



CENTRE FOR  
INVASIVE SPECIES SOLUTIONS

# GLOVEBOX GUIDE FOR MANAGING RABBITS

BROWN A, COX T, WISHART J, HARRIS C,  
DAY P, KLEINERT H, BURGI A.



[www.pestsmart.org.au](http://www.pestsmart.org.au)

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# SNAPSHOT

## Main messages

Wild European rabbits are an environmentally disruptive pest in all but the northern parts of Australia and some islands. The harm they cause spreads through landscapes and ecosystems, due to:

- overgrazing and their preferential grazing of selected plant species
- soil disturbance, erosion and the spread of weeds
- their role as prey, sustaining feral predators such as cats and foxes.

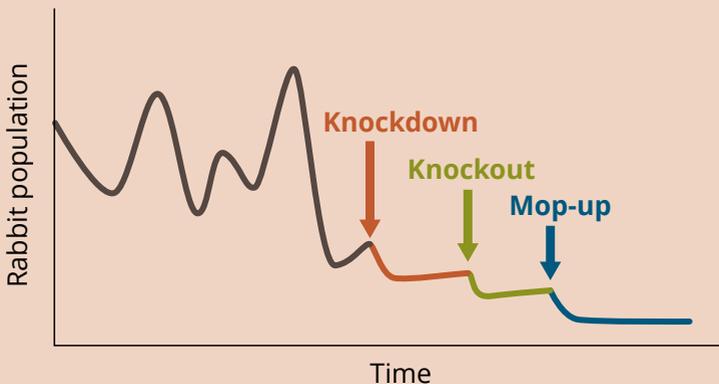
Their capacity to breed means a few rabbits can soon become many.

However, their reliance on safe harbour for breeding, commonly provided by warrens, can be exploited for long-lasting control.

Some keys to effective rabbit control are:

- Integrating a series of well-sequenced and well-timed control techniques that progressively:
  - knockdown (reduce rabbit numbers, e.g. baiting)
  - knockout (remove breeding sites, e.g. rip warrens)
  - mop-up (clean up remaining rabbits, e.g. fumigation or shooting).

## The aim of integrated rabbit control



- Destroying warrens or other harbour limits breeding and sustains the benefits of control; avoiding an annual repeat of knockdown campaigns.
- Taking advantage of seasonal conditions to control rabbits when their numbers are lowest. This is when chosen techniques will be most effective.
- Monitoring rabbits before, during and after control to target control programs and evaluate their effectiveness – the number of rabbits remaining per hectare is more important than the number removed.
- Following [Standard Operating Procedures](#) to get the best, most humane, results with the least risk to off-target animals.
- Breaking up big control programs by staging them over several years or by zoning to manage different areas for different goals, e.g. eradication vs managed suppression.
- Coordinating your activities with your neighbours to avoid re-infestation, removing weeds that shelter or feed rabbits, and controlling feral cats and foxes to avoid prey-switching.



Image: Anne Young

## About this Guide

This *Glovebox Guide for Managing Rabbits* is a practical resource to help Australian land managers alleviate the harm caused by wild European rabbits.

This Guide:

- provides information on how rabbits live and breed
- outlines options for control, their benefits and conditions for use
- introduces monitoring techniques
- will help you develop a cost-effective rabbit management plan.

It provides information about feral rabbits, their behaviour and their impacts, then steps through the development and implementation of a management plan. The steps are:

- **Assess:** Define your problem, be clear where rabbits are, and understand all your management options and any associated risks.

- **Plan:** Set a clear objective and boundaries for your plan, determine who will be involved, document who will do what, where and when, and note any resources or approvals needed.
- **Manage:** Line up all necessary inputs, training or approvals, apply controls following best practice guidelines, and monitor before, during and after implementation.
- **Improve:** Evaluate performance and effectiveness before retuning or refocusing your plan, adopting an ethic of continuous improvement.

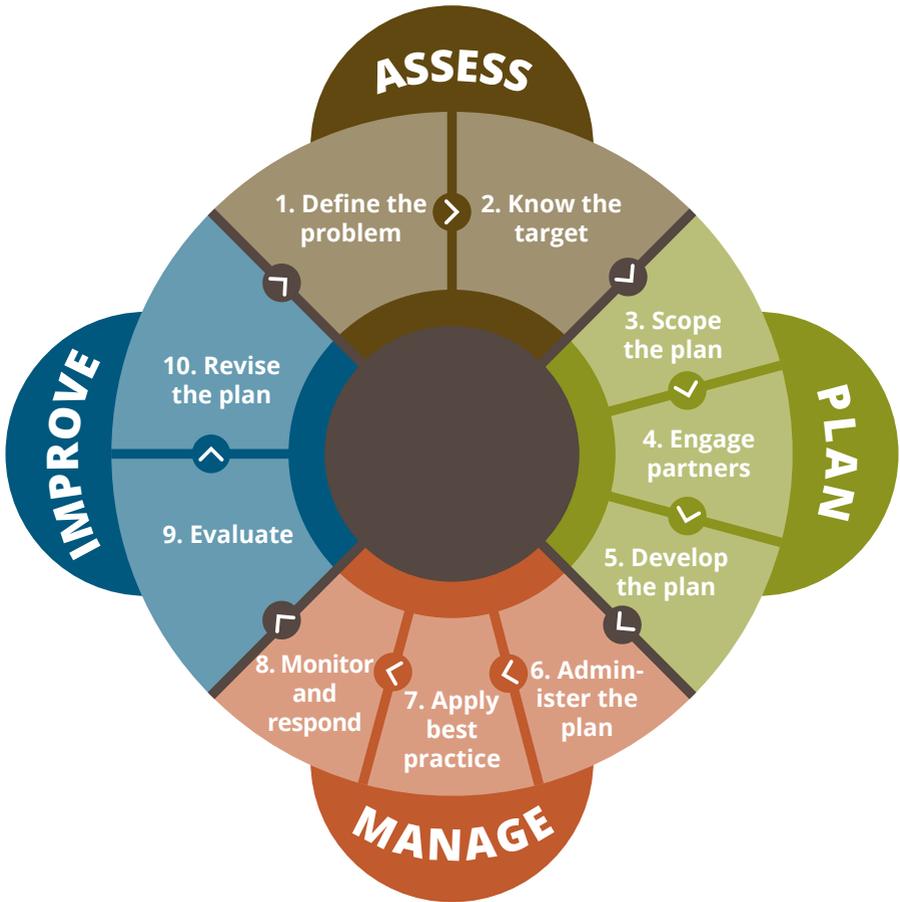
This Guide is intended for use in conjunction with the PestSmart/ Rabbits website, [pestsmart.org.au](http://pestsmart.org.au), and the Standard Operating Procedures (SOPs) and Codes of Practice (CoPs) available there.

It covers the following rabbit control techniques and explains the role they often play in integrated rabbit control.

## Integrated rabbit control



## Adaptive management framework for managing rabbits



*The ten steps in the adaptive management graphic are section headings in the Assess, Plan, Manage and Improve chapters of this Guide.*

## Your plan to manage rabbits

This Guide poses questions to help you prepare your rabbit management plan. Refer to relevant sections in this Guide for information to help in answering the questions.

### Assess

#### Define the problem

**Be clear on why rabbit control is needed and make fixing that problem the aim of your control program.**

**Q1.** What harm are rabbits causing and why is it a problem?

**Q2.** What is the root cause of the problem – why have rabbits become an issue?

Documenting the harm caused by rabbits gives focus to rabbit control, can build a common understanding between neighbours, and helps when comparing the costs and benefits that justify a lethal control program.

#### Know the target

**Record rabbit and warren distribution and consider all the control options that could be feasible in your situation.**

**Q3.** Where do rabbits live, breed and feed, and how abundant are they?

**Q4.** What control options might best manage rabbits and suit your situation?

Knowing all about your rabbits means you can better target control efforts, and provides a benchmark against which to measure success. Listing all the available control options helps you pick the ones that will be a best fit for your situation.

### Plan

#### Scope the plan

**Determine the area to be managed and who will be involved.**

**Q5.** Are rabbits likely to re-invade from adjacent properties if not controlled there?

**Q6.** Are there other associated pest animals (e.g. feral cats and foxes) or rabbit-sustaining weeds that need control as well?

Deciding the area to be covered in a plan, whether different zones of management are needed within it, and whether to link rabbit control with pest or weed control, sets some boundaries for the job ahead. It will determine if the plan is for your use alone, or if neighbours or management agencies will have contributions to make.

## Engage partners

### **Secure commitment from neighbours or interested agencies.**

**Q7.** Are there other people or agencies dealing with the same problems who may have advice, resources or experiences to share?

**Q8.** What will bring together those needed for an effective rabbit control program?

Rabbits do not respect boundaries and the long-term gains from managing rabbits in one area are likely to be affected by the actions, or inaction, of people in surrounding areas. Working with others, be they neighbours, regional or community groups, local government, or government agencies, can give better, longer-lasting results at less cost, both overall and individually.

## Develop the plan

### **Be clear on your objectives and commit to how they'll be met.**

**Q9.** What outcomes do you want to achieve?

**Q10.** Which control options will best fit your situation and available resources?

**Q11.** In what order, when and where will control operations be undertaken, and by whom?

Being clear on why you want to control rabbits helps determine the level of control to aim for, and whether you will have different management zones with different goals, e.g. eradication near high-value crops or conservation areas or containing densities in pastures to avoid competition with livestock. It may also mean setting priorities; choosing the most important areas in which to begin a program that may be staged over several years.

Each control method has its advantages and disadvantages. An assessment of risks and how to manage them, is part of choosing the most appropriate techniques for any site. Also consider their cost:benefit, their fit with each other, and the resources available for control.

## Manage

### Administer the plan

#### **Get organised – lay the foundations for successful management.**

**Q12.** Are all necessary resources available and any training or regulatory approvals satisfied?

**Q13.** Is it clear who will manage and coordinate the program, and how it fits with other activities?

Time spent sorting administrative matters will reap big rewards. Do it early to make the going easier and avoid unwanted surprises.

### Apply best practice control techniques

#### **Use the right technique the right way, in the right place, at the right time.**

**Q14.** Is everything in place to ensure ‘best practice’ or ‘standard operating procedures’ are followed?

Integrated rabbit control applies best practice to sequence well-timed interventions for optimal, long-lasting results. It compounds the benefits of individual techniques. It ideally has three phases; knockdown numbers to manageable levels, knockout breeding sites (warrens), and mop-up remaining rabbits.

The main control options are biocontrols, baiting, warren destruction, harbour removal, fumigation, shooting or trapping. Information on each and directions to Standard Operating Procedures are in the Manage section of this Guide.

### Monitor and respond

#### **Monitor and respond: Continually monitor for response-triggering feedback and to track overall effectiveness.**

**Q15.** What will you measure to know your plan is working and achieves the desired outcome, and how and when will you collect and store information?

Actively monitoring the effectiveness of your efforts as you go lets you quickly make any changes needed for better success. It highlights any parts that didn't work and need to be redone or re-imagined. A bottom-line is monitoring rabbit distribution and abundance, but measures like the number of warrens treated and any that were re-opened or monitoring and mapping the uptake of baits, can be very useful.

## Improve

### Evaluate the plan

**Evaluate the plan: Determine what worked, what didn't, and why.**

**Q16.** Which aspects of the plan were most successful, and which weren't?

**Q17.** For aspects that weren't as successful as hoped, was it because of problems with implementation or because the expected outcomes didn't occur?

Reflect on the effectiveness of the plan and lessons learnt with reference to pre-control, in-program, and post-program monitoring data, along with anecdotal and other evidence. Consider if your goals were met, if the program went to plan, and if there are opportunities for improvement.

### Revise the plan

**Revise. Modify the plan as required and recommit to the next phase.**

**Q18.** What changes are needed for the plan to be more effective and efficient?

**Q19.** How will you acknowledge and celebrate success?

Use what you've learnt from the review to address any problems and, if appropriate, change the focus for the future. Most importantly, celebrate success with those who contributed to it.

A revised plan will address issues identified from review and respond to changed circumstances - if your plan has been as successful as hoped, the next phase of management may require quite a different approach.

**The questions used in this Guide draw upon those developed by Foundation for Rabbit-Free Australia for its website and subsequently adapted in the 'Peri-urban Rabbit Framework' available from the PestSmart website.**

# INTRODUCTION

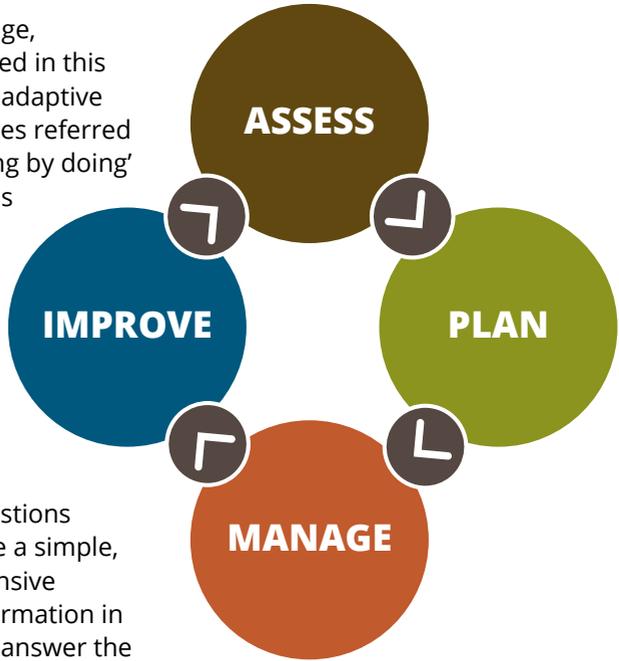


## Adaptive management

The 'Assess, Plan, Manage, Improve' framework used in this Guide is an example of adaptive management (sometimes referred to as structured 'learning by doing' or 'plan, do, review'). It is about getting on with management while learning what does or doesn't work in your situation and making adjustments for a better outcome.

This Guide uses the framework to pose questions that will help you create a simple, realistic and comprehensive management plan. Information in the Guide will help you answer the questions to prepare your plan.

## Adaptive management framework



*Tell-tale grazing line at rabbit height. Image: Brian Cooke*

## Coordinated pest and weed management

Wild rabbits have a web of relationships with other animals and plants (both native and introduced), and rabbit control is just one part of looking after farms and natural environments. Rabbit management should be integrated with the management of related parts of that system. Consider:

**Working with neighbours:** Rabbits can readily re-invade rabbit-free areas if left un-managed in adjacent lands and not excluded by suitable fencing. Rabbits don't respect boundaries; collaborate with neighbours and coordinate activities for optimal effect and potentially better cost efficiency.

**Feral predators:** Wild rabbits can be a major food source for feral cats and foxes. Controlling rabbits can reduce predator numbers, make them more likely to take baits and may lead to short-term prey switching. Controlling rabbits, feral cats and foxes together will make those efforts more effective and reduce any risks of a temporary increase in predation of native animals through prey-switching. Removing rabbits and feral predators together has major net benefits for production and conservation outcomes.



*Image: Peter Elsworth*



*Image: Daniel Schembri*

*Rabbit control can be integral to feral cat and fox control.*

**Weeds:** Rabbits are also linked with weeds. They create conditions suitable for them, and use them for shelter, food and hydration. Controlling weeds like blackberry, lantana and gorse exposes rabbits and their warrens and makes the environment less suitable for rabbit survival, while also reducing fire hazard. Weeds, including their roots and bulbs, may help sustain rabbits when other feed or water is scarce – controlling those weeds makes it harder for rabbits to survive. For more information on weed management see Weeds Australia, [www.weeds.org.au](http://www.weeds.org.au)



*Weeds can help sustain rabbits. Onion grass corms (Romulea rosea) are de-husked by rabbits for summer feed.*  
Image: Ron Sinclair

**TIP:** Make rabbit control Step 1 for successful revegetation or carbon planting programs.

Ideally, rabbit control should be embedded within a broader property plan, normalising pest and weed control as an integral part of management and biosecurity operations. It may be as simple as a guiding strategy (e.g. running an annual mop-up program), or tactics could be spelt out in detail and integrated into an annual calendar of property operations.

**TIP:** Rabbit control gets easier if the environment is made less attractive to rabbits by weed control.

## Local considerations

The information in this Guide is relevant Australia-wide, but rabbits occur in very different social and environmental settings across the country. Choices about rabbit control techniques and how they are applied, and the nature and extent of consultation required, will be shaped by local circumstances and regulations.

Local resources and information from state and territory government agencies, regional pest management bodies or local governments should be sought to supplement this Guide.

**TIP:** Be on the ‘front-foot’ – build rabbit control into your annual property management plan.

# EUROPEAN WILD RABBITS



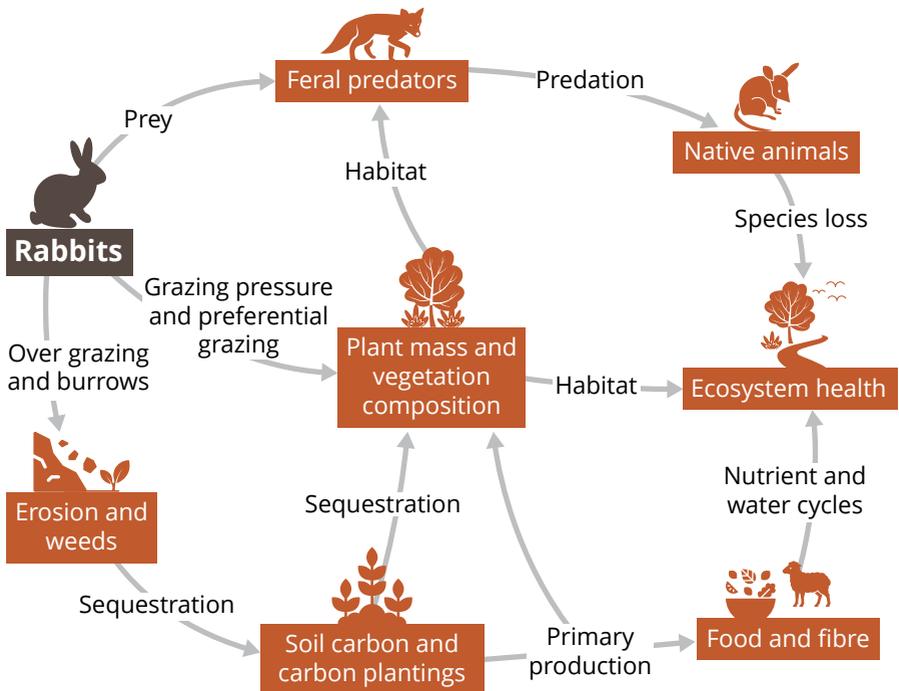
## About rabbits

### Distribution and abundance

In their homeland, the Iberian Peninsula of Spain and Portugal, the wild European rabbit (*Oryctolagus cuniculus*) has influence throughout the environment, making it a 'keystone species'. Its web of interactions with plants and other animals help to maintain the structure, diversity and health of ecosystems. It has a similar, though opposite, effect in Australia where their web of influence is environmentally destructive.

Even in low numbers, wild European rabbits disrupt key parts of Australian environments through their selective grazing, which prevent the regeneration of palatable plant species and changes the structure and composition of pastures and vegetation. When abundant, rabbits are a reliable food source for feral predators and boost their populations. In high numbers, rabbits devastate entire landscapes, competing with other herbivores (including livestock), inviting weeds and erosion, and destroying habitat that other animals rely upon.

### Rabbits. A web of influence



Credit: Adapted from 'Benefits of rabbit control' by Foundation for Rabbit-Free Australia.

Wild European rabbits are a pest throughout much of Australia. Their distribution and numbers are difficult to quantify as populations fluctuate in response to breeding, natural mortality, biocontrols, predators or drought, the availability of food, water and shelter and, of course, control by land managers.

### Biology, reproduction and diet

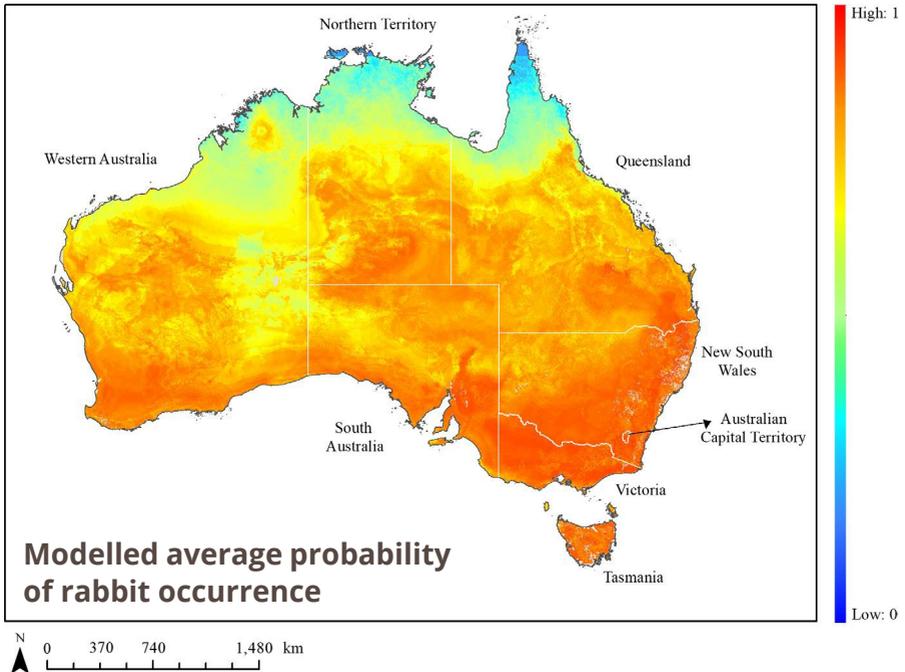
Wild European rabbits commonly have grey-brown backs and white-grey bellies, but can vary from sandy light brown to ginger, black and occasionally, white. Adults, both male and female, weigh 1–2.25 kg and are 35–45 cm long.



Ringbarking of tree violet (*Melicactus dentatus*) by rabbits. Image: Tim Bloomfield



Rabbit control exploits their behaviour and biology. Image: David Kleinert



Models that incorporate available data are used to predict the likely national distribution of rabbits. Source: Roy-Dufresne E et al. (2019)

**FACT:** Their high reproduction rate means ‘a few’ rabbits can soon become ‘many’.

Rabbit breeding is stimulated by high protein feed, such as green grass. Rabbits can begin breeding at just four months of age and, in good seasons, can produce five or more litters in a year, with up to five young (kittens or kits) per litter. Rabbits have a gestation time of 28–30 days.

**FACT:** High protein feeds (12-15% or more) stimulate production of the sex hormone oestrogen, triggering the onset of mating. Higher protein levels result in larger litters and healthier kittens.

Kittens suckle from their mothers for about three weeks before starting on solids and are weaned by 6–8 weeks. They are cared for in specially constructed nursing chambers.



*Rabbit grazing of punty bush (Senna artemisioides), a food plant to moth and butterfly larva. Image: Tim Bloomfield*



*Rabbit nesting chamber. Image: CSIRO*

In temperate Australia, the main breeding season is from autumn to spring after good rainfall. However, rabbits can breed at any time of year when food is in good supply. If there is green grass available, rabbits are likely to be breeding.

During the breeding season, rabbits form territorial groups, often containing 1–2 males (bucks) and 4–5 females (does), led by a dominant pair. Bucks mark their territory with chin glands and dung heaps and mark females and their young with sprayed urine.

The social hierarchy results in dominant males and females producing most of the surviving offspring.

**FACT:** Mortality rates are high for kittens but unless 85% of the rabbits die or are removed, the population can grow 10 times larger in a single favourable season.

Dominant rabbits defend their territory against intruders, especially during the breeding season. However, rabbits move up to 1.5 km between warrens outside of breeding seasons; mainly from densely populated to less-populated warrens. Young sub-dominant individuals (especially males) are often more mobile in response to challenges from dominant rabbits.

Rabbits eat a wide variety of plants, including crops, pastures, young trees and vines. They prefer soft, short and succulent plants such as grass and herbs. They preferentially target palatable species and seedlings, and can be slow to try novel feeds. However, they will eat anything when feed is scarce. They can graze plants to ground level and will dig to gnaw on roots and bulbs. They will even climb trees to reach edible foliage during drought.

**FACT:** Rabbits are coprophagic – they eat their own faeces. Rabbits produce hard pellets when grazing and soft pellets when underground. Soft pellets are re-ingested, extracting the maximum amount of protein and moisture.

Rabbits may consume up to one-third of their own body weight daily, although their average daily intake is 100–150 g dry weight. In arid areas rabbits may need access to water, but elsewhere they generally get enough moisture from their food.

### Biological and behavioural weaknesses

Warrens provide cover and protection from predators and extreme temperatures. They are made up of interconnecting burrows and entrances (usually about 1.5 to 3 entrances per rabbit). Their depth and size vary with soil type. They are often up to 3 m deep and tend to be larger in more open country.

**FACT:** Rabbits prefer to feed within 150–200 m of the safety of their warren but venture up to 300–400 m as feed becomes scarce; and much further in drought as food availability, nutrition and plant moisture levels drop.

Rabbits depend on warrens or other shelter to protect their young when breeding. Destruction of harbour reduces the local rabbit population and inhibits breeding. Rabbits do not readily dig new warrens so the benefits of warren destruction can last for decades. 'Squats', a shallow depression protected by vegetation or debris, may be used in the absence of warrens.

Because rabbits graze further from their burrows and are more likely to try other feeds in dry conditions, they are more susceptible to baiting at those times. They are also attracted by disturbed soil.



*Burrows are safe havens for rabbits and their young. Image: Peter Day*

Rabbits are also susceptible to predators and disease. Their most significant predators are feral cats, foxes and wild dogs but, except at low densities of rabbits, the rate of rabbit breeding exceeds the rate of predation from cats and foxes.

The close social proximity of rabbits within warrens makes them susceptible to readily transmitted diseases.

## **Harm caused by rabbits**

Rabbits negatively affect primary production (costing crop and livestock producers more than \$200 million a year), the natural environment (being a risk to more than 300 threatened native species), social welfare (damaging cultural sites and mental wellbeing) and community assets (burrowing under structures and buildings ranging from garden sheds to industrial facilities).



*Rabbits undermine infrastructure. Images: Darling Downs-Moreton Rabbit Board*

## Economic

An economic assessment from 2013-14 concluded that, on average, wild rabbits cost dryland agriculture \$216 million in production losses each year – more than wild dogs and foxes combined.

This loss is mainly caused by rabbits grazing pastures. As well as reducing crop and pasture yields, grazing can prevent regeneration of seedlings and increase competition for feed with livestock. Selective grazing of preferred species can shift pasture composition and favour less edible weeds.

Grazing competition may affect the carrying capacity of livestock, resulting in lower weight gain, lower wool production and reduced births. In drought, more stock may die because of starvation due to reduced feed. In general, about 9–12 rabbits/ha is equivalent to one dry sheep equivalent (DSE).

**TIP:** Don't let rabbits feed on scarce pastures during drought. Destroy warrens to save feed for livestock and encourage regeneration when rains come.

Rabbits are linked to increases in weeds such as Paterson's curse (or Salvation Jane) and horehound. Paterson's curse can be toxic to a range of livestock; pigs and horses are highly susceptible, cattle are moderately susceptible. Overgrazing by rabbits creates bare patches and selective grazing removes palatable species, creating conditions in which weeds thrive.

Rabbits can also contribute to:

- greater lambing losses through predation by fox populations supported by rabbits.
- reduced sheep fleece quality through exposure to soil from bare ground
- livestock leg injuries or breakages in rabbit burrows
- poor recovery of pastures following drought.



*A 'halo' of crop loss caused by rabbit grazing. Image: Susan Campbell and Carlo Pacioni*

Rabbits also affect irrigated agriculture, horticulture, viticulture and forestry. Those costs have not been assessed in a national context, though they are known to be high in localised situations.

In peri-urban and urban areas, rabbits damage lawns, gardens, golf courses, sportsgrounds, parks and reserves. They undermine buildings, garages and sheds, and even industrial and transport infrastructure. The cost of rabbits in urban areas has not been estimated.

## Health

Rabbits can be a host for parasites, including ticks, and diseases. They may carry dog tapeworms and sheep liver fluke. Rabbits may transmit John's disease (*Mycobacterium avium paratuberculosis*) to cattle and act as a vector of infective *Escherichia coli* and the Q Fever-causing *Coxiella burnetii* in humans.

Larvae, pupae and some adult Australian paralysis tick (*Ixodes holocyclus*) were commonly found in a study of wild rabbits near Sydney. This generalist tick from high rainfall areas, such as the east coast of Australia, can cause flu-like symptoms, allergic reactions and paralysis in humans.

## Environmental

Rabbits directly compete with native wildlife for food and shelter and degrade the land. The decline and extinction of many small species has been attributed to impacts caused by rabbits, particularly in the arid and semi-arid zones. Even at low population levels following the release of calicivirus as a biocontrol, rabbits can hold Australian rangelands in a degraded state, with increased weeds and inhibited recruitment of palatable woody species.

The impact that rabbits have on the environment varies with the density of the rabbit population and the availability of food. At high densities and scarce food resources, rabbits will eat almost anything and exert considerable grazing pressure—the sheer volume of consumption is a problem.

**FACT:** Rabbit density of 1 rabbit per 2 ha will prevent the regeneration of palatable plant species.

At very low densities and with plentiful food they will selectively graze on preferred plants such as tree and shrub seedlings. Just 1 rabbit per 2 ha will prevent the regeneration of palatable species like casuarinas, changing the entire structure of plant communities.

**TIP:** If you are in an area where episodic events like heavy summer rainfall or fire drive the recruitment of palatable seedlings, make sure rabbits are under control or risk losing a whole generation of those plant species.



*Young Callitris only exist inside a rabbit-proof enclosure. Image: Neil Ross*

'Competition and land degradation by rabbits' is listed as a threatening process under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Rabbits affect more than 300 species of native plants and animals listed as a threatened under the legislation. Rabbits affect native plants by ringbarking, grazing and preventing seedlings from maturing. Their burrowing, digging and browsing reduces vegetation cover and creates bare ground and tunnels, which can result in soil erosion and slope instability.



*Warrens can lead to soil erosion. Image: Darling Downs-Moreton Rabbit Board*

Rabbits can also affect native animals through their aggressive and territorial behaviour. There are historic accounts of them ejecting bilbies from their burrows.

Greater bilbies are similar in size to rabbits and also live in warrens. Though once common in much of Australia, they are now listed as a threatened species with vulnerable status under the EPBC Act and restricted to feral-free reserves and the northerly range of rabbit distribution.

**TIP:** 'Bilbies not Bunnies' is a reminder that rabbits need management to make environments suitable for bilbies and other native plants and animals.

As a prey species for feral cats and foxes, rabbits can sustain predators and amplify the harm they cause to native animals.

## Case Study: A cascade of consequences

Sweet Bursaria (*Bursaria spinosa*), also known as Christmas Bush because of its summer flowering, is preferentially grazed by rabbits. Even at very low numbers rabbits prevent the growth of Sweet Bursaria seedlings, robbing bushland of the services the plants provide.

▶ The plant's small white flowers attract birds and feed pollinators including beetles, butterflies, moths, wasps and native bees at a time when few other native plants are flowering, helping support those species and the plants and crops they pollinate.

▶ Caterpillars also feed on the plants, including some that graze on lichen growing on branches.



▶ Its dense foliage and spiny branches provide shelter and nesting sites for small birds.

The preferential grazing of rabbits can leave bushland a 'hollow shell' – dominant species may survive but the rich biodiversity found in rabbit-free areas is missing. It is an example of the 'invisible harm' caused by rabbits.

For more on rabbits and their ecosystem impacts, search for information on:

- The Eltham Copper Butterfly (*Paralucia pyrodiscus lucida*), *Notoncus* ants and Sweet Bursaria.
- Drooping Sheoak (*Allocasuarina verticillata*) and Kangaroo Island Glossy-black Cockatoos (*Calyptorhynchus lathami halmaturinus*). See 'Banjo Frog's Concert Spectacular' for an illustrated children's book telling the story, available via [www.rabbitfreeaustralia.org.au](http://www.rabbitfreeaustralia.org.au).

## Social

The damage caused by rabbits to lawns, gardens and sportsgrounds is costly and can inconvenience communities relying on these amenities. Their burrows can be a threat to cultural heritage, such as cemeteries and First Nations burial sites.



*Rabbits can thrive in urban gardens.  
Image: Bruce Munday*

Broader impacts may include psychological stress, such as anxiety, frustration and depression, due to financial loss through reduced agricultural production, coping with the realities of undertaking lethal control, trauma associated with finding sick animals, and concern about potential injury to horses or livestock from warrens.

Owners of pet rabbits may have concerns about rabbit biocontrol viruses. Vaccinations against the RHDV-K1 calici virus (see [Controlling rabbits / Biocontrols](#) for more information) are available from vets for domestic breeds of rabbits.

## Controlling rabbits

### Integrated rabbit control

A key to effective rabbit control is using a mix of techniques in a staged program, that is:

- well timed (e.g. taking advantage of low rabbit numbers or seasonal rabbit behaviour)
- well sequenced (e.g. starting with a method suited to a broad scale, then progressively using methods suited to smaller areas or sites with fewer rabbits).

A series of controls that build on each other optimises the efficiency, effectiveness and legacy of rabbit control work, while reducing the risk of building immunity to biocontrols in rabbit populations and causing off-target impacts.

When possible, a 3-step management program is recommended.



*Biocontrols can be a foundation to rabbit control, but other methods are still needed for effective management. Although bait, rip, fumigate is a reliable integrated approach, other options can be used to suit local situations. Images: Bruce Munday, Wayne Meyer, Adrian Martins*

## Integrated rabbit control

A carefully timed, sequence of biological, chemical and physical techniques

**Knockdown**

**Knockout**

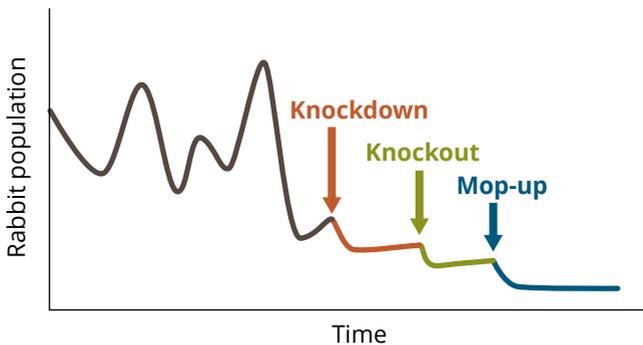
**Mop-up**

- **Knockdown:** Knock down rabbit numbers for easier management. Start when numbers are already low, e.g. when feed is scarce. Baiting or biocontrols are effective over larger areas.
- **Knockout:** Stop rabbits breeding by knocking out their warrens or removing debris or thickets that provide safe harbour. This will further reduce numbers and, more importantly, stop recruitment making subsequent management easier.
- **Mop-Up:** Search out and remove residual rabbits and warrens. Fumigation or shooting are effective for small areas and relatively low numbers of rabbits.

Well timed and sequenced controls stop rabbit numbers from rebounding.

**TIP:** Best practice relies on doing the right thing, in the right place, at the right time.

### The aim of integrated rabbit control



*A knockdown, knockout, mop-up sequence, followed by ongoing maintenance can be very effective and cost-efficient in temperate areas (Williams and Moore, 1995) but numerous options can be selected for individual circumstances. Rabbit-Free Australia after Foran et al. (1985), Williams et al. (1995) and Taggart*

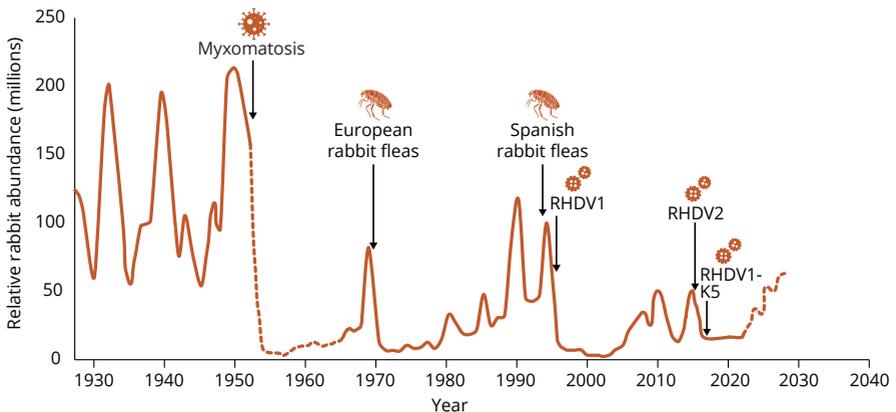
## Biocontrols

Two of the deadliest diseases to rabbits are myxomatosis and rabbit haemorrhagic disease (RHD). They, and European rabbit fleas that were introduced to help spread myxomatosis, are freely circulating (self-disseminating) biocontrols in Australia, developed through years of painstaking research.

Myxomatosis is caused by the myxoma virus. RHD is caused by Rabbit Haemorrhagic Disease Virus (RHDV), a calicivirus. A benign calicivirus, RCV-A1, was present in Australia before the introduction of RHDV.

'Myxo' and RHDV have dramatically lowered the number of rabbits in Australia and still 'do the heavy lifting' for rabbit control, but that will never be sufficient to eradicate wild rabbits or prevent them causing significant harm. Additional chemical and physical controls are necessary for effective rabbit control.

RHDV1-Czech v351 was the strain of calicivirus first introduced to Australia in the mid-1990s. RHDV1-K5 was introduced in 2017 and is available for use as a biocide (a biological control that is unlikely to spread widely but is suited to local applications). RHDV2 was recorded in Australia in 2015 and is now the predominant strain of self-dispersing RHDV in the country.



Impact of biocontrol agents on the Australian rabbit population over time. Modified from Cooke *et al.* (2013). For the purposes of illustration only: dotted line denotes estimated data.

*Biocontrols have been incredibly successful, but their effectiveness can wane.*

Source: Cooke *et al.* (2013)

Biocontrols are not uniformly effective. Virulence (the ability of a microorganism to cause disease in the host) differs between strains and across target populations. Furthermore, some rabbits are more genetically resistant, and immunity can also develop in the survivors of infection, reducing the effectiveness of these diseases as biological controls over time.

Additionally, RCV-A1 (which occurs mainly in wetter areas) provides some temporary immunity to RHDV. Outbreaks of RDHV and releases of RHDV-K5 may therefore be less effective where RCV-A1 occurs.

Decades of research is typically needed to develop a new biocontrol and provide sufficient evidence about its effectiveness and safety before approval is given for release. A pipeline of research is needed so new options are available when needed.

**TIP:** Over time, the effectiveness of biocontrols can wane and rabbit populations rebound. A mix of physical, chemical and biological controls is a proven approach for rabbit management.



Image: David Kleinert

# ASSESS



*Record rabbit damage and warrens to plan effective control. Image: Brian Cooke*

## Define the problem

**Be clear on why rabbit control is needed and make fixing that problem the aim of your control program.**

**Q1.** What harm are rabbits causing and why is it a problem?

**Q2.** What is the root cause of the problem – why have rabbits become an issue?

## Document the damage

Documenting the harm caused by rabbits gives focus to rabbit control. It can build a common understanding between neighbours, and helps when comparing the costs and benefits that justify a lethal control program.

Simple damage assessments can be used to record rabbit problems. Some signs of rabbit damage and the possible rabbit populations causing them are presented below.

### Signs of rabbit damage and indicative rabbit densities (rabbits/ha) causing it.

Evidence of harm caused by rabbits	Rabbits/ha
No evidence. Good ground cover and plant species diversity. All plant growth stages present including abundant seedlings.	0.0
Absence of seedlings of highly palatable plant species. Distinct browse lines 50 cm above ground on foliage in reach of rabbits.	0.5
Cover of native plants reduced by 50%. Crops eaten out within 50 m of warrens.	1.0
Absence of seedlings of moderately palatable plant species. Invasive weeds more common.	2.0
Cover of native plants reduced by 90%.	5.0
Absence of young native shrubs. Unpalatable weeds common. Soil heavily disturbed.	10+
Notes: 1 rabbit/ha is equivalent to 1 cow or 9 sheep/ km <sup>2</sup> . 5 rabbits/ha is equivalent to 5 cows or 45 sheep/km <sup>2</sup> .	

*References: Cooke et al. (2014), Mutze et al. (2016a), Mutze et al. (2016b), Ross and Letnic (2023), Cooke (2025) pers comms.*



Local authorities may have rabbit assessment guides tailored to your area or see 'Rabbits: A threat to conservation and natural resource management' for help at the PestSmart/Rabbits website.

When assessing suspected rabbit damage, remember that other animals such as locusts, hares and wallabies might cause similar harm. Look for distinctive signs of rabbits, such as trench-like scratchings, dung heaps and chisel-shaped bite marks, or set camera traps to be certain.

Reflecting on any local changes, like growth of weedy thickets, reduced effort in rabbit control, or changes in land use, can indicate why rabbits have become a problem. If possible, attending to those 'root causes' can help your rabbit control be effective.



*Digging and scratching are signs of rabbit activity. Image: Peter Day*



*Dung-heaps are signs of rabbits. Image: Darling Downs-Moreton Rabbit Board*

## Know the target

**Record rabbit and warren distribution and consider all the control options that could be feasible in your situation.**

**Q3.** Where do rabbits live, breed and feed, and how abundant are they?

**Q4.** What control options might best manage rabbits and suit your situation?

Knowing all about your rabbits means you can target control efforts, and it provides a benchmark against which to measure success. Listing all the control options available lets you pick the ones that will be a best fit for your situation.

## Monitoring rabbits

Large populations of rabbits are relatively easy to detect as the damage they cause is usually widespread and highly visible. However, the damage caused by small or low density rabbit populations can be much harder to identify. What is not there, e.g. a lack of palatable seedlings, can be as informative as what is there.

**FACT:** Rabbit numbers or density does not always correlate with damage. A small population in a highly sensitive ecological community with endangered species could be a serious threat.

Rabbit numbers, and changes in their impact, can vary dramatically in a short period of time. Without ongoing monitoring and control, these changes can go unnoticed and the problem can get out of hand, resulting in higher management costs.

**TIP:** The RabbitScan app or website (see Further information) can be used to map warren locations and record rabbit data.

Rabbit density is a practical indicator of a potential rabbit problem and can be measured easily, quickly and cheaply. Estimate density directly by counting rabbits (e.g. spotlight counts) or indirectly by counting warrens, active warren entrances, or signs of rabbits (e.g. footprint tracks and dung). Sniffer dogs can find warrens in dense vegetation.

A quick method to assess a rabbit problem is to take a 15 minute walk through the area of interest, covering about 2-3 hectares. Look carefully for rabbit pellets but don't stop too long at any given point. See the table below for how pellets relate to rabbit density.

Signs of rabbit abundance: Density as rabbits/ha. Rabbit pellets (faeces) found in a 15 minute search.	Score	Approximate rabbits/ha
None found.	0	0
Isolated pellets and small clumps of 5-10 pellets, 10 m or more apart.	1	0.5
Scattered pellets and clumps less than 10 m apart.	2	1
Common, pellets in large clumps and occasional dung-heaps on about half the area searched.	3	2
Abundant, pellets often in large clumps and dung-heaps obvious but not present across the whole area.	4	5
Very abundant, pellets and dung-heaps always apparent.	5	10 or more

Note: 0.5 rabbits/ha is the density threshold above which rabbits exert selective grazing pressure.

Source: After Cooke, McPhee and Hart (2008).

Other monitoring methods can be found in the following references which are available for download from [www.pestsmart.org.au](http://www.pestsmart.org.au):

- Monitoring techniques for vertebrate pests: Rabbits (Mitchell and Balogh 2007)
- Managing vertebrate pests: rabbits (Williams *et al.* 1995).



*A chisel-shaped bite mark is distinctive of rabbits. Image: Ron Sinclair*

## Is it a rabbit or a hare?

Hares are similar in appearance to rabbits. Hares are an introduced species from the same genetic family as rabbits (Leporidae), and they live in similar habitats. However, hares are usually solitary and live entirely above ground; they do not build warrens like rabbits do.



*European brown hare.*

Other key differences between the species are:

- hares are noticeably larger than rabbits, with a head and body length of 55 cm while rabbits are about 40 cm in length
- a hare can weigh twice as much as a rabbit
- a hare's hind legs are relatively larger than a rabbit's
- hares can run faster than rabbits
- hares have relatively longer ears than rabbits, with distinct black tips.

**TIP:** If unsure what animals are living in burrows, set up a camera trap to find out.



*European rabbit. Image: Neil Schultz*



*A rabbit-height browse line indicates rabbits are about in numbers sufficient to prevent regeneration of palatable plant species. Image: Rabbit-Free Australia*

## Control options

Integrated rabbit control may include biological, chemical and physical methods:

- Biocontrols: RHDV-K5 delivered by baits. RHDV2 (spread by flies and contact) and myxomatosis (spread by mosquitoes and rabbit fleas) are now naturally occurring.
- Toxicants/chemicals: Sodium fluoroacetate (1080) and pindone are used in carrot or grain baits.
- Warren destruction: Ripping, explosion, implosion, or harbour destruction.
- Fumigation: Diffusion or pressurised gasses, usually phosphine.
- Shooting: Small calibre or low powered firearms.
- Trapping: Padded-jaw traps, soft nets or cages.
- Exclusion fencing: Small aperture fencing with a mesh apron.
- Aversion: Localised scaring devices or deterrents.

Regulations governing these options vary between states and territories. Refer to Codes of Practice and Standard Operating Procedures for best practice guidelines and details of relevant legislation. More information on each method is available in the [Manage section](#) of this Guide.

Following the Code and Standard Operating Procedures will lead to effective, efficient and humane rabbit control programs that also respect animal welfare issues, aiming for as short a lead time to death and least pain as possible for the targeted animals. Best practice will also minimise risks to off-target animals.



*Rabbit activity can promote weeds. Image Brian Cooke*

# PLAN



## Scope the plan

### Determine the area to be managed and who will be involved.

**Q5.** Are rabbits likely to re-invade from adjacent properties if not controlled there?

**Q6.** Are there other associated pest animals (e.g. feral cats and foxes) or rabbit-sustaining weeds that need control as well?

Deciding the area to be covered in a plan, whether different zones of management are needed within it, and whether to link rabbit control with pest or weed control, sets some boundaries for the job ahead. It will determine if the plan is for your use alone, or if neighbours or management agencies will also have contributions to make.

Factors to consider include:

- The likelihood of re-infestation and/or the practicality of exclusion fencing to safeguard rabbit-free areas.
- Whether rabbits compete with other pests, native animals or livestock for feed or habitat.
- If rabbits shelter in weedy thickets or help spread weeds.
- If rabbits are preyed on by feral predators or native animals.
- The availability of resources (e.g. equipment and labour) and any approvals or training necessary to conduct a control program.

**TIP:** RabbitScan can help when working with other landowners to record where rabbits are a problem and deciding on priority areas for management.

## Engage partners

### Secure commitment from neighbours or interested agencies.

**Q7.** Are there other people or agencies dealing with the same problems who may have advice, resources or experiences to share?

**Q8.** What will bring together those needed for an effective rabbit control program?

Rabbits do not respect boundaries and the long-term gains from managing rabbits in one area are likely to be affected by actions, or inaction, of people in surrounding areas. Working with neighbours, regional organisations, community groups, local councils, or government agencies can lead to better, longer lasting outcomes at a lower overall cost for everyone involved.

It ensures all stakeholders have input and buy-in, while costs and effort can be shared; typically meaning a little bit of work from a lot of people, rather than a lot of work from a few.

**TIP:** Reducing rabbit numbers is best achieved when controls are applied across broad areas at the same time, regardless of property boundaries.

## Develop the plan

**Be clear on your objectives and commit to how they'll be met.**

**Q9.** What outcomes do you want to achieve?

**Q10.** Which control options will best fit your situation and available resources?

**Q11.** In what order, when and where will control operations be undertaken, and who by?

## Manage big jobs for big outcomes

**TIP:** RabbitScan can help when assessing the scale of a rabbit problem and deciding which control options will work best and where.

Some jobs may initially look too big to tackle but become manageable when broken into bite-sized pieces. The most important thing is to make a well-planned start.

It might mean staging the control program over several years, securing sections zone by zone,

ensuring reinfestation of treated areas doesn't occur. Natural or constructed barriers can help. Or it might be setting different goals for different zones, e.g. eradication near high-value crops or conservation areas while containing densities in grazing pastures to avoid competition with livestock.



*A simple rabbit-exclosure will demonstrate the grazing impact of rabbits. Palatable plants only occur inside the enclosure. Image: Rabbit-Free Phillip Island*

A broad-scale, coordinated approach to remove all rabbits from an area is a feasible, long-term management option if there is a concerted effort between neighbouring stakeholders. However, effective landscape-scale control is only possible if all rabbit-prone areas are eventually treated. Costs may be high initially, but ongoing and future costs are substantially reduced.

Whatever the approach, participating landholders will need to monitor treated areas to ensure there is no re-infestation, and to quickly respond if there is. A major benefit of removing warrens or other breeding areas is that little further action, apart from mopping up missed or invading rabbits, should be necessary.

**TIP:** Repetitive poisoning year after year is not effective for landscape-scale rabbit control. It could lead to bait avoidance (shyness) or tolerance to poisons.

Another strategy is to work with nature. Natural disasters like drought or bushfire can be opportunities to control rabbits while their numbers are low and warrens exposed.

**TIP:** Control rabbits during drought:

Remove rabbits to eliminate their grazing pressure – optimise pasture use by the animals you want to survive.

Destroy warrens – stop rabbits breeding and ensure pastures and bushland can recover without them.

Monitor and mop-up – make sure there is no chance of ‘just a few’ survivors becoming ‘many’.

## Choosing the right control tools

Every control method has its advantages and disadvantages. An assessment of risks and how to effectively manage them, should be part of choosing the most appropriate techniques for any site, as well as their cost:benefit, their fit with each other, and the resources available for control activities.

Some techniques should only be used as the last remaining option; others will not be practical for every situation. Some control methods, e.g. 1080 baiting, are not permissible in all areas.

Important factors to consider when choosing control methods are:

- cost-effectiveness, efficacy, skills and equipment available
- time of year and seasonal conditions (e.g. breeding season)
- humaneness (animal welfare) and off-target risks
- local regulations.

Climate, terrain and land use (e.g. agricultural production, peri-urban community or endangered ecological community) may also influence the type of control applied. Use local knowledge and seek advice from local pest control authorities and professional pest controllers when deciding on the most suitable techniques to use.

Information on the relative humaneness of control options is available from PestSmart.

### Working with the law

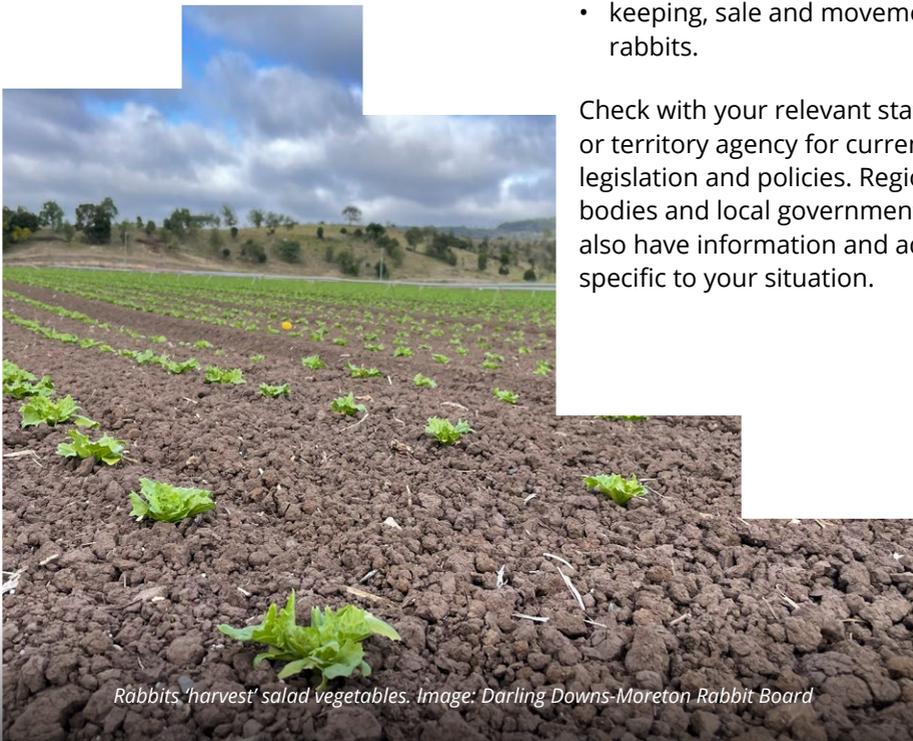
Laws are in place in all Australian states and territories requiring landowners to take reasonable actions to control rabbits on their land. 'Control' is often defined as taking action to minimise the species' impact and limit its spread.

National Codes of Practice and Standard Operating Procedures provide 'best practice' guidance for rabbit management and most control techniques. Some states have their own codes and procedures consistent with the national framework.

Numerous state laws, regulations or policies may need consideration, such as:

- land tenure, ownership and use, which may affect management obligations and access to, and use of, firearms and toxicants
- obligations of landowners for pest and weed control
- animal welfare (for rabbits and native animals, livestock and pets)
- training or certification to undertake specific control techniques, such as fumigation
- purchase and use of poisons, firearms, ammunition and traps
- heritage protection, native vegetation and/or native title
- keeping, sale and movement of rabbits.

Check with your relevant state or territory agency for current legislation and policies. Regional bodies and local government may also have information and advice specific to your situation.



*Rabbits 'harvest' salad vegetables. Image: Darling Downs-Moreton Rabbit Board*

# MANAGE



## Administer the plan

**Get organised – lay the foundations for successful management.**

**Q12.** Are all necessary resources available and any training or regulatory approvals satisfied?

**Q13.** Is it clear who will manage and coordinate the program, and how it fits with other activities?

Time spent sorting administrative matters will reap big rewards. Do it early to make the going easy and avoid unwanted surprises.

## Apply best practice control techniques

**Use the right technique the right way, in the right place, at the right time.**

**Q14.** Is everything in place to ensure ‘best practice’ or ‘standard operating procedures’ are followed?

Integrated rabbit control applies best practice to sequence well-timed interventions for optimal, long-lasting results. It compounds the benefits of individual techniques. It ideally has three phases; knockdown numbers to manageable levels, knockout breeding sites (warrens), and mop-up remaining rabbits.

**TIP:** Compound the interest. Use a series of control techniques that build upon the success of previous efforts.

### Integrated rabbit control

Biological, chemical and physical techniques



**Knockdown:** Control rabbits when their numbers are lowest and start with a control method that will cause the largest knockdown, like baiting (1080 or pindone), taking advantage of a burst of locally active biocontrols (myxomatosis or RHDV2), or work with nature (during a drought or immediately after fire or floods). If naturalised biocontrols aren't present, rabbits aren't breeding and poisoning isn't practical, then baiting with RHDV-K5 is an option.

**Knockout:** Make conditions unsuitable for rabbits and stop them breeding by destroying warrens or removing harbour that provides safety and nesting sites. This step is vital to prevent re-infestation and is the most effective way to make lasting inroads into rabbit problems. It ensures the benefits of rabbit control flow on for many years, making initial investments even more cost-effective.

**Mop-Up:** Monitor for any surviving or re-infesting rabbits and mop-up with site-specific techniques like fumigation, trapping, targeted baiting, shooting or ferrets.

**Exclusion:** If control isn't feasible in all areas, protect important assets by keeping rabbits away from them with fences or guards. Fencing can protect treated areas and can be made multi-purpose by designing it to exclude other vertebrate pests.

**FACT:** The benefits of warren destruction persist for decades. It is a key to the sustained management of wild rabbits.

## Control techniques: Overview

This section provides an overview of control techniques. Read the relevant Standard Operating Procedures (SOPs) for more information and specific guidance on each one.

SOPs are available from the PestSmart/Rabbits website. See [Further Information](#) for a list of all SOPs.

### Biocontrol

Biological control is the deliberate use of one organism (such as a virus or predator) to regulate the population of a pest organism.

In many parts of Australia, wild European rabbits are preyed on by introduced and native predators (e.g. foxes and cats or eagles and goannas respectively). The level of predation is generally not enough to control rabbit numbers (except where rabbits occur in low densities).

There are two introduced rabbit biological control agents active in Australia:

- myxomavirus (which causes myxomatosis)
- rabbit haemorrhagic disease virus (RHDV, a calicivirus).

Both are transmitted by contact and vectors; such as mosquitoes or the introduced European rabbit flea for myxomatosis, or flies for RHDV.

**Myxoma virus** is no longer commercially available, but does persist with regularly occurring natural outbreaks. Rabbits visibly affected by, or surviving, myxomatosis will have a weakened immune system and may be more susceptible and vulnerable to RHDV.

**RHDV** is a humane method of controlling wild rabbits. Susceptible rabbits usually succumb within 72 hours of infection. Most will develop a fever and may exhibit signs of lethargy. After the onset of fever, death occurs within 6–12 hours in 70–90% of cases. The overall welfare impact prior to death has been assessed as low using the relative humaneness model developed under the Australian Animal Welfare Strategy.

RHDV1-K5 is registered by the Australian Pesticides and Veterinary Medicines Authority and can be purchased for release, subject to state and territory legislation. It does not generally spread well due to competition from RHDV2, the dominant naturally disseminating form of calicivirus across Australia. RHDV2 is a true freely dispersing biocontrol. RHDV1-K5 is a biocide – it doesn't spread far.

Until three weeks of age rabbits are fully resistant to RHDV1, including RHDV1-K5. This resistance wanes until about 9-12 weeks of age when naïve (un-infected) rabbits are fully susceptible. Young rabbits of any age are, however, susceptible to infection with RHDV2 – unless protected by maternal antibodies. Young rabbits exposed to RHDV while protected by maternal antibodies can generate their own immunity, lasting for life.

RHDV1-K5 should therefore only be released when:

- RHDV2 is NOT active (as RHDV2 is more effective than RHDV1-K5).
- Rabbits are NOT breeding (as young rabbits will generally survive infection and can develop life-long immunity to RHDV-K5, which is also cross protective against RHDV2). Rabbit breeding is stimulated by protein-rich, green grass and herbage, so rabbits can be assumed to be breeding if there is actively growing forage available to them.



*K5-laced bait trail. Image: Heidi Kleinert*

The Elizabeth Macarthur Agricultural Institute (EMAI) provides commercial testing services for rabbit antibodies so levels of population immunity may be estimated before planned virus releases. They also provide diagnostic testing for RHDV itself. For more information search for EMAI RHDV testing.

Kits to test if calicivirus or myxoma virus caused the death of a found dead rabbit are available from CSIRO (search for CSIRO RHDV testing), or via RabbitScan for RHDV.

**TIP:** Refer to RabbitScan or CSIRO (RHDV Updates) to see any cases of RHDV1-K5 from test results in your area.

RHDV1-K5 is a useful part of integrated rabbit control in the right conditions but should be used in conjunction with warren destruction and other targeted control options like fumigation.

**FACT:** RHDV1 K5 baiting is not a silver-bullet by itself. If it's not planned and applied properly, it can deliver poor results and undermine long term rabbit control efforts.

## Toxicants

Toxicants (poison) baits are made by mixing bait material (chopped carrot, oat grains or pellets) with poison. Baits are laid along a trail or spread through rabbit-infested areas. Sodium fluoroacetate (compound 1080) and pindone are approved for use on rabbits in accordance with label instructions.

1080 occurs naturally in some plant species (especially in WA) but there is no antidote for it. There is, however, an antidote for pindone (vitamin K1). Subject to state regulations pindone is used in more built-up areas to reduce risks of harm to stray pets. If there is a significant risk of poisoning non-target animals, bait should not be laid, or special measures taken to reduce the risk.

**TIP:** Lay baits when feed is scarce to attract as many rabbits as possible.

Baits should be laid in known rabbit feeding areas. Any uneaten bait should be retrieved or buried to reduce risks of off-target consumption. Sick rabbits often retreat to burrows but any found carcasses of poisoned rabbits should be buried or incinerated to minimise risks of off-target poisoning. When baits are applied correctly, they are an effective and efficient component of integrated rabbit control.



*Bait-layer. Image: Victorian Rabbit Action Network*

## Equipment

Broad-scale baiting with either 1080 or pindone requires use of a bait layer, which has two functions. First, it creates a furrow by turning over soil, and turned soil attracts rabbits to the bait trail. Second, the bait layer scatters small amounts of bait across the bait trail allowing more rabbits to access the bait.

Trail baiting is the most effective means of poisoning, but bait stations (wire mesh or solid covers over small amounts of scattered bait) may be an option to reduce risk of bait consumption by off-target species when managing small numbers of rabbits. Monitoring free feeds with trail cameras will show how many rabbits are feeding and check that off-targets species are not taking baits. Exclusion fencing that is permeable to rabbits but not kangaroos or wallabies may be another option.

Protective equipment (e.g. gloves) is required; especially if laying baits by hand in small areas. Refer to the labels on the bait and visit PestSmart for more detailed advice.

## Pre-feed

Pre-feeding (feeding with un-poisoned carrot or oats) is required, unless using specially formulated one-shot baits that are only available in WA and contain predominantly un-poisoned 'free-feed' mixed with poisoned baits.

Free-feeding allows you to gauge how much bait is needed for the poison program, and whether you have non-target animals taking the feed. It gives the rabbits the opportunity to discover the bait trail and become accustomed to the feed. When undertaking a poison program, you want as many rabbits as possible to take the bait.

**TIP:** If unsure what animals are taking unpoisoned free-feed baits, use a trail camera to find out.

### Warren destruction and harbour removal

Rabbit warrens can be destroyed using equipment ranging from shovels to heavy machinery or explosives. Above-ground rabbit refuges, such as rubbish, disused building materials or weeds (especially thickets like blackberries or lantana) should also be removed.

Warrens can be as shallow as 30 cm or as deep as 300 cm. Dig a trench to see the extent and depth of the warren system and determine the type of equipment required.

**TIP:** Rip warrens after baiting or outbreaks of RHD when rabbit numbers are low.

There are numerous ways to rip a warren depending on the slope, soil, vegetation and type of equipment being used. Equipment may range from bulldozers and tractors with tyres, to backhoes or excavators, to a shovel for small or specialist jobs. Check with local experts for regional recommendations and state regulations.



Image: Darling Downs Moreton Rabbit Board



Image: Agriculture Victoria



Image: Victorian Landcare



Image: Darling Downs Moreton Rabbit Board

Tools and machinery can match any job.

## Fumigation

Fumigation involves the use of toxic gas which is either forced into a rabbit warren under pressure (pressure fumigation) or generated inside the warren and left to diffuse throughout the burrow (diffusion fumigation), leading to the death of rabbits inside the warren.

Aluminium phosphide tablets, which release phosphine gas when activated by moisture, are most commonly used.

Protective equipment is essential for all operators and state regulations must be followed.

It is important to locate and block all burrow entrances. A warren smoker can be used to find openings in dense vegetation.



*Appropriate safety gear must be worn when handling chemicals, such as Phostoxin tablets when fumigating rabbit warrens. Image: Adrian Martins*

**TIP:** Exclusion fencing or netting may be installed after fumigation if there is concern about rabbits reinvading treated areas, such as under buildings or shipping containers. Having shipping containers at least 400 mm above ground limits their use by rabbits.

## Shooting

Shooting can be labour-intensive and requires a high skill level, e.g. trained, accredited professionals with appropriate permits, subject to state legislation. It is a useful and humane mopping-up technique when rabbit numbers are low or in situations where other techniques cannot be used. Specialist professionals are able to operate within built-up areas.

You can count the number of rabbits shot for an indication of how many rabbits were around before control. After control, a survey is needed to estimate how many rabbits are left and how effective the program was.

As with all control efforts, the number and population density of rabbits remaining is more important than the number removed.

**TIP:** Monitoring to estimate rabbit population density before, during and after any control program lets you assess effectiveness and consider the level of harm that a residual rabbit population could cause.

## Trapping and ferreting

Cage traps, soft nets and soft-jawed leg-hold traps can be used when small numbers of rabbits are present, subject to any relevant local regulations. Caught rabbits must be euthanised as soon as possible after capture so regular monitoring is necessary. Trapping is labour-intensive but is feasible for mopping up small numbers of residual, invading or re-establishing rabbits.

Ferrets may be an option to target small residual numbers of rabbits in some situations, but experienced handlers are required, and the welfare of rabbits must be considered. Check state regulations regarding ferrets and animal welfare requirements.

## Exclusion fencing

Rabbit-proof fencing is used to protect assets and to prevent re-infestation of treated areas. Pay attention to design.

For example:

- Fencing to keep out rabbits must be wire netting of sufficient gauge to withstand gnawing by rabbits (plastic can be eaten through).
- Mesh size is typically 40 mm or less (some recommendations are 30 mm) and at least 900 mm high (rabbits can jump over 500 mm fences), with an apron or underground skirt of at least 180 mm.
- Electrification may be useful.
- It is possible to install combined fox, cat and rabbit exclusion fences; and to include special 'gateways' for priority native animals like echidnas.
- Fences must be monitored for damage and breaches. Gates, waterway crossings and the seaward ends of fences are often weak points.



*Netting can exclude rabbits from infrastructure. Image: Darling Downs-Moreton Rabbit Board*

Tree guards are a common way to exclude rabbits from planted seedlings.

## Aversion techniques

There are a range of tools and devices to deter rabbits from small areas like ornamental gardens or vegetable patches. They include liquid spray repellents, specialised sounding alarms or flashing lights. If successful, deterrents may protect some assets but divert rabbits to other locations rather than control them, and rabbits may learn to ignore them.

## Control techniques: Summary table

Rabbit control is most effective when a combination of control techniques is applied in a strategic manner. The following summaries are generally directed to temperate climatic zones; seasonal advice may differ in other regions. Standard Operating Procedures, available from the PestSmart website provide additional 'how to' information for most of the following techniques.



Match machinery to the job. Image: Darling Downs-Moreton Rabbit Board

Technique	When to use	Benefits	Precautions
Biocide RHDV1-K5	<ul style="list-style-type: none"> <li>When rabbits are not breeding (no green grass) and few young are present, to maximise effectiveness</li> <li>No recent outbreaks or releases of RHDV</li> </ul>	<ul style="list-style-type: none"> <li>Works well in low rainfall areas</li> <li>Target specific</li> <li>Can be used in urban areas or where RHDV has not spread naturally</li> <li>Best used in conjunction with other control methods</li> </ul>	<ul style="list-style-type: none"> <li>Variable effectiveness</li> <li>Cannot be used in extreme weather</li> <li>Not suitable when breeding or juvenile rabbits are present (e.g. if green feed is available)</li> <li>Needs large rabbit numbers for it to spread successfully</li> <li>Must be followed up with another control method to be effective</li> <li>Regulations about who can prepare and use RHDV baits differ between States. Check with local authorities.</li> </ul>
1080 baiting	<ul style="list-style-type: none"> <li>During the (dry) non-breeding season</li> <li>When there is little other feed available</li> </ul>	<ul style="list-style-type: none"> <li>Most cost-effective control method</li> <li>Large areas treated quickly</li> <li>Can be applied on-ground or from the air in some States. Check with local authorities.</li> <li>Native animals can have high tolerance to 1080</li> </ul>	<ul style="list-style-type: none"> <li>No effective antidote</li> <li>Humans, livestock, pets (cats / dogs), native animals can be at risk</li> <li>Restrictions on its use (e.g. cannot be used in built-up areas or close to dwellings)</li> <li>Approval process varies across states / territories</li> <li>Uneaten baits need to be buried</li> <li>Loses toxicity on exposure to rain. Dry weather required</li> <li>Needs to be followed up with other methods</li> </ul>

Technique	When to use	Benefits	Precautions
Pindone baiting	<ul style="list-style-type: none"> <li>• During the (dry) non-breeding season</li> <li>• Before seeding, planting or regeneration activities</li> <li>• When alternative feed is least available</li> </ul>	<ul style="list-style-type: none"> <li>• Moderate cost</li> <li>• Less hazardous to domestic animals because an antidote is available</li> </ul>	<ul style="list-style-type: none"> <li>• Must not be used in presence of some native animals (toxic to kangaroos, birds of prey and bandicoots)</li> <li>• Only useful in built-up areas close to dwellings</li> <li>• Relatively expensive and less humane compared to 1080</li> </ul>
Warren ripping	<ul style="list-style-type: none"> <li>• When dry for sandy soils</li> <li>• When moist for clay soils</li> <li>• Before planting or seeding</li> <li>• After initial reduction from poisoning or disease</li> <li>• After breeding when young are dispersed (Sep/Oct)</li> </ul>	<ul style="list-style-type: none"> <li>• Cost effective and long-lasting control</li> <li>• Can be carried out by a contractor</li> <li>• Minimal ongoing control required after ripping</li> </ul>	<ul style="list-style-type: none"> <li>• Appropriate equipment is needed; usually heavy machinery with multiple ripping tynes and appropriate track type for terrain</li> <li>• Skilled operator required</li> <li>• Labour intensive; need to map warrens before ripping</li> <li>• High initial cost</li> <li>• Need care to not damage sensitive areas or promote erosion</li> </ul>

Technique	When to use	Benefits	Precautions
Warren blasting (explosives)	<ul style="list-style-type: none"> <li>Better in moist, heavier soils</li> </ul>	<ul style="list-style-type: none"> <li>Long-term control</li> <li>Can destroy deep warrens effectively</li> <li>Useful for warrens among rocks and boulders or hard to access areas</li> </ul>	<ul style="list-style-type: none"> <li>Operators must be trained and licenced</li> <li>Relatively expensive, compared to ripping</li> <li>Labour intensive</li> </ul>
Harbour destruction or removal	<ul style="list-style-type: none"> <li>Year round, subject to seasonal conditions.</li> </ul>	<ul style="list-style-type: none"> <li>Best used where it will be supported by other control methods</li> </ul>	<ul style="list-style-type: none"> <li>Labour intensive</li> <li>May not be practical or feasible to remove harbour</li> </ul>
Fumigation: Pressure (gasses pumped into the warren) or Diffusion (gases generated and diffuse in the warren)	<ul style="list-style-type: none"> <li>During breeding season</li> <li>After poisoning or warren ripping</li> <li>When the soil is damp</li> </ul>	<ul style="list-style-type: none"> <li>Good option in sensitive areas</li> <li>Can be carried out by a contractor</li> <li>Useful in areas where ripping is not practical</li> <li>Can be used near urban areas</li> <li>Relatively target specific</li> <li>Dogs have been used to drive rabbits into their warrens</li> <li>Most effective as a follow-up technique</li> </ul>	<ul style="list-style-type: none"> <li>Skilled operator required; e.g. current chemical handling certificate</li> <li>Must strictly follow poison label and take safety precautions; e.g. do not touch tablets with bare hands, avoid breathing the fumes, work upwind of gas</li> <li>Labour intensive</li> <li>Expensive</li> <li>Only small areas treated at a time</li> <li>Some animal welfare concerns</li> <li>Does not stop remaining rabbits reopening warrens</li> </ul>

Technique	When to use	Benefits	Precautions
Shooting	<ul style="list-style-type: none"> <li>Best used as a mop-up technique</li> </ul>	<ul style="list-style-type: none"> <li>Humane and target specific</li> </ul>	<ul style="list-style-type: none"> <li>Can only be used over limited areas</li> <li>Does not give long term control</li> </ul>
Trapping	<ul style="list-style-type: none"> <li>Best used when feed is scarce, or where bait will be more desirable than available food</li> </ul>	<ul style="list-style-type: none"> <li>Can be used as a mop-up technique</li> <li>Non-target animals can be released</li> <li>Can be effective in small, targeted areas where other techniques are not practical or permitted; e.g. vegie patches or ornamental gardens</li> </ul>	<ul style="list-style-type: none"> <li>Skill required in trapping and euthanasia</li> <li>Risk of catching non-target animals</li> <li>Not cost-effective for big areas</li> <li>Not effective for reducing large rabbit numbers</li> <li>Must meet animal welfare regulations and standards. Check local regulations.</li> </ul>
Exclusion fencing	<ul style="list-style-type: none"> <li>Effective year-round</li> </ul>	<ul style="list-style-type: none"> <li>Can be justified to protect highly valued assets</li> </ul>	<ul style="list-style-type: none"> <li>High initial costs</li> <li>Requires ongoing monitoring and upkeep</li> <li>Offers protection only, not control</li> </ul>



## Case Study: The benefits of warren destruction.

Several studies have shown that significant reductions in rabbit numbers have persisted for over ten years after warrens were destroyed. Anecdotally, many landholders report the benefits persist for three or more decades.

Warren destruction removes shelter, denies rabbits access to safe breeding sites, and makes rabbit re-establishment much less likely. It has been shown to have an annual benefit/cost ratio in excess of 10:1.

'Well-implemented, coordinated rabbit control programmes based on warren ripping will consistently result in large and sustained reductions of rabbit numbers,' (McPhee and Butler 2010).

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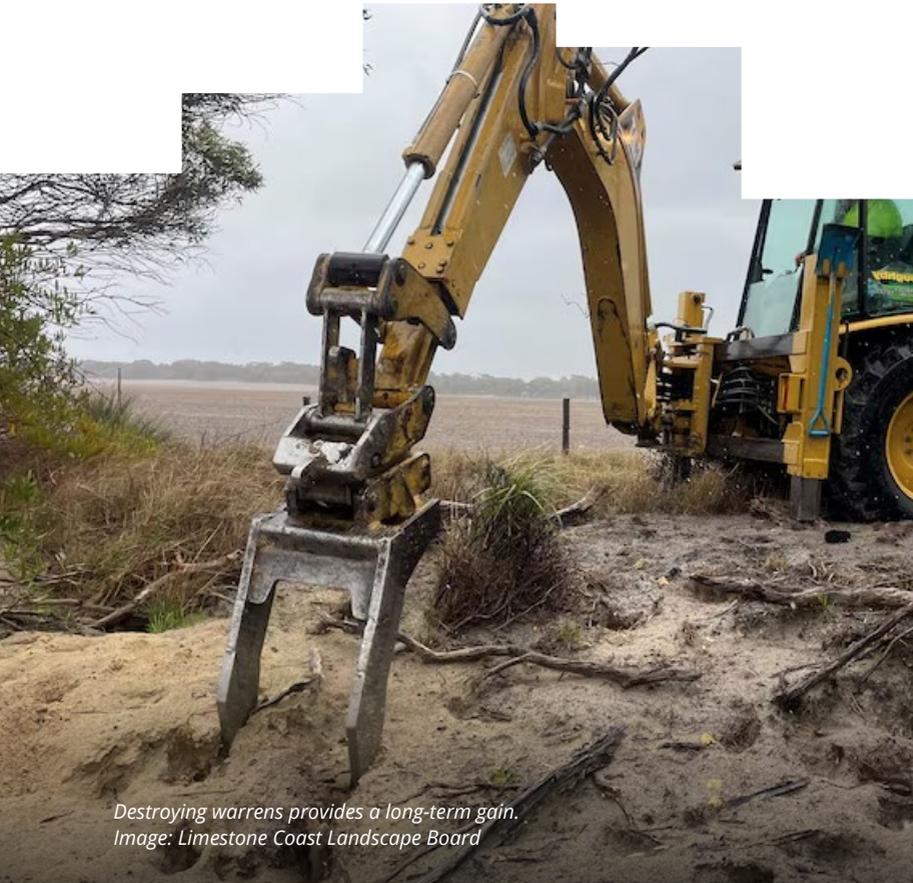
## Monitor and respond

**Continually monitor for response-triggering feedback and to track overall effectiveness.**

**Q15.** What will you measure to know your plan is working and achieves the desired outcome, and how and when will you collect and store information?

**TIP:** Rabbit Scan can be used to map where control is undertaken and any sightings of rabbits after control has been done.

Actively monitoring the effectiveness of your efforts provides information so changes can be made if needed, in the short and long term. It highlights any parts that didn't work and need to be redone or re-imagined. A bottom-line is monitoring rabbit distribution and abundance, but measures like the number of warrens treated and any that were re-opened or monitoring and mapping the uptake of baits, can also be very useful.



*Destroying warrens provides a long-term gain.  
Image: Limestone Coast Landscape Board*

# IMPROVE



## Evaluate the plan

**Determine what worked, what didn't, and why.**

**Q16.** Which aspects of the plan were successful and which weren't?

**Q17.** For aspects that weren't as successful as hoped, was it because of problems with implementation or because the expected outcomes didn't occur?

Reflect on the effectiveness of the plan and lessons learnt with reference to pre-control, in-program, and post-program monitoring data, along with anecdotal and other evidence. It should include information on the harm and rabbit population that triggered the control program, activities and funds expended, and any residual capacity of rabbits to cause harm – such as rabbit population density (rabbits/ha) or the proportion or number of rabbits and warrens remaining.

**TIP:** Always have a plan but also be prepared to change it in light of experience gained, or changed circumstances.

Consider if your goals were met, if the program went to plan, and if there are opportunities for improvement.

Every person who was involved in a rabbit control program may have valuable insights on the effectiveness of their components or ways to improve it. Consult as widely as possible to cover all angles, as well as drawing on monitoring data and records.

## Revise the plan

**Modify the plan as required and recommit to the next phase.**

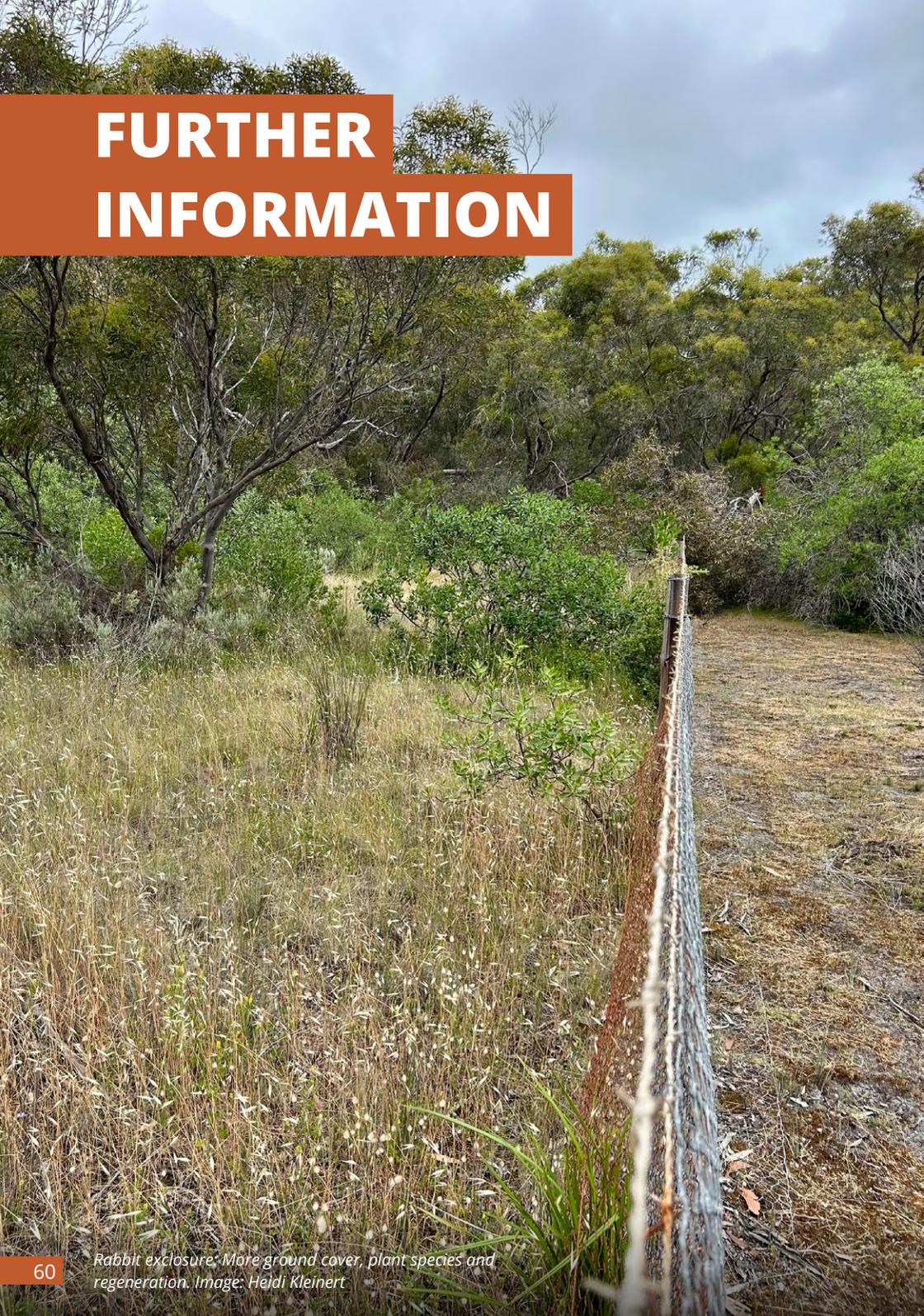
**Q18.** What changes are needed for the plan to be more effective and efficient?

**Q19.** How will you acknowledge and celebrate success?

Use what you've learnt from the review to address any problems and, if appropriate, change the focus for the future. Most importantly, celebrate success with those who contributed to it. Take a moment to reflect on what has been achieved and the improvement you have made for the environment, production or community wellbeing.

A revised plan will address issues identified from review and respond to changed circumstances. If rabbit distribution and density have changed as hoped, then the next phase of management may require quite a different approach. The emphasis may shift from 'knockdown' or 'knock-out' activities to surveillance and mopping up.

# FURTHER INFORMATION



## PestSmart

The PestSmart website ([pestsmart.org.au](http://pestsmart.org.au)) has many resources to help you manage rabbits, and is updated as new information and innovations become available. For further information on rabbit control resources, information and references visit [pestsmart.org.au/toolkits/European-rabbits](http://pestsmart.org.au/toolkits/European-rabbits)

### Control techniques: Online resources

Standard Operating Procedures provide advice on 'best practice' and are available on PestSmart:

- Bait delivery of RHDV1-K5
- Ground baiting with 1080
- Ground baiting with pindone
- Warren destruction by ripping
- Warren destruction by explosives
- Diffusion fumigation of warrens
- Ground shooting
- Trapping using padded-jaw traps
- Trapping using cage traps

**TIP:** Have you found a dead rabbit? Visit [RabbitScan](http://RabbitScan) to report and submit a sample.

## RabbitScan

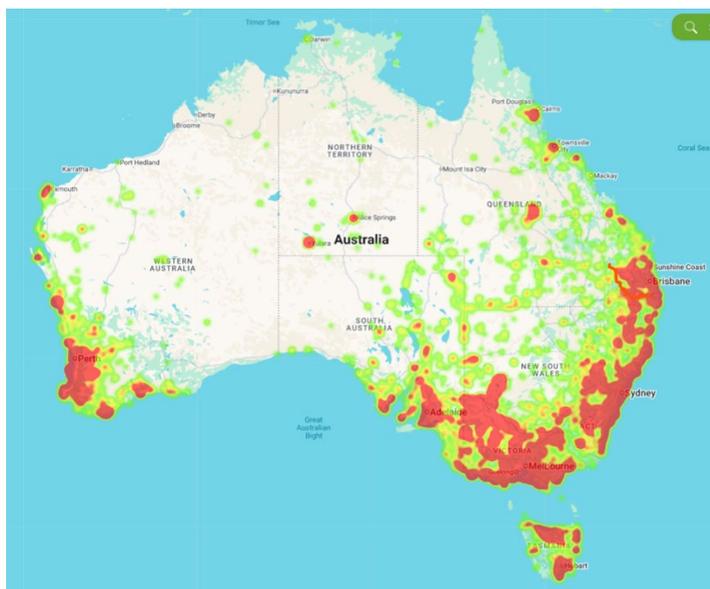
RabbitScan is a website and a mobile app. It provides free mapping, record-keeping and monitoring tools: online at [www.feralscan.org.au/rabbitscan](http://www.feralscan.org.au/rabbitscan). Download the FeralScan app from your favourite Appstore. It is a secure, discreet resource for landholders, community groups and pest controllers.

You can use RabbitScan to:

- map rabbit sightings and warrens
- report problems or damage caused by rabbits, such as soil erosion
- document your management actions, such as warren ripping
- record rabbit disease outbreaks, such as RHDV, and see other reports from your area.



Image: David Kleinert



*RabbitScan will help you plan your rabbit management and map local rabbit distribution. Image: Peter West, DPIRD*

Using RabbitScan to record new (and historical) observations of rabbits in your local area will help build a detailed picture of rabbit populations. Your data can help you collaborate and plan, evaluate the success of your efforts, or showcase how big the issue is to leverage action or investment.

You can keep your data private or share it with others (e.g. neighbours, work colleagues, Landcare groups or local councils). Government agencies and biosecurity authorities may use rabbit data to help guide future pest management programs.

How to get started:

1. Learn about RabbitScan at [www.feralscan.org.au/rabbitscan](http://www.feralscan.org.au/rabbitscan).
2. Register your name or just use your email address.
3. Record where you see wild rabbits, warrens or damage, or conduct management.
4. Submit your record and view it on the secure website.
5. If you wish, you can share your reports with others via a private group.

If you need help using RabbitScan, visit [www.feralscan.org.au/rabbitscan](http://www.feralscan.org.au/rabbitscan)



Bait layers are used to treat large areas efficiently. Image: Bruce Munday

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