et al.* 2013). This has reduced the general awareness of rabbits as a problem, which has often resulted in diminished support in the community for ongoing rabbit research and control (Williams *et al.* 1995; Cox *et al.* 2013). Fewer government officials with rabbit control responsibilities has also reduced the opportunities for direct public engagement and awareness raising.

As a step towards engaging stakeholders and raising their awareness of the impacts caused by rabbits, educational material (e.g. manuals and videos on monitoring impacts and control techniques) has been developed. However, effectively collaborating with the community so that land managers get the skills necessary to recognise environmental impacts of rabbits (particularly at low levels) and be able to undertake effective management still needs further development and ongoing effort. This should include learning from communication techniques used by effective local groups. In addition to this, different audiences will need to be engaged via different methods and emphasis will need to be placed on the benefits of individual and group contributions.

Williams *et al.* (1995) and Adams (2014) found that for groups to successfully engage in the management of rabbit control, there needs to be:

- a high degree of local community understanding of the nature and extent of rabbit damage
- a respected rabbit expert for the local community to go to
- group reinforcement through peer pressure and good communication
- clear, identifiable and shared goals
- synchronisation of control efforts, and
- strong support from local and state pest management authorities.

Key actions for Objective 4 include ensuring better communication, engagement and awareness with and between land managers on the threat of rabbits to native species and other ecological processes, and how the use of integrated management methods can further reduce rabbit numbers. Successful rabbit management relies heavily on community understanding and adoption of best practice rabbit management principles. Achieving successful rabbit management relies heavily on community engagement and, to bring about any level of change, authorities need to engage with the particular community to understand the underlying values and behaviours of those land managers. Only then will they be able to stimulate change. Experienced community groups can assist others in this process.

Action 4.1 seeks to develop further training programs to help land managers (particularly supervisors and those planning local and regional programs) to evaluate and adopt control methods appropriate for local/regional conditions, and determine in what circumstances and when they should be used. This should include an assessment of any unintended consequences of a control program, such as predators switching from taking rabbits to native animals. These training programs should provide land managers with the skills to recognise an increase in rabbit populations, prior to substantial damage being caused (see Cooke 2012a). Training should also focus on providing contractors with specialised skills to operate machinery to conduct control activities more cost-effectively over a range of properties. Train-the-trainer approaches may be useful and will allow knowledge and experience to be passed on to other land managers.

Action 4.2 focuses on engaging with the community, raising general awareness of the impact of rabbits, and garnering support for the use of control tools. This should include:

- raising awareness that more than 0.5 rabbit per hectare can significantly reduce the recruitment and regeneration ability of many native plants
- aiming to reduce community reliance on biocontrol agents as the only control tool for reducing rabbit numbers, and
- promoting the use of new biocontrol agents and humane control tools.

As part of action 4.2, specific communication campaigns will need to be developed for any new biocontrol agents proposed for release, or other new control methods. By bringing the community onboard with proposed actions, there is a greater chance of achieving effective and coordinated rabbit control within these areas. It will also help reinforce how their contributions are valued and the benefit these actions can bring to their community and surrounding environment.

Action 4.3 seeks to promote the adoption of model codes of practice and standard operating procedures for the effective and humane management of rabbits (Sharp & Saunders 2012). This helps to ensure that rabbit management follows best practice and is undertaken humanely by land managers through adequate consideration of available control methods. In undertaking

this action, it will be important for those promoting these codes of practice and standard operating procedures to acknowledge that relevant state and territory and occupational health and safety legislation must also be adhered to. Model codes of practice and standard operating procedures should be developed for management tools as they are developed. Updating these documents will be necessary when new information is available.

Action 4.4 aims to determine the barriers to uptake of conventional and integrated control methods by land managers and how best to increase uptake of best practice control methods. This will involve understanding a wide range of perceptions and motivations for rabbit control activities, including limiting factors which may need to be overcome. This action has linkages to action 4.2 and 4.1.

#### *Performance indicators*

- Land managers are able to recognise damage from an increasing number of rabbits and implement best-practice control methods at the most effective time.
- Contractors have skills to operate specialised machinery and undertake rabbit control activities.
- The general community has an increased interest in the control of rabbits.
- There is an increased use of standard operating procedures and codes of practice for the effective and humane management of rabbits.

Action	Priority and timeframe	Outcome	Output	Responsibility
4.1 Develop further training programs to help land managers adopt locally appropriate monitoring and control methods.	Very high priority, long term - ongoing	Land managers implement the most effective monitoring and control programs and pass on knowledge and information to other land managers.	Further education/ training materials are developed and utilised.	Government, NRM groups and local councils
4.2 Promote and seek engagement by all people in the community in: <ul style="list-style-type: none"> <li>• understanding the threat to biodiversity posed by rabbits</li> <li>• supporting rabbit</li> </ul>	High priority, long term - ongoing	Community support for the management of rabbits.	Further education materials developed and utilised. Community groups, land managers and government assisting each other to	Government, land managers, community groups, members of the general public



Action	Priority and timeframe	Outcome	Output	Responsibility
management and the control actions used, including development of new control techniques  • supporting the use of best practice, humane, cost-effective and integrated rabbit control methods.			improve rabbit management.	
4.3 Continue to promote the adoption of the model codes of practice and standard operating procedures for effective and humane management of rabbits.	High priority, long term	Rabbits are not subjected to unacceptable suffering during control operations.  Rabbit control actions undertaken are humane and effective, while showing a measurable reduction in the number of rabbits.	Further education materials to promote the codes and procedures developed and utilised.  Model codes of practice and standard operating procedures developed for new management tools.	Government and land managers
4.4 Undertake research into the barriers to uptake of best practice control methods, and how this may be addressed.	High priority, short term.	An increase in land managers adopting best practice rabbit control.	Research papers on social and behavioural aspects of rabbit control are published.  Research is translated into actions that address the barriers to uptake by land managers.	Researchers and Government.

## Duration and cost of the plan

This plan reflects the ongoing nature of the threat abatement process, given that there is no likelihood of national rabbit eradication in the near future. In general, most rabbit control

programs aim for long-term suppression of rabbit populations, and a reduction in damage to the environment and agricultural assets in the most cost-efficient manner.

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. The Commonwealth is committed, via the EPBC Act, to *implement the threat abatement plan to the extent to which it applies in Commonwealth areas*. However, it should be noted that the Australian Government is unable to provide funding to cover all actions in this threat abatement plan across all of Australia and requires financial and implementation support from stakeholders. Partnerships amongst and between governments, non-government organisations, industry, community groups and individuals will be key to successfully delivering significant reductions in the threats posed by rabbits.

Investment in many of the TAP actions will be determined by the level of resources that stakeholders commit to management of the problem.

Given the extent of rabbits across Australia, an indicative estimate of the costs involved to undertake control actions outlined in this plan are provided below. It is important to note that the cost of controlling rabbits will continue to rise if rabbit populations are not continually managed and are allowed to increase due to favourable environment conditions and increasing resistance to RHD. The costs provided will also be highly variable depending on the location (including habitat and soil type), and availability of skilled contractors or persons able to assist with control activities. An indicative site size has been chosen as 300 hectares; however, site sizes may range from less than a hectare (e.g. a small cemetery with a single warren) to thousands of hectares on a rangeland station. Anyone looking to implement an action is strongly recommended to undertake their own budget exercise for their particular circumstances and outcomes sought.

Action	Costs anticipated or known at the time of TAP development for action items	Estimated total cost across TAP
Poison baiting	\$52 per hectare using 1080 oat baits (Cooke 2012a)	Annual cost of \$7,800,000 at 500 sites of 300 hectares each across Australia.
Ground shooting	\$5000–10,000 per week for ground shooting at a single site using professional shooters. Use of appropriately trained and assessed volunteer shooters (e.g. SSAA National) would cost considerably less than this.	Annual cost of \$400,000 – \$800,000 for 8 weeks of control at 10 sites across Australia. Less if volunteers are utilised.
Trapping	\$3000-4000 per week for trapping at a single site.	Annual cost of \$240,000 - \$320,000 for 8 weeks over 10 sites across Australia.

Action	Costs anticipated or known at the time of TAP development for action items	Estimated total cost across TAP
Fumigation of warrens	\$56 per hectare using aluminium phosphide tablets (Cooke 2012a). Contractors typically charge \$70 per hour and would require >1 hr to treat warrens in a moderate to high density over 1 hectare. Two-three visits may be required.	Annual cost of \$1,680,000 for fumigating 100 sites of 300 hectares across Australia for aluminium phosphate tablets. Annual cost of approximately \$6,000,000 for contractors for 100 sites of 300 hectares.
Warren destruction	\$40 per hectare where there is a moderate infestation of rabbits (Cooke 2012a); \$69 per hectare using a bobcat backhoe at steep sand hills with dense scrub: (Cooke 2012a)	Annual cost of \$6,000,000 - \$10,350,000 at 500 sites of 300 hectares across Australia.
Exclusion fencing (using 30mm or smaller mesh)	\$5000 per kilometre to construct (Lowe <i>et al.</i> 2003).  \$10,000 per year for maintenance and monitoring of a 10 km <sup>2</sup> site.	\$1,000,000 for construction of fences around 5 sites of 10 km <sup>2</sup> across Australia.  \$250,000 for ongoing maintenance of these 5 sites for 5 years.
Monitoring and surveillance activities.	Costs will be dependent on the type of monitoring used i.e. camera traps may be less expensive than physical monitoring.  On average, \$4000 per site.  Aerial survey using a helicopter and video cost 90 cents per hectare on the Hay Plains, NSW.	Monitoring repeated every 3 months at 50 sites \$600,000.
Release of biocontrol agents	\$52 per hectare using oat/carrot baits	Annual cost of \$1,560,000 across 100 sites of 300 hectares in Australia.
Island eradications	\$210 per hectare (based on using a combination of control methods). This does not involve integrated control for other pest species.	Dependent on size of island. Per island: \$210,000 for smaller islands (approx. 1,000 hectares) to \$2,730,000 for larger islands (approx. 13,000 hectares).



Action	Costs anticipated or known at the time of TAP development for action items	Estimated total cost across TAP
Research projects, including development of new control tools and models.	\$250,000 annually per researcher  Additional costs for registrations and production of the product/biological control agent. Note: these costs will be dependent on the complexity and number of registrations required, and costs to produce the product/agent.	To be determined for each project, model or control tool.
Social research into barriers for rabbit control.	\$200,000 including community engagement.	\$200,000.
Prioritisation of rabbit control areas	\$100,000 for initial regional reviews of areas per state/territory	\$800,000 plus additional funding for finer scale prioritisation.
Development of coordinated reporting mechanisms	\$50,000 per state/territory	\$400,000.
Development of management plans	\$10,000 for each regional plan	\$200,000 for 20 regions.
Community education	\$200,000 per state/territory for general promotion per year. This amount may decline as material can be reused and education levels rise.  Additional \$200,000 per state/territory for releases of new biocontrol agents.	\$1.2 million per state/territory over 5 years.
Training	\$10,000 to \$100,000 to develop different materials and programs.  \$2000 to \$100,000 for delivery.	\$20,000 to \$200,000 over 5 years.  \$500,000 over 5 years.

## Implementing the plan

The Department of the Environment and Energy will work with other Australian Government agencies, state and territory governments and national and regional industry, non-government organisations managing land for conservation, and community groups, to facilitate the implementation of the plan. Specific recovery plans for threatened species and other action plans will need to be taken into account when prioritising areas for management. There are also many different stakeholder interests and perspectives to take into account in managing rabbits and it will be important to consult and involve the range of stakeholders in implementing the

actions in this plan. Greater integration between agricultural/pastoral and other control efforts will be encouraged.

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

## References

- Bengsen, A & Cox, T 2014, *The role of rabbit and other invasive herbivore control in reducing Australia's greenhouse gas emissions*, PestSmart Toolkit publication, Invasive Animals Cooperative Research Centre, Canberra, Australia.
- Bergstrom, DM, Lucieer, A, Kiefer, K, Wasley, J, Belbin, L, Pedersen, TK & Chown, SL 2009, Indirect effects of invasive species removal devastate World Heritage Island, *Journal of Applied Ecology* 46, 73-81.
- Bird, P, Mutze, G, Peacock, D, Jennings, S 2012, Damage caused by low-density exotic herbivore populations: the impact of introduced European rabbits on marsupial herbivores and *Allocasuarina* and *Bursaria* seedling survival in Australian coastal shrubland, *Biological Invasions* 14, 743-755.
- Brown, A 2012, *Glovebox Guide for Managing Rabbits*, PestSmart Toolkit publication, Invasive Animals Cooperative Research Centre, Canberra, ACT.
- Cooke, BD 1993, Integrated control of rabbits, In: *Australian rabbit control conference*, Cooke BD (ed), Australian Rabbit Control Conference, Adelaide, 2-3 April 1993, Anti-Rabbit Research Foundation of Australia, 14-17.
- Cooke, BD, Chudleigh, P, Simpson, S & Saunders, G 2013, The Economic Benefits of the Biological Control of Rabbits in Australia, 1950–2011, *Australian Economic History Review* 53, 91-107.
- Cooke, BD, Jones, R & Gong, W 2010. An economic decision model of wild rabbit *Oryctolagus cuniculus* control to conserve native vegetation, *Wildlife Research*, 37, 558-565.
- Cooke, BD 2012a, *Planning landscape-scale rabbit control*. PestSmart Toolkit publication, Invasive Animals Cooperative Research Centre, Canberra, Australia.
- Cooke, BD, 2012b, Rabbits: manageable environmental pests or participants in new Australian ecosystems? *Wildlife Research* 39, 279-289.
- Cooke, BD, McPhee S & Hart Q 2008, *Rabbits: a Threat to Conservation and Natural Resource Management: How to rapidly assess a rabbit problem and take action*, Bureau of Resource Sciences, Canberra.
- Cox, T, Strive, T, Mutze, G, West, P & Saunders, G 2013, *Benefits of rabbit biocontrol in Australia*, PestSmart Toolkit publication, Invasive Animals Cooperative Research Centre, Canberra.
- Department of the Environment and Energy 2016a, *Background document: Threat abatement plan for competition and land degradation by rabbits*, Commonwealth of Australia. Available at: <http://www.environment.gov.au/biodiversity/threatened/threat-abatement-plans/approved>.
- Department of the Environment 2015b, *Species Profile and Threats Database*. Commonwealth of Australia, Available at: <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>.
- DEWHA 2008, *Threat abatement plan for competition and land degradation by rabbits*, Commonwealth of Australia, Canberra.

- Glen, AS & Dickman, CR 2005, Complex interactions among mammalian carnivores in Australia, and their implications for wildlife management, *Biological Review* 80, 387-401.
- Gong, W, Sinden, J, Braysher, M, Jones, R & Wales, NS 2009, *The economic impacts of vertebrate pests in Australia*, Invasive Animals Cooperative Research Centre Canberra.
- Holden, C & Mutze, G 2002, Impact of rabbit haemorrhagic disease on introduced predators in the Flinders Ranges, South Australia, *Wildlife Research* 29, 615-626.
- Invasive Animals CRC 2012a. *Fumigation for Rabbit Control*, PestSmart Factsheet publication, Invasive Animals Cooperative Research Centre, Canberra, Australia.
- Invasive Animals CRC 2012b. *Poison Baiting for Rabbit Control*, PestSmart Factsheet publication, Invasive Animals Cooperative Research Centre, Canberra, Australia.
- Lowe, TJ, Wheeler, SH & Twigg, LE 2003, Impact of rabbits on native bush remnants, *Journal of the Royal Society of Western Australia* 86: 97-105.
- McLeod, SR 2004, *Counting the cost: impact of invasive animals in Australia, 2004*, Cooperative Research Centre for Pest Animal Control Canberra.
- Mitchell, B & Balogh, S 2007, *Monitoring Techniques for Vertebrate Pests – Rabbits*, New South Wales Department of Primary Industries, Orange, NSW.
- Murray, JV, Berman, DM & van Klinken, RD 2014, Predictive modelling to aid the regional-scale management of a vertebrate pest, *Biological Invasions* 16(11), pp 2403-2425.
- Mutze, G, Bird, P, Cooke, BD, & Henzell, R 2008, Geographic and seasonal variation in the impact of rabbit haemorrhagic disease on European rabbits, *Oryctolagus cuniculus*, and rabbit damage in Australia, in: C. Alves, N.F.a.K.H. (Ed.), *Lagomorph Biology: Evolution, Ecology and Conservation*, Springer-Verlag, Berlin, pp. 279-293.
- Olsen, J, Cooke, B, Trost, S & Judge, D 2014, Is wedge-tailed eagle, *Aquila audax*, survival and breeding success closely linked to the abundance of European rabbits, *Oryctolagus cuniculus*? *Wildlife Research* 41, 95-105.
- Pedler, RD, Brandle, R, Read JL, Southgate R, Bird P and Moseby KE 2016, Rabbit biocontrol and landscape-scale recovery of threatened desert mammals, *Conservation Biology* 30, 774-782.
- Read, J & Bowen, Z 2001, Population dynamics, diet and aspects of the biology of feral cats and foxes in arid South Australia, *Wildlife Research* 28, 195–203.
- Saunders, G, Cooke, B, McColl, K, Shine, R & Peacock, T 2010, Modern approaches for the biological control of vertebrate pests: an Australian perspective, *Biological Control* 52, 288-295.
- Sharp, T & Saunders, G 2012, *Model Code of Practice for the Humane Control of Rabbits*. PestSmart Toolkit publication, Invasive Animals Cooperative Research Centre, Canberra, Australia.

Williams, CK, Parer, I, Coman, BJ, Burley, J & Braysher, ML 1995, *Managing Vertebrate Pests: Rabbits* Australian Government Publishing Service, Canberra.

Woinarski, J, Burbidge, A & Harrison, P 2014, *The Action Plan for Australian Mammals 2012*, Collingwood: CSIRO Publishing.

## Appendix A

### EPBC Act listed species and ecological communities affected by rabbits

All species in Appendix A were determined from profiles in the Australian Government's Species Profile and Threats Database (SPRAT) which identified rabbits as a threatening process. Note: the identification of these species as being affected by rabbits is based on a range of evidence, with some having solid scientific evidence to support the impact of rabbits on this species, where others may be based on expert opinions. All species and ecological communities listed below are those which are listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999*. EPBC Act listing statuses are as at September 2015.

**Table A1:** EPBC Act ecological communities identified as being affected by rabbits

Vegetation community	EPBC Act listing status
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions (NSW, Vic., SA)	Endangered
Eastern Stirling Range Montane Heath and Thicket (WA)	Endangered
Perched Wetlands of the Wheatbelt region with extensive stands of living sheoak and paperbark across the lake floor (Toolibin Lake) (WA)	Endangered
Sedgelands in Holocene dune swales of the southern Swan Coastal Plain (WA)	Endangered
Eastern Suburbs Banksia Scrub of the Sydney Region (NSW)	Endangered
Shrublands and Woodlands of the eastern Swan Coastal Plain (WA)	Endangered
Silurian Limestone Pomaderris Shrubland of the South East Corner and Australian Alps Bioregions (Vic.)	Endangered
Temperate Highland Peat Swamps on Sandstone (NSW, Vic.)	Endangered
Upland Wetlands of the New England Tablelands and the Monaro Plateau (NSW)	Endangered

**Table A2:** EPBC Act threatened flora identified as being affected by rabbits

Scientific name	Common name	EPBC Act listing status
<i>Acacia araneosa</i>	Spidery Wattle, Balcanoona Wattle	Vulnerable
<i>Acacia ataxiphylla</i> subsp. <i>magna</i>	Large-fruited Tammin Wattle	Endangered
<i>Acacia auratiflora</i>	Orange-flowered Wattle	Endangered
<i>Acacia awestoniana</i>	Stirling Range Wattle	Vulnerable
<i>Acacia caerulea</i>	Limestone Blue Wattle, Buchan Blue, Buchan Blue Wattle	Vulnerable
<i>Acacia carneorum</i>	Needle Wattle, Dead Finish, Purple-wood Wattle	Vulnerable
<i>Acacia cretacea</i>	Chalky Wattle	Endangered
<i>Acacia curranii</i>	Curly-bark Wattle	Vulnerable
<i>Acacia enterocarpa</i>	Jumping-jack Wattle	Endangered
<i>Acacia glandulicarpa</i>	Hairy-pod Wattle	Vulnerable
<i>Acacia insolita</i> subsp. <i>recurva</i>	Yornaning Wattle	Endangered
<i>Acacia latzii</i>	Latz's Wattle	Vulnerable
<i>Acacia lobulata</i>	Chiddarcooping Wattle	Endangered
<i>Acacia peuce</i>	Waddy, Waddi, Waddy-wood, Birdsville Wattle	Vulnerable
<i>Acacia phasmoides</i>	Phantom Wattle	Vulnerable
<i>Acacia pickardii</i>	Birds Nest Wattle	Vulnerable
<i>Acacia pinguifolia</i>	Fat-leaved Wattle	Endangered
<i>Acacia rhamphophylla</i>	Kundip Wattle	Endangered
<i>Acacia rhetinocarpa</i>	Neat Wattle, Resin Wattle (SA)	Vulnerable
<i>Acacia sciophanes</i>	Wundowlin Wattle, Ghost Wattle	Endangered
<i>Acacia subflexuosa</i> subsp. <i>capillata</i>	Hairy-stemmed Zig-Zag Wattle	Endangered
<i>Acacia terminalis</i> subsp. <i>terminalis</i> MS	Sunshine Wattle	Endangered
<i>Acacia vassalii</i>	Vassal's Wattle	Endangered

Scientific name	Common name	EPBC Act listing status
<i>Acacia volubilis</i>	Tangled Wattle, Tangle Wattle	Endangered
<i>Acanthocladium dockeri</i>	Spiny Everlasting, Spiny Daisy	Critically Endangered
<i>Adenanthos pungens</i> subsp. <i>effusus</i>	Sprawling Spiky Adenanthos	Endangered
<i>Allocasuarina robusta</i>	Mount Compass Oak-bush	Endangered
<i>Ammobium craspedioides</i>	Yass Daisy	Vulnerable
<i>Andersonia gracilis</i>	Slender Andersonia	Endangered
<i>Anigozanthos bicolor</i> subsp. <i>minor</i>	Little Kangaroo Paw, Two-coloured Kangaroo Paw, Small Two-colour Kangaroo Paw	Endangered
<i>Asterolasia nivea</i>	Bindoon Starbush	Vulnerable
<i>Atriplex infrequens</i>		Vulnerable
<i>Austrostipa metatoris</i>		Vulnerable
<i>Austrostipa wakoolica</i>		Endangered
<i>Azorella macquariensis</i>	Macquarie Azorella, Macquarie Cushions	Critically Endangered
<i>Ballantinia antipoda</i>	Southern Shepherd's Purse	Endangered
<i>Banksia cuneata</i>	Matchstick Banksia, Quairading Banksia	Endangered
<i>Banksia ionthocarpa</i>	Kamballup Dryandra	Endangered
<i>Banksia nivea</i> subsp. <i>uliginosa</i>	Swamp Honeypot	Endangered
<i>Banksia oligantha</i>	Wagin Banksia	Endangered
<i>Banksia serratuloides</i> subsp. <i>serratuloides</i>	Southern Serrate Dryandra	Vulnerable
<i>Barbarea australis</i>	Native Wintercress, Riverbed Wintercress	Endangered
<i>Beyeria lepidopetala</i>	Small-petalled Beyeria, Short-petalled Beyeria	Endangered
<i>Boronia capitata</i> subsp. <i>capitata</i>	a shrub	Endangered
<i>Borya mirabilis</i>	Grampians Pincushion-lily	Endangered
<i>Brachyscias verecundus</i>	Ironstone Brachyscias	Critically Endangered
<i>Brachyscome muelleri</i>	Corunna Daisy	Endangered



Scientific name	Common name	EPBC Act listing status
<i>Caladenia actensis</i>	Canberra Spider Orchid	Critically Endangered
<i>Caladenia amoena</i>	Charming Spider-orchid	Endangered
<i>Caladenia arenaria</i>	Sand-hill Spider-orchid	Endangered
<i>Caladenia argocalla</i>	White-beauty Spider-orchid	Endangered
<i>Caladenia audasii</i>	McIvor Spider-orchid, Audas Spider-orchid	Endangered
<i>Caladenia barbarella</i>	Small Dragon Orchid, Common Dragon Orchid	Endangered
<i>Caladenia behrii</i>	Pink-lipped Spider-orchid	Endangered
<i>Caladenia bryceana</i> subsp. <i>bryceana</i>	Dwarf Spider-orchid	Endangered
<i>Caladenia bryceana</i> subsp. <i>cracens</i>	Northern Dwarf Spider-orchid	Vulnerable
<i>Caladenia busselliana</i>	Bussell's Spider-orchid	Endangered
<i>Caladenia caesarea</i> subsp. <i>maritima</i>	Cape Spider-orchid	Endangered
<i>Caladenia calcicola</i>	Limestone Spider-orchid	Vulnerable
<i>Caladenia caudata</i>	Tailed Spider-orchid	Vulnerable
<i>Caladenia concolor</i>	Crimson Spider-orchid, Maroon Spider-orchid	Vulnerable
<i>Caladenia drakeoides</i>	Hinged Dragon Orchid	Endangered
<i>Caladenia elegans</i>	Elegant Spider-orchid	Endangered
<i>Caladenia formosa</i>	Elegant Spider-orchid, Blood-red Spider-orchid	Vulnerable
<i>Caladenia gladiolata</i>	Bayonet Spider-orchid, Clubbed Spider-orchid	Endangered
<i>Caladenia hastata</i>	Melblom's Spider-orchid	Endangered
<i>Caladenia hoffmanii</i>	Hoffman's Spider-orchid	Endangered
<i>Caladenia insularis</i>	French Island Spider-orchid	Vulnerable
<i>Caladenia intuta</i>	Ghost Spider-orchid	Critically Endangered
<i>Caladenia lowanensis</i>	Wimmera Spider-orchid	Endangered
<i>Caladenia macroclavia</i>	Large-club Spider-orchid	Endangered

Scientific name	Common name	EPBC Act listing status
<i>Caladenia melanema</i>	Ballerina Orchid	Critically Endangered
<i>Caladenia ornata</i>	Ornate Pink Fingers	Vulnerable
<i>Caladenia ovata</i>	Kangaroo Island Spider-orchid	Vulnerable
<i>Caladenia rigida</i>	Stiff White Spider-orchid	Endangered
<i>Caladenia robinsonii</i>	Frankston Spider-orchid	Endangered
<i>Caladenia rosella</i>	Rosella Spider-orchid, Little Pink Spider-orchid	Endangered
<i>Caladenia tensa</i>	Greencomb Spider-orchid, Rigid Spider-orchid	Endangered
<i>Caladenia tessellata</i>	Thick-lipped Spider-orchid, Daddy Long-legs	Vulnerable
<i>Caladenia thysanochila</i>	Fringed Spider-orchid	Endangered
<i>Caladenia versicolor</i>	Candy Spider-orchid	Vulnerable
<i>Caladenia viridescens</i>	Dunsborough Spider-orchid	Endangered
<i>Caladenia wanosa</i>	Kalbarri Spider-orchid	Vulnerable
<i>Caladenia woolcockiorum</i>	Woolcock's Spider-orchid	Vulnerable
<i>Caladenia xanthochila</i>	Yellow-lip Spider-orchid	Endangered
<i>Caladenia xantholeuca</i>	White Rabbits, Flinders Ranges White Caladenia	Endangered
<i>Calectasia pignattiana</i>	Stilted Tinsel Lily	Vulnerable
<i>Callistemon wimmerensis</i>	Wimmera Bottlebrush	Critically Endangered
<i>Callitriche cyclocarpa</i>	Western Water-starwort	Vulnerable
<i>Callitris oblonga</i>	Pygmy Cypress-pine, Pigmy Cypress-pine, Dwarf Cypress-pine	Vulnerable
<i>Calytrix breviseta</i> subsp. <i>breviseta</i>	Swamp Starflower	Endangered
<i>Cassinia tegulata</i>	Avenue Cassinia	Critically Endangered
<i>Centrolepis caespitosa</i>		Endangered
<i>Chamelaucium</i> sp. Gingin (N.G.Marchant 6)	Gingin Wax	Endangered
<i>Chorizema humile</i>	Prostrate Flame Pea	Endangered

Scientific name	Common name	EPBC Act listing status
<i>Codonocarpus pyramidalis</i>	Slender Bell-fruit, Camel Poison	Vulnerable
<i>Commersonia erythrogyna</i>	Trigwell's Rulingia	Endangered
<i>Commersonia prostrata</i>	Dwarf Kerrawang	Endangered
<i>Conospermum undulatum</i>	Wavy-leaved Smokebush	Vulnerable
<i>Conostylis dielsii</i> subsp. <i>teres</i>	Irwin Conostylis	Endangered
<i>Conostylis drummondii</i>	Drummond's Conostylis	Endangered
<i>Conostylis lepidospermoides</i>	Sedge Conostylis	Endangered
<i>Conostylis micrantha</i>	Small-flowered Conostylis	Endangered
<i>Conostylis misera</i>	Grass Conostylis	Endangered
<i>Conostylis rogeri</i>	Kulin Conostylis, Single-flowered Conostylis	Vulnerable
<i>Conostylis seorsiflora</i> subsp. <i>trichophylla</i>	Hairy Mat Conostylis	Endangered
<i>Conostylis setigera</i> subsp. <i>dasys</i>	Boscabel Conostylis	Critically Endangered
<i>Correa calycina</i>		Vulnerable
<i>Corybas dentatus</i>	Toothed Helmet-orchid, Finnis Helmet-orchid	Vulnerable
<i>Cynanchum elegans</i>	White-flowered Wax Plant	Endangered
<i>Darwinia apiculata</i>	Scarp Darwinia	Endangered
<i>Darwinia carnea</i>	Mogumber Bell, Narrogin Bell	Endangered
<i>Darwinia collina</i>	Yellow Mountain Bell	Endangered
<i>Darwinia foetida</i>	Muchea Bell	Critically Endangered
<i>Darwinia meeboldii</i>	Cranbrook Bell	Vulnerable
<i>Darwinia polychroma</i>	Harlequin Bell	Endangered
<i>Darwinia whicherensis</i>	Abba Bell	Endangered
<i>Daviesia bursarioides</i>	Three Springs Daviesia	Endangered
<i>Daviesia cunderdin</i>	Cunderdin Daviesia	Endangered

Scientific name	Common name	EPBC Act listing status
<i>Daviesia euphorbioides</i>	Wongan Cactus	Endangered
<i>Dichanthium setosum</i>	bluegrass	Vulnerable
<i>Diuris basaltica</i>	Small Golden Moths Orchid, Early Golden Moths	Endangered
<i>Dodonaea procumbens</i>	Trailing Hop-bush	Vulnerable
<i>Drakaea concolor</i>	Kneeling Hammer-orchid	Vulnerable
<i>Drakaea elastica</i>	Glossy-leafed Hammer-orchid, Praying Virgin	Endangered
<i>Eleocharis obicis</i>	a spike rush	Vulnerable
<i>Eremophila denticulata</i> subsp. <i>denticulata</i>	Fitzgerald Eremophila	Vulnerable
<i>Eremophila denticulata</i> subsp. <i>trisulcata</i>	Cumquat Eremophila	Endangered
<i>Eremophila nivea</i>	Silky Eremophila	Endangered
<i>Eremophila subteritifolia</i>	Lake King Eremophila	Endangered
<i>Eremophila viscida</i>	Varnish Bush	Endangered
<i>Eucalyptus cadens</i>	Warby Range Swamp Gum	Vulnerable
<i>Eucalyptus gunnii</i> subsp. <i>divaricata</i>	Miena Cider Gum	Endangered
<i>Eucalyptus leprophloia</i>	Scaly Butt Mallee, Scaly-butt Mallee	Endangered
<i>Eucalyptus mckieana</i>	McKie's Stringybark	Vulnerable
<i>Eucalyptus morrisbyi</i>	Morrisbys Gum	Endangered
<i>Eucalyptus rhodantha</i>	Rose Mallee	Vulnerable
<i>Euphrasia arguta</i>		Critically Endangered
<i>Euphrasia collina</i> subsp. <i>muelleri</i>	Purple Eyebright, Mueller's Eyebright	Endangered
<i>Frankenia conferta</i>	Silky Frankenia	Endangered
<i>Frankenia parvula</i>	Short-leaved Frankenia	Endangered
<i>Gastrolobium lehmannii</i>	Cranbrook Pea	Vulnerable
<i>Genoplesium littorale</i>	Tuncurry Midge Orchid	Critically Endangered

Scientific name	Common name	EPBC Act listing status
<i>Gentiana wissmannii</i>	New England Gentian	Vulnerable
<i>Glycine latrobeana</i>	Clover Glycine, Purple Clover	Vulnerable
<i>Goodenia integerrima</i>	Gypsum Goodenia	Vulnerable
<i>Grevillea althoferorum</i>		Endangered
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	Narrow curved-leaf Grevillea	Endangered
<i>Grevillea dryandroides</i> subsp. <i>hirsuta</i>	Hairy Phalanx Grevillea	Endangered
<i>Grevillea elongata</i>	Ironstone Grevillea	Vulnerable
<i>Grevillea humifusa</i>	Spreading Grevillea	Endangered
<i>Grevillea kennedyana</i>	Flame Spider-flower	Vulnerable
<i>Grevillea maccutcheonii</i>	McCutcheon's Grevillea	Endangered
<i>Grevillea pythara</i>	Pythara Grevillea	Endangered
<i>Grevillea scapigera</i>	Corrigin Grevillea	Endangered
<i>Grevillea treueriana</i>	Mt Finke Grevillea	Vulnerable
<i>Gyrostemon reticulatus</i>	Net-veined Gyrostemon	Critically Endangered
<i>Hakea aculeata</i>	Column Hakea	Vulnerable
<i>Hakea maconochieana</i>		Vulnerable
<i>Hakea pulvinifera</i>		Endangered
<i>Hemiandra gardneri</i>	Red Snakebush	Endangered
<i>Hemiandra rutilans</i>	Sargents Snakebush, Colourful Snakebush	Endangered
<i>Hibbertia crispula</i>	Ooldea Guinea-flower	Vulnerable
<i>Hibbertia humifusa</i> subsp. <i>erigens</i>	Euroa Guinea-flower	Vulnerable
<i>Homoranthus darwinioides</i>		Vulnerable
<i>Ixodia achillaeoides</i> subsp. <i>arenicola</i>	Sand Ixodia, Ixodia	Vulnerable
<i>Jacksonia quairading</i>	Quairading Jacksonia, Quairading Stinkwood	Endangered

Scientific name	Common name	EPBC Act listing status
<i>Lambertia echinata</i> subsp. <i>occidentalis</i>	Western Prickly Honeysuckle	Endangered
<i>Lechenaultia chlorantha</i>	Kalbarri Leschenaultia	Vulnerable
<i>Lechenaultia laricina</i>	Scarlet Leschenaultia	Endangered
<i>Lepidium aschersonii</i>	Spiny Pepper-cress	Vulnerable
<i>Lepidium hyssopifolium</i>	Basalt Pepper-cress, Peppercress, Rubble Pepper-cress, Pepperweed	Endangered
<i>Lepidium monoplacoides</i>	Winged Pepper-cress	Endangered
<i>Lepidium peregrinum</i>	Wandering Pepper-cress	Endangered
<i>Leucopogon gnaphalioides</i>	Stirling Range Beard Heath	Endangered
<i>Leucopogon marginatus</i>	Thick-margined Leucopogon	Endangered
<i>Macarthuria keigheryi</i>	Keighery's Macarthuria	Endangered
<i>Melaleuca kunzeoides</i>		Vulnerable
<i>Micromyrtus grandis</i>		Endangered
<i>Microtis angusii</i>	Angus's Onion Orchid	Endangered
<i>Minuria tridens</i>	Minnie Daisy	Vulnerable
<i>Myoporum cordifolium</i>	Jerramungup Myoporum	Vulnerable
<i>Myriophyllum lapidicola</i>	Chiddarcooping myriophyllum	Endangered
<i>Nematoceras dienemum</i>	Windswept Helmet-orchid	Critically Endangered
<i>Olearia astroloba</i>	Marble Daisy-bush	Vulnerable
<i>Ornduffia calthifolia</i>	Mountain Villarsia	Endangered
<i>Patersonia spirifolia</i>	Spiral-leaved Patersonia	Endangered
<i>Pelargonium</i> sp. <i>Striatellum</i> (G.W.Carr 10345)	Omeo Stork's-bill	Endangered
<i>Phebalium lowanense</i>	Lowan Phebalium	Vulnerable
<i>Philotheca basistyla</i>	White-flowered Philotheca	Endangered
<i>Pimelea curviflora</i> var. <i>curviflora</i>		Vulnerable

Scientific name	Common name	EPBC Act listing status
<i>Pimelea pagophila</i>	Grampians Rice-flower	Vulnerable
<i>Pimelea spinescens</i> subsp. <i>spinescens</i>	Plains Rice-flower, Spiny Rice-flower, Prickly Pimelea	Critically Endangered
<i>Pityrodia scabra</i>	Wyalkatchem Foxglove	Endangered
<i>Pomaderris subplicata</i>	Concave Pomaderris	Vulnerable
<i>Prasophyllum correctum</i>	Gaping Leek-orchid	Endangered
<i>Prasophyllum frenchii</i>	Maroon Leek-orchid, Slaty Leek-orchid, Stout Leek-orchid, French's Leek-orchid, Swamp Leek-orchid	Endangered
<i>Prasophyllum goldsackii</i>	Goldsack's Leek-orchid	Endangered
<i>Prasophyllum murfetii</i>	Fleurieu Leek Orchid	Critically Endangered
<i>Prasophyllum pallidum</i>	Pale Leek-orchid	Vulnerable
<i>Prasophyllum petilum</i>	Tarengo Leek Orchid	Endangered
<i>Prasophyllum pruinosum</i>	Plum Leek-orchid	Endangered
<i>Prasophyllum spicatum</i>	Dense Leek-orchid	Vulnerable
<i>Prasophyllum subbisectum</i>	Pomonal Leek-orchid	Endangered
<i>Prasophyllum validum</i>	Sturdy Leek-orchid	Vulnerable
<i>Prostanthera calycina</i>	West Coast Mintbush, Limestone Mintbush, Red Mintbush	Vulnerable
<i>Prostanthera eurybioides</i>	Monarto Mintbush	Endangered
<i>Pterostylis arenicola</i>	Sandhill Greenhood Orchid	Vulnerable
<i>Pterostylis basaltica</i>	Basalt Greenhood	Endangered
<i>Pterostylis bryophila</i>	Hindmarsh Valley Greenhood	Critically Endangered
<i>Pterostylis cheraphila</i>	Floodplain Rustyhood	Vulnerable
<i>Pterostylis chlorogramma</i>	Green-striped Greenhood	Vulnerable
<i>Pterostylis cucullata</i>	Leafy Greenhood	Vulnerable
<i>Pterostylis despectans</i>	Lowly Greenhood	Endangered
<i>Pterostylis gibbosa</i>	Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood	Endangered

Scientific name	Common name	EPBC Act listing status
<i>Pterostylis lepida</i>	Halbury Greenhood	Endangered
<i>Pterostylis mirabilis</i>	Nodding Rufoushood	Vulnerable
<i>Pterostylis sinuata</i>	Northampton Midget Greenhood	Endangered
<i>Pterostylis</i> sp. Hale (R.Bates 21725)	Hale Dwarf Greenhood	Endangered
<i>Pterostylis xerophila</i>	Desert Greenhood	Vulnerable
<i>Ptilotus beckerianus</i>	Ironstone Mulla Mulla	Vulnerable
<i>Ptilotus fasciculatus</i>	Fitzgerald's Mulla-mulla	Endangered
<i>Ranunculus anemoneus</i>	Anemone Buttercup	Vulnerable
<i>Roycea pycnophylloides</i>	Saltmat	Endangered
<i>Rutidosia heterogama</i>	Heath Wrinklewort	Vulnerable
<i>Sclerolaena walkeri</i>		Vulnerable
<i>Senecio macrocarpus</i>	Large-fruit Fireweed, Large-fruit Groundsel	Vulnerable
<i>Senecio megaglossus</i>	Superb Groundsel	Vulnerable
<i>Solanum karsense</i>	Menindee Nightshade	Vulnerable
<i>Stachystemon nematophorus</i>	Three-flowered Stachystemon	Vulnerable
<i>Stylidium coroniforme</i>	Wongan Hills Triggerplant, Wongan Triggerplant	Endangered
<i>Swainsona murrayana</i>	Slender Darling-pea, Slender Swainson, Murray Swainson-pea	Vulnerable
<i>Swainsona pyrophila</i>	Yellow Swainson-pea	Vulnerable
<i>Symonanthus bancroftii</i>	Bancrofts Symonanthus	Endangered
<i>Synaphea quartzitica</i>	Quartz-loving Synaphea	Endangered
<i>Synaphea</i> sp. Fairbridge Farm (D.Papenfus 696)	Selena's Synaphea	Critically Endangered
<i>Synaphea</i> sp. Pinjarra (R.Davis 6578)	Club-leafed Synaphea	Critically Endangered
<i>Tetradlea deltoidea</i>	Granite Tetradlea	Endangered
<i>Tetradlea gunnii</i>	Shy Susan	Critically Endangered



Scientific name	Common name	EPBC Act listing status
<i>Thelymitra cyanapicata</i>	Blue Top Sun-orchid, Dark-tipped Sun-orchid	Critically Endangered
<i>Thelymitra epipactoides</i>	Metallic Sun-orchid	Endangered
<i>Thelymitra mackibbinii</i>	Brilliant Sun-orchid	Vulnerable
<i>Thelymitra matthewsii</i>	Spiral Sun-orchid	Vulnerable
<i>Thelymitra stellata</i>	Star Sun-orchid	Endangered
<i>Thesium australe</i>	Austral Toadflax, Toadflax	Vulnerable
<i>Thomasia glabripetala</i>	Sandplain Thomasia	Vulnerable
<i>Tribonanthes purpurea</i>	Granite Pink	Vulnerable
<i>Trichanthodium baracchianum</i>	Dwarf Yellow-heads	Vulnerable
<i>Verticordia densiflora</i> var. <i>pedunculata</i>	Long-stalked Featherflower	Endangered
<i>Verticordia fimbrialepis</i> subsp. <i>fimbrialepis</i>	Shy Featherflower	Endangered
<i>Verticordia hughanii</i>	Hughan's Featherflower	Endangered
<i>Verticordia plumosa</i> var. <i>pleiobotrya</i>	Narrow-petalled Featherflower, Mundijong Featherflower	Endangered
<i>Verticordia spicata</i> subsp. <i>squamosa</i>	Scaly-leaved Featherflower	Endangered
<i>Verticordia staminosa</i> subsp. <i>staminosa</i>	Wongan Featherflower	Endangered
<i>Verticordia staminosa</i> var. <i>cylindracea</i>	Granite Featherflower	Endangered
<i>Westringia crassifolia</i>	Whipstick Westringia	Endangered
<i>Wurmbea tubulosa</i>	Long-flowered Nancy	Endangered
<i>Xerothamnella parvifolia</i>		Vulnerable
<i>Zieria baeuerlenii</i>	Bomaderry Zieria, Bomaderry Creek Zieria	Endangered

Table A3 outlines the threatened bird, reptile, amphibian and insect species which may be affected by rabbits.

**Table A3:** EPBC Act reptiles, amphibians, birds and insects affected by rabbits

Species Type	Scientific name	Common name	EPBC Act listing status	IUCN listing status	Main impact by rabbits
Reptile	<i>Aprasia parapulchella</i>	Pink-tailed Worm-lizard, Pink-tailed Legless Lizard	Vulnerable	<i>Not listed</i>	Habitat degradation
	<i>Christinus guentheri</i>	Lord Howe Island Gecko, Lord Howe Island Southern Gecko	Vulnerable	Vulnerable	Habitat degradation
	<i>Delma impar</i>	Striped Legless Lizard	Vulnerable	Vulnerable	Habitat degradation
	<i>Eulamprus tympanum marnieae</i>	Corangamite Water Skink	Endangered	Endangered	Habitat degradation
	<i>Ophidiocephalus taeniatus</i>	Bronzeback Snake-lizard	Vulnerable	Vulnerable	Habitat degradation
	<i>Tympanocryptis pinguicolla</i>	Grassland Earless Dragon	Endangered	Vulnerable	Habitat degradation
Amphibian	<i>Philoria frosti</i>	Baw Baw Frog	Endangered	Critically endangered	Habitat degradation
Bird	<i>Amytornis barbatus barbatus</i>	Grey Grasswren (Bulloo)	Endangered	Least concern <sup>1</sup>	Habitat degradation
	<i>Amytornis modestus</i>	Thick-billed Grasswren	Vulnerable	<i>Not listed</i>	Habitat degradation
	<i>Anthochaera phrygia</i>	Regent Honeyeater	Endangered	Critically endangered	Habitat degradation
	<i>Calyptrorhynchus lathamii halmaturinus</i>	Glossy Black-Cockatoo (Kangaroo Island), Glossy Black-Cockatoo (South Australian)	Endangered	Least concern <sup>1</sup>	Habitat degradation
	<i>Cinclosoma punctatum anachoreta</i>	Spotted Quail-thrush (Mt Lofty Ranges)	Critically Endangered	Least concern <sup>1</sup>	Habitat degradation; competition for resources
	<i>Geophaps scripta scripta</i>	Squatter Pigeon (southern)	Vulnerable	Least concern <sup>1</sup>	Habitat degradation
	<i>Hylacola pyrrhopygia parkeri</i>	Chestnut-rumped Heathwren (Mt Lofty Ranges)	Endangered	Least concern <sup>1</sup>	Habitat degradation; competition for resources
	<i>Leipoa ocellata</i>	Malleefowl	Vulnerable	Vulnerable	Habitat degradation
	<i>Neophema chrysogaster</i>	Orange-bellied Parrot	Critically Endangered, Marine	Critically endangered	Habitat degradation - removing food resources
	<i>Pedionomus torquatus</i>	Plains-wanderer	Vulnerable	Endangered	Habitat degradation

<sup>1</sup> IUCN Red List Status provides the status at species level and is taken to include the subspecies (a separate assessment at the subspecies level has not been completed at this stage).

Species Type	Scientific name	Common name	EPBC Act listing status	IUCN listing status	Main impact by rabbits
	<i>Pezoporus occidentalis</i>	Night Parrot	Endangered	Endangered	Habitat degradation
	<i>Poephila cincta cincta</i>	Black-throated Finch (southern)	Endangered	Least concern <sup>1</sup>	Habitat degradation
	<i>Polytelis alexandrae</i>	Princess Parrot, Alexandra's Parrot	Vulnerable	Near threatened	Habitat degradation
	<i>Polytelis anthopeplus monarchoides</i>	Regent Parrot (eastern)	Vulnerable	Least concern <sup>1</sup>	Poisoning by rabbit oat baits
Insect	<i>Synemon plana</i>	Golden Sun Moth	Critically Endangered	<i>Not listed</i>	Habitat degradation

Table A4 outlines the various statuses of mammals which may be affected by rabbits and the relative risk of rabbits on those species. These species were determined from *The Action Plan for Australian Mammals 2012* (Woinarski *et al.* 2014) and from profiles which identified rabbits as a threatening process in SPRAT. The overall threat rating considers both the severity and extent of habitat degradation by livestock and introduced herbivores and has been developed from *The Action Plan for Australian Mammals 2012* (Woinarski *et al.* 2014). For example, the threat is considered to be high risk where there may be a moderate consequence over the entire range, a severe consequence across a large extent of the range, or a catastrophic consequence across a moderate extent of the range (Woinarski *pers. comm.* March 2015). Note: the overall threat for habitat degradation is cumulative for both livestock and introduced herbivores (which rabbits are one of). Therefore this rating may not be solely representative of the impact of rabbits.

**Table A4:** EPBC Act threatened mammals affected by rabbits

Scientific name	Common name	EPBC Act listing status	IUCN listing status	Main impact by rabbits	Overall threat rating
<i>Bettongia penicillata ogilbyi</i>	Woylie	Endangered	Critically endangered <sup>1</sup>	Competition for resources; support predators	<i>Not assessed</i>
<i>Burramys parvus</i>	Mountain Pygmy-possum	Endangered	Critically endangered	Habitat degradation and resource depletion; support predators (cats)	<i>Not assessed</i>
<i>Dasyercus cristicauda</i>	Crest-tailed Mulgara	Vulnerable	Least Concern	Habitat degradation and resource depletion; support predators	High
<i>Dasyuroides byrnei</i>	Kowari, brushy-tailed marsupial rat, Byrne's crest- tailed marsupial rat	Vulnerable	Vulnerable	Habitat degradation and resource depletion, including reducing prey abundance; support predators	Moderate
<i>Dasyurus geoffroii</i>	Chuditch, Western Quoll	Vulnerable	Near threatened	Habitat degradation and resource depletion; support predators	<i>Not assessed</i>
<i>Lagorchestes conspicillatus conspicillatus</i>	Spectacled Hare-wallaby (Barrow Island)	Vulnerable	Least concern <sup>1</sup>	Habitat degradation; support predators	<i>Not assessed</i>
<i>Lagorchestes hirsutus</i>	Mala, Rufous Hare-Wallaby	Endangered	Vulnerable <sup>1</sup>	Competition for resources; support predators	<i>Not assessed</i>
<i>Lasiorhinus krefftii</i>	Northern Hairy-nosed Wombat, Yaminon	Endangered	Critically endangered	Competition for resources; habitat degradation	Minor
<i>Macrotis lagotis</i>	Greater Bilby	Vulnerable	Vulnerable	Habitat degradation; competition for resources; support predators	Minor
<i>Notomys fuscus</i>	Dusky Hopping-mouse, Wilkiniti	Vulnerable	Vulnerable	Habitat degradation; support predators	High - very high
<i>Onychogalea fraenata</i>	Bridled Nail-tail Wallaby	Endangered	Endangered	Habitat degradation; competition for resources; support of predators	Very high
<i>Perameles gunnii</i>	Eastern Barred Bandicoot	Endangered	Near threatened <sup>1</sup>	Habitat degradation; competition for shelter; support predators	Minor
<i>Petrogale lateralis</i> MacDonnell Ranges race	Warru, Black-footed Rock-wallaby (MacDonnell Ranges race)	Vulnerable	Near threatened <sup>1</sup>	Competition for resources; support predators	Moderate

Scientific name	Common name	EPBC Act listing status	IUCN listing status	Main impact by rabbits	Overall threat rating
<i>Petrogale lateralis lateralis</i>	Black-flanked Rock-wallaby	Vulnerable	Near threatened <sup>1</sup>	Competition for resources; support predators	Minor
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	Vulnerable	Near threatened	Competition for resources; support predators	High
<i>Petrogale xanthopus xanthopus</i>	Yellow-footed Rock-wallaby (SA and NSW)	Vulnerable	Near threatened <sup>1</sup>	Competition for resources; support predators	High
<i>Pseudomys australis</i>	Plains Rat, Palyoora	Vulnerable	Vulnerable	Habitat degradation; support predators	High
<i>Pseudomys fieldi</i>	Shark Bay Mouse, Djoongari, Alice Springs Mouse	Vulnerable	Vulnerable	Habitat degradation; support predators	<i>Not assessed</i>
<i>Pseudomys fumeus</i>	Koonoom, Smoky Mouse	Endangered	Endangered	Habitat degradation; support predators	<i>Not assessed</i>
<i>Pseudomys oralis</i>	Hastings River Mouse, Koontoo	Endangered	Vulnerable	Habitat degradation; support predators	Minor