7 The management plan: objectives and options

Developing a management plan

Once the pest management problem has been identified and the social, economic and environmental boundaries determined (see Chapter 6, pages 81–93), the next step is to plan how best to address the problem. For larger scale problems, this should be a joint exercise with key interest groups and is best based on cooperative action at the local or regional level. Developing the pest management plan involves several steps:

- setting clear objectives;
- identifying the appropriate management option or combination of options;
- selecting control techniques(s);
- establishing criteria to measure effectiveness of control and designing a monitoring program;
- deciding which regions form management units (see ‘Defining management units’, page 102); and
- bringing all the elements together to complete the management plan.

Once objectives are set, and the management option and the technique or combination of techniques (see Chapter 4, pages 56–73) has been selected, the manager in consultation with other key players can put the management plan together. This requires deciding when, where and how the management program will be conducted. However, the management plan is not complete without a monitoring and evaluation component (see the section on ‘Monitoring and evaluation’, pages 117–118), which establishes criteria to measure the effectiveness of control and sets out a monitoring program.

Setting objectives

Effective pest animal management should have clear objectives aimed at reducing pest animal damage to an acceptable level. Where practicable, the objectives should also be measurable and time-limited. The level of reduction sought will be determined mainly by the value of the resource affected by the pest, and the cost of pest control.

For a high value crop, such as a pine plantation, the objective may be to reduce losses caused by rabbits to less than 2 per cent of the total crop value within one year. Meeting this objective will be expensive but the value of the product may justify the high cost of control. An objective for a fox management program might...
be to improve lamb marking by 20 per cent after two years of fox control. For a nature reserve, the manager may aim to increase the population of rock-wallabies by 200 per cent after four years of fox control.

However, often the level of pest animal damage is not known or poorly known and land managers need to make some assumptions. They might assume that the level of damage is directly related to pest density, as is sometimes the case (see 'Does increased pest control result in reduced pest damage?', pages 54-55).

The objective of pest animal control can then be stated in the form of reduced density of the pest. An example for rabbit control to enable mulga regeneration in semi-arid areas may be the objective of a 90 per cent reduction, within one year, of rabbits seen on a spotlight transect. However, it is important to bear in mind that, unless the relationship between pest density and the level of damage is known, the objective of a reduction in numbers is only an indicator of the desired outcome—a reduction in rabbit damage. It is possible that even a 90 per cent reduction in rabbit numbers may fail to significantly reduce mulga losses.

Management options

There are three main options for pest control: eradication, short- or long-term management or no action. With the exception of islands or isolated populations of pests, complete eradication is rarely feasible or economically sensible. Usually land managers opt either for short-term control at a critical time such as lambing or for longer-term sustained pest control. The most appropriate option will depend on local circumstances, including the resource under threat, the nature of the land, available techniques, the attitude of neighbours and the availability of financial and other resources (also see: 'When is it worth managing a pest population?', page 97). To protect a valuable vegetable crop from rabbits, a farmer may choose intensive control using a combination of poisoning, Warren ripping and fumigation followed by the erection of a rabbit-proof fence to prevent reinvasion. By contrast, the manager of a pastoral lease in the far north-west of New South Wales may only be able to afford warren destruction on the most productive parts of the property and decide to leave rabbits uncontrolled in the harsher limestone outcrops.

More specifically, the options for addressing pest animal damage include the following:
- local eradication;
- strategic management: one-off management, sustained management, and targeted management;
- crisis management;
- commercial management; and
- no management.

When determining the appropriate management option or combination of options, the following factors need to be considered:
- the level of current and future resources available for pest control;
- the reduction required in the pest population to achieve the desired reduction in damage; and
- the availability and practicality of control techniques.
AUSTRA LIA'S PEST ANIMALS

Depending on the dynamics of the situation and restrictions on the use of certain control techniques, a land manager may choose only one or a combination of techniques (see Chapter 4 pages 56-73). For example, because of the risk of killing domestic pets, 1080 poisoning of rabbits is rarely possible near towns and an alternative poison such as pindone, that has an antidote, may need to be used in locations where pets are at risk.

Each situation needs to be assessed individually and the appropriate management option or combination of options identified. Too often, costly but inappropriate strategies are adopted in managing pest animal damage to production and wildlife conservation values.

To help managers decide how to allocate scarce resources, the Department of Conservation in New Zealand uses a process which ranks areas according to their priority for pest management (see Appendix 1). The process may seem complex but is basically simple with a finite level of resources allocated to pest management, how is it best spent on a farm or nature reserve? In essence, it is a mapping exercise (also see “Where is the problem?” pages 89-90) that considers the following:

1. Is it only the best country that matters or does the treated area?
2. Will I get better returns by putting more funds into water distribution and better rams?
3. Will I poison every second year and put more money into weed control will it get a better return than from widespread water ripping?

A farmer has many options to weigh up before deciding which, if any, pest management option is best under the circumstances.
When is it worth managing a pest population?

The aim of economic pest management is to reduce the pest population to a level below which further reductions give no additional cost-effective benefit, that is, below which any extra benefits do not exceed the extra costs of control. This is often called the economic injury level (EIL). The costs are the cost of the initial reduction to the required population density and the cost of maintaining that density. The costs of short-term, targeted management, such as baiting of foxes just before lambing, are likely to differ from those for sustained management, to put to any extent beasting population from foxes. The relationship between pest numbers and pest damage is also important (see "Does increased pest control result in reduced pest damage?" pages 54-55): these may need to be a greater reduction in a fox population to conserve beasting than to protect lambs. Thus, for the same pest, in this case the fox, the EIL may differ according to the resource being damaged and the management strategy adopted.

The cost of the same management strategy may also vary according to conditions. For example, management may be less costly and more effective when applied in drouths compared to good seasons and when disease or predation is having an impact on the pest population compared with when the population is unaffected by these.

The Figure illustrates the concept of EIL for a hypothetical pest. The EIL is greater than zero density (eradication) and because the pest animal population often exceeds this level it is regarded as a pest. In theory, any attempt at eradication or control when the pest density is lower than the EIL generally will not be profitable.

However, although it is a useful way to view pest problems, the EIL concept has several shortcomings. In particular, if the population is to be kept below the EIL, then action must be taken at some lower pest density because the time for control actions to have an effect. At this lower level—the pest density at which action should be taken to avoid an impending pest problem by preventing the population from exceeding its EIL—that is often most important for practical pest management.

![Graph showing population fluctuations and EIL](image)

The population fluctuations of a hypothetical pest animal over time (data from Bogg et al.). Abundance increases rapidly when the population size is small and reaches an equilibrium abundance set by the pest's interactions with its food, predators, and so forth. The population then fluctuates about this equilibrium. Intuitively, it makes economic sense to manage the pest when its abundance exceeds the economic injury level (EIL), below which further reductions in the pest population give no additional benefit. However, due to rapid fluctuations in the population size of many pests and delays in the effects of control, management may need to start before the population reaches the EIL.
Local eradication

Complete and permanent removal of a pest from a region is rarely possible except on a local scale, and usually at high cost (see 'Eradication is rarely possible', pages 104–107). Nevertheless, it has been used successfully in Australia to eradicate rabbits and goats from several small offshore islands. On Townsend Island, Queensland, a small herd of milking goats left behind when the sole grazier moved from the island grew to about 2000 in number and was having a large impact on the native vegetation. In 1993, 16 Dingoes were introduced and within 15 months they had reduced the goat population to 200 and the vegetation had begun to recover. After 21 months, 21 goats remained. Six months later only four survived on a rugged part of the island and these were shot. The Dingoes were then removed.

Before attempting local eradication of a pest, managers should critically assess whether the criteria for eradication can be met (see 'Criteria for local eradication', pages 104–106). For mainland Australia, local eradication is likely to be successful only where there is a permanent barrier to recolonisation, such as a wide band of unsuitable habitat between the potential invaders and the treated area, or a fence.

The Western Australian Government, for example, has successfully eradicated Starlings from the State. Pockets of Starlings were shot and trapped, and a team established to regularly patrol coves and other potential roosts sites on the Nullarbor Plain, thereby maintaining an effective barrier to potential immigrants from eastern Australia.

Strategic management

When local eradication is not practicable, strategic management is the most popular option. There are three possible forms: one-off management; targeted management; and sustained management.

One-off management

Long-term or permanent reduction in the damage caused by some pests may be possible with one action or set of actions, such as some biological control, erecting appropriate fencing, or modifying habitat so that it is less suitable for pests. For example, in some areas it appears that the release of myxomatosis severely reduced rabbit numbers and the habitat subsequently became much less suitable for rabbits, limiting reinvasion. Three 160 square kilometre properties in the eastern Riverina district of New South Wales were surveyed for rabbits before the release of myxomatosis in 1950–51 and after release in 1975. Despite little other control the estimates of rabbit infestation on the three sites dropped from 38, 26 and 52 per cent to 0, 26, 0, 04 and 13 per cent, respectively. Habitat changes between the early and later surveys included collapse of established warrens and taller vegetation that no longer provided suitable food and blocked vigilance for approaching predators.
THE MANAGEMENT PLAN: OBJECTIVES AND OPTIONS

Sustained management

Ideally, sustained management is when pest animal density is reduced and then maintained at, or near, a threshold density at which there is no increase in benefit (damage reduction) from additional control. This option usually involves two steps: an initial knockdown aimed at removing a high proportion of the population, followed by periodic maintenance control to slow or prevent recovery. The threshold density for a pest is likely to vary according to many factors including the relationship between pest damage and density, the region, climate and land use (also see "Does increased pest control result in reduced pest damage?", pages 54-55 and "When is it worth managing a pest population?", page 97). It is therefore complex and often difficult to implement, not least because the relationship between pest animal density and the level of damage is rarely known.

Alternatively, a manager may choose an arbitrary level of pest damage or pest density that they find acceptable and manage the pest to maintain damage or density at, or below, that level.

Maintenance is an important element of sustained control. For example, between 1959 and 1969, 8892 goats were shot in Mount Pirongia Forest Park, New Zealand, to protect native plants, at a cost of $500,000. Most of this was wasted as goats were not held at a sufficiently low level, long enough to allow regeneration of the native plants and animals being damaged.

How often maintenance control is needed depends on how quickly the pests recover and cause unacceptable damage. A variation of sustained control, intermittent control, is used periodically to reduce a pest population to low levels to enable other factors to come into play. For example, it has been suggested that some animal species may be kept at low numbers by a predator; in what is known as a 'predator pit'. It may be possible to control rabbits or feral pigs by reducing their density to a level where their primary predators, foxes and wild dogs respectively, could slow or prevent their return to former densities.

This approach can also be considered in the reverse to protect native animals. In the case of Numbat threatened by fox predation, if the fox population is reduced for a sufficient period, Numbat may be able to build up their numbers to such an extent that they can withstand further predation. This may reduce the need for more fox control, unless the population of Numbat again drops to low levels due to chance factors such as large-scale fires.

Targeted management

Targeted management is where action is directed at the individuals or group of individuals that cause the majority of the damage, or applied at that time when damage is most critical. For example, in the sheep country of Western Australia, it appears that most sheep kills are caused by younger, dispersing feral dogs. It is also believed that the older, more wily foxes are the primary predators of Malleefowl chicks near nest mounds. Control targeted at those problem animals may be more effective than aiming to reduce the overall density of the pest population.

However, a targeted approach is not always practicable. Usually it requires a good understanding of the behaviour and biology of the pest to determine which individuals are the key animals to target. In addition, it is often the problem animals that are more experienced and avoid conventional control techniques.
Hypothetical model of an Australian rabbit population and suggested application of control techniques for sustained management beginning at seven years (after Williams et al. 1993). Initially, when rabbit numbers are low during drought, quarries are reaped, followed by further quarries destruction as food sources become available. Then, after good rains in year 10, myxomatosis is introduced. As this is a costly management strategy it would be appropriate only for highly productive country.

A variation of targeted management is to conduct control only at critical times, such as baying (poisoning) foxes just before lambing. Similarly, some pests such as House Mice cause little damage until seasonal conditions become favourable and they build up to plague levels. Models can now help to predict when a plague is likely and assist farmers to target mouse control just prior to the major population build-up.

**Crisis management**

All too often farmers and reserve managers undertake pest control only when the pest animals or their damage become too obvious to ignore; this is crisis management. There is no clear objective for the control other than to kill pests and control efforts are largely wasted because the damage has already been done. Crisis management is not a desirable management strategy. The poisoning of mice at the height of an outbreak, when the mice are at high density, have spread widely and caused massive damage, is an example of crisis management.

**Commercial management**

Many pests are harvested either by recreational hunters or for commercial gain and it is argued that they should be seen as a resource as well as a pest. Commercial pest harvesting industries in Australia are estimated to earn in excess of $100 million a year, mostly from export products, and are growing rapidly. The value of commercial harvesting of pest animals as a means to control pest damage has been questioned. Commercial use is likely to play little or no role in the management of some species such as rabbits and wild dogs. However, it has potential for other species such as feral horses, goats and pigs. For example, harvesting in the form of mustering and selling the animals is a component of
some control programs for feral goats and horses and any profit can be used to offset the cost of follow-up control. Nevertheless, commercial harvesting is rarely built into pest management plans. Indeed commercial harvesting is quite often carried out independently of other control action, as is the case for most feral pig harvesting in Queensland and New South Wales. The effectiveness of this type of control in reducing pest impact has rarely been determined, and should be assessed for more situations. (1)

Commercial harvesting as it is currently practiced is usually concentrated relatively close to processing plants in areas where the pest is abundant, and these may not be the areas where control is most needed. Nevertheless, there are advances which may make the commercial harvesting of species such as feral goats and other large feral animals more effective as a management option. These include the development of larger and more reliable overseas and domestic product markets which add stability to the industry, and large portable chillers which enable harvesters to work in more remote areas. (2)

No management

Many pest animals, including feral cats, foxes, camels, starlings and feral pigs, are not managed over much of their range, especially in conservation areas. This situation is likely to continue due to limited resources. A consequence is that in some areas certain land uses are not possible, such as wool production outside wild dog fences or re-establishment of small endangered native mammals.

Reserve managers may not have the resources to control pests over the whole reserve or they may not regard pests as a major problem. Nevertheless, when assessing the costs and benefits of pest control, they have a responsibility to consider the impact of pests dispersing onto neighbouring land. A compromise may be that pest management is carried out in the buffer zone where the reserve adjoins farming land.
Defining management units

Maps and a process of ranking according to pest management priority, such as that used by the Department of Conservation in New Zealand, can be used to identify practical units for pest animal management. In the past, a lot of pest animal management has been based on inappropriate management units. Too often, fox control was carried out on individual properties or nature reserves with little coordination between neighbours, and was of limited success due mainly to reinvasion by foxes.

Around Mildura, bird damage to sultana grapes is generally insignificant because they are grown over a vast area and ripe at the same time. By comparison, the scattered vineyards in the Barossa Valley, adjoining scrub or other timbered areas, suffer more damage. The greatest losses occur in the Riverland of South Australia, where vineyards, mixed orchards and horticultural areas border croplands, offering pest birds a year-round smorgasbord. Clearly, the scale of the management units will differ for each of the areas.

The size of the management unit can also be influenced by the time-frame over which control is required. For example, protecting a lambing paddock for one month just before and after lambing would be a much smaller operation than ensuring the survival of an endangered species that was under constant threat of predation in a large nature reserve. In the case of the reserve, it is likely that control of dispersing foxes in a buffer zone between the reserve and neighbouring farmland, as well as action in the reserve itself, would be necessary. This would require coordinated management involving several land managers and greatly increase the size of the pest management unit.

Incomplete knowledge: dealing with risk

There is often little good information about the amount of damage pests cause and the likely benefits from a given level of pest control. As a result there is considerable risk involved in deciding the level of resources that should be allocated to pest control. Most land managers, but especially farmers, understand the concept of risk because it is a daily part of management; a farmer may weigh up the risks and benefits of planting canola instead of wheat or of delaying winter planting if the season is late. Comparing the risks and benefits of various levels of pest control against diverting the resources to other aspects of a farm operation is a similar assessment process.

The attitude of the land manager to risk will affect how they are likely to approach pest control. If farmers are risk-averse, they are likely to choose a pest management option that offers them the least losses due to pest animals even in the worst situation, or, alternatively, by deciding not to spend money on control until the problem becomes very obvious (crisis management). By choosing a safe option they usually reduce their chances of achieving a much more economical and beneficial outcome.

A conservation example of the impact of risk on pest management is the control of fox predation on native animals. Studies in Western Australia have shown that intensive fox control over large areas often allows an increase in threatened native
mammals such as Numhats and Brush-tail Bettongs. Intensive fox control is expensive, but it may be possible to lower costs by reducing the frequency of fox baiting when the native animal population reaches a higher level. The theory is that a larger Numbat or Bettong population will produce more young and be able to withstand an increased level of fox predation. A risk-averse reserve manager would not risk any increased losses of Numhats and Bettongs and would continue intensive fox control.

However, the potential benefits from choosing the more risky option of reducing the frequency of fox baiting is that resources saved on fox control in one area could be directed to controlling foxes or other pests in other reserves. The possible losses from adopting the more risky approach can be reduced by appropriate monitoring of changes in the Bettong and Numbat populations in response to the changed frequency of fox baiting. If the decline is too great, fox baiting can be increased again.

Management options for feral pig impact on lamb production: considering risk

Feral pig predation can cause an economically significant loss of winter lambs in western New South Wales. To reduce lamb predation, several possible actions are available, either alone or in combination, and each has economic costs and associated risks. A manager’s objective is to maximise benefit while taking appropriate account of associated risks. For pig control, some of the possible actions and associated risks a manager might consider are:

- **Action:** poison or trap pigs in late summer to early autumn to reduce winter density.
  
  **Risks:** pigs can be difficult to poison or trap outside winter, a few rogue boars that take the majority of lambs may not be removed. and motivation to act early, before the problem becomes evident, may be lacking.

- **Action:** coordinate lambing with neighbours to spread losses.
  
  **Risks:** neighbours may not cooperate because feral pig distribution is patchy, and chance weather fluctuations may devastate all district lamb production.

- **Action:** change lambing to spring when alternative foods are available to pigs.
  
  **Risks:** poorer lamb prices, and more lambs may die or be stunted because rainfall in spring is less reliable than in winter.

- **Action:** erect electric fence around lamb paddock to exclude pigs.
  
  **Risks:** a short-term break at a critical time could result in high loss of lambs, and the fence may not exclude rogue boars.

- **Action:** implement control only when damage occurs.
  
  **Risks:** losses may be unacceptable before action is taken and by then the range of control options is reduced.

- **Action:** no control.
  
  **Risks:** losses may be unacceptably high.

Managers must identify and evaluate potential actions or combinations of actions, and weigh the associated risks and benefits to determine which actions are most suitable. A decision matrix to determine if options are practicable, feasible and economically desirable can help.
Eradication is rarely possible

The hope behind most pest animal control campaigns has been eradication—the complete and permanent removal of a pest. Pests have been destroyed by shooting, poisoning or trapping, by fencing them in or out, or, in the case of rabbits, by encouraging the spread of disease, and cats and other predators such as mongoose. The methods were often applied with little concern about non-target effects. For example, chemicals such as carbon disulphide and yellow phosphorus were spread indiscriminately to control rabbits, but often killed many non-target native animals. They were also very dangerous to the user.

Eradication is appealing because it requires no understanding of the relationship between pest density and the level of damage. Also there are no ongoing costs. The results of eradication are always assumed to be beneficial, but this is not necessarily so. Rabbits were eradicated from Bowen Island, a 100 hectare island in Jervis Bay, New South Wales, primarily to increase the amount of nesting burrow habitat available to Little Penguins and nesting shearwaters. After rabbit removal, kikuyu grass, an introduced weed formerly grazed by rabbits, spread and prevented some penguins from reaching their burrows and feeding their chicks. Expensive kikuyu control had to be conducted to correct the imbalance.

It is sobering to note that, despite years of effort no widely established, common pest animal has been eradicated from Australia. Given that most established pests are widespread and common, and that there are relatively few techniques to control them, usually the best management goal is to reduce the level of damage to an acceptable level rather than to attempt eradication. Killing more pests than is needed to achieve this goal is expensive and wasteful when budgets are limited.

Criteria for local eradication

Eradication of established pest animals is possible only on a local scale. To determine whether eradication is likely to be successful, six criteria can be applied: three essential for the achievement of eradication and three to indicate whether eradication is preferable to ongoing control.

Essential
Peats can be killed at a faster rate than they can replace themselves. This seems obvious but it is difficult to achieve in practice. There are two main reasons. First, many pest populations have a high natural rate of increase. Second, as the density of a pest declines, it takes progressively more time and more expense to locate and remove the last few animals.

The cost per goat killed at different densities of feral goats in the Kincaid Range, New Zealand (after Purvis). At low goat densities calling a goat is much more costly than at high densities.
Immigration can be prevented.

If animals can recolonise an area from nearby populations or by escape from captive populations such as domestic herds of goats and pigs, elimination of the pest will at best be temporary. This criterion can be met for islands, but is often difficult to achieve on the mainland.

Immigration to a local area may be prevented where fencing and control at ongoing cost, creates a perfect barrier. An example is the successful campaign to prevent the Common Starling from crossing the Nullarbor Plain to south-western Australia. However, this does not come cheap. It costs the Western Australian Government about $350,000 each year to kill the 1000 or so starlings annually that attempt to migrate into the south-west. Given the damage Starlings could cause to crops and native species this is probably money well spent.

All reproductive individuals are at risk from the available techniques.

It is not necessary to remove all pest animals at the first attempt. However, all reproductive or potentially reproductive members of the pest population must be able to be taken by the techniques available. This is rarely possible in part because there is only a limited armament of techniques. If, for example, some animals become trap-shy or avoid poisoned baits then those animals cannot be removed and eradication will not be achieved. Trap-shyness, bait-avoidance and resistance to poisons, are common among pest animals.

Desirable

The pest can be maintained at very low densities.

If the animal cannot be detected at very low densities, then there is no way of knowing whether all animals have been eliminated. However, most population assessment techniques cannot detect animals at very low densities. The difficulty in meeting this criterion is illustrated by the attempts to remove rabbits from Phillip Island; a small population of rabbits was found on the island two years after it was thought that all of them had been removed (see ‘Eradication of rabbits on Phillip Island’, page 100).

The socio-political environment supports eradication.

Even when all the technical problems can be met, social and political factors may prevent successful eradication. Community attitudes may oppose killing large numbers of animals on moral, emotional or cultural grounds (refer to Chapter 1, pages 18–27). Also, eradication is expensive. Political factors may withdraw funds from the program before eradication is achieved.

The high costs of eradication can be justified.

It is appealing to think that the value of perpetual freedom from a pest is very high, but this may not be so. Future benefits such as those obtained from eradicating pests have a lower economic value than benefits that are available immediately. This is because the value of future benefits is discounted. Calculating discount rates involves the reverse of the equation to calculate interest rates on invested money. Using a hypothetical model of the costs and benefits of eradication it was shown that when the discount rate was set at 10%, eradication became cost effective after 28 years. Setting a very low discount rate of 3.5 per cent made
eradication cost effective after 47 years, but, at 10 per cent, eradication never became cost-effective.

The practice of discounting the value of future benefits assumes that land managers act in an economically rational manner. However, pests seem to evoke strong emotional responses to the extent that management aims and expenditure are often far from rational. The resource being protected also has to have a monetary value allocated to it in order to determine whether eradication is economic. Yet the monetary value of conservation and biodiversity is difficult to assess. There are methods to do so, such as contingent valuation, but their usefulness is debatable.

Eradication of rabbits on Phillip Island

The combined impact of rabbits, goats, and pigs caused almost complete elimination of the vegetation on Phillip Island in the tiny Norfolk Island Group, an Australian territory in the south-west Pacific. During the 1800s, the islands' dense forest was logged for timber and the animals were introduced as food for the convicts and sport for the officers of the penal settlement on Norfolk Island. At their peak, the pigs alone were said to number 4000-5000 on the 190 hectare island.104 By 1912, when the pigs had gone and only the rabbit survived in numbers, they had created a bizarrely beautiful, barren landscape.

The original vegetation and fauna was poorly documented, so the full extent of the loss will never be known. At least one plant species, the 'lily', has been lost from the island and only single specimens remain of several others.105 Since settlement, two of the island group's 14 endemic land birds have become rare and one has not been seen for several years despite considerable efforts to find it. Six bird species have become extinct and of these, a parrot, the Norfolk Island Kaka, was last seen on Phillip Island in 1931. Convicts and settlers probably hunted the parrot and a pigeon to extinction, but habitat destruction through clearing and the impacts of introduced animals may have contributed to their demise and that of the other species.106

The island has significant natural values and in the 1980s it was considered economically, socially and politically desirable to eradicate the rabbits. A rabbit flea carrying a virulent strain of myxomatosis was released and reduced the population for a time; when numbers began to build up again, poisoned baits were laid, and the remainder of the rabbits were shot. Rabbits even lived on ledges on sea cliffs on the rugged island, thus it was not surprising that the 'last rabbit' was eliminated twice—once in 1986 and again in 1988. The effort required to remove the rabbits from this 190 hectare island was high: in human resources alone it took the equivalent of seven people each working for 100 days.

During the century when pest animals were present, it is estimated that over 4 metres of soil was eroded from the island. Nevertheless, since rabbits were eliminated, re-vegetation has begun, mainly in the gullies and crevices where soil remains. The Phillip Island Hibiscus, formerly on the brink of extinction,107 has started to re-establish itself and another plant, the Norfolk Island Abutilon, not seen since 1912, has also re-colonised several patches on the island.108
Even on small islands such as Phillip Island, stripped to a dramatic moonscape by goats, pigs and rabbits released for food and sport, eradication of pests can be a major task.

Source: Dennis Chater