

THE WAR ON PESTS:

Dealing to key pest plants
and animals that threaten
native species

A landowners guide for Banks
Peninsula and Kaitorete Spit

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Editor's note

This document has had a long and winding journey. The ultimate goal was to provide a tool in the battle to protect and restore native plants and animals on Banks Peninsula. Invasive introduced pests are the single biggest threat to our native heritage, and without intervention many vulnerable species of plants, insects, lizards, and birds will simply continue to disappear.

However, pest control is complex. To be effective it requires careful planning, coordination, vision and endurance. The active support and involvement of private landowners, in partnership with local agencies is essential. Pest species don't respect property boundaries and the vast majority of Banks Peninsula is private land.

The vision for this document is to assist in coordination of effort; save landowners' time by providing user-friendly information; inspire and encourage those involved in pest control as they learned about some of the work currently underway; and facilitate more strategic and collaborative approaches to pest management.

Pest management has been approached from two angles – species led and site led. In the former, a species is targeted because it may be able to be eradicated (e.g. feral goats), or is so damaging it is worth removing any time it is encountered (e.g. old man's beard clematis). In the latter, a decision is made to protect a valuable site or particular species, such as a penguin colony or montane rock outcrop, and a strategic pest control approach developed.

To facilitate collaboration, there is a section on 'who is doing what where'. As anyone who has attempted to collect this sort of information soon realises, it is more difficult than it sounds, and maps are soon obsolete as activities have grown and changed. Apologies to the many groups and individuals that we doubtless missed, or whose information is now out of date.

An attempt was made to map and describe some of the key areas worth protecting (e.g. penguin colonies, covenants, reserves), and to map the location of pest species. This has also proved more difficult in practice than theory. Hopefully in the future someone may take up this challenge. A map is worth a thousand words.

Acknowledgments

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1 Introduction

“Collectively invasive pests pose the single greatest threat to our remaining natural ecosystems and habitats and threatened native species” - New Zealand Biodiversity Strategy

“Invasive pests and weeds have become the greatest single threat to biodiversity on land, surpassing even habitat loss.” - New Zealand Conservation Board

Banks Peninsula is an ecologically rich area containing remnant original forest, regenerating native shrub and forest, tussocks, and productive farmland. Several native plant species reach their southern or northern limits here. In its mosaic of habitats live threatened plants and animals, as well as six endemic plants and at least 60 endemic invertebrates (i.e. found nowhere else in the world). Three of five lizards on the Peninsula are threatened¹, as are 41 species of plants². Twelve birds are locally extinct, but given the right conditions – including effective predator control – some (e.g., tui and the eastern buff weka) could return to the Peninsula. Private landowners have a key role to play in protecting native plants and animals as only 4% of the Peninsula is in formal reserves.



Photo 1 Jewelled gecko, Little River (Photo: Landcare Research)

Pest plants and animals are a critical threat to many native plants and animals on Banks Peninsula. Weeds and planting-eating animals like possum can alter or prevent regeneration. A few weed species and animals, such as feral goats, can overwhelm or destroy the understoreys in intact native forests. Animal predators such as possum, rats, mustelids (stoats, ferrets and weasels), and feral cats are critical threats to birds such as kereru and penguins, and the presence of such predators constrains our options to restore many of the ‘lost’ native animals that once lived on Banks Peninsula.

Government agencies, runaka of Ngai Tahu, community groups, conservation trusts, and individuals are currently active in the control of animal and plant pests on Banks Peninsula, either to protect native biodiversity values or to limit damage to production – or to achieve both. These efforts have largely developed in isolation from each other.

¹ Lettink & Whitaker 2004

² Wilson 2002

It is hoped that this guide will help assist with coordination of pest animal and weed control, build on past and current efforts, and increase awareness of the threats to native plants and animals on the Peninsula.

Broadly, pest control can be approached in two ways – ‘species led’ (e.g. eradicating all Darwin’s barberry from Banks Peninsula) or ‘site-led’ (e.g. at Hinewai Reserve controlling possums to low numbers and eliminating all old man’s beard clematis).

Pest control efforts also vary with the objectives. Therefore there are three ‘modules’ within this document: bush remnants, breeding penguin colonies, and rocky outcrops.

Only a few key references are given throughout the report. We have attempted to choose those that should be most readily available, rather than the primary scientific literature, and have listed these in a general bibliography at the end of the report. These can be obtained from John Parkes, Landcare Research.

1.1 Pest control – the principles

Pest management is not simple. So, a good pest manager needs:

- **A clear policy or goal.** For example: a sustainable population of penguins, a vegetation succession towards native tall forest, less than 10% predation on monitored kereru nests.
- **A strategy to achieve the goal.** This can be either to stop new pests and weeds establishing in the area, eradication, or sustained control (see below). The key purpose of a strategy is to identify how to intervene against the pests – which pests or weeds, where, how often, and how intensively – sufficient to achieve the goals set.
- **Tactics or means of control** (e.g. traps, toxins, shooting, biocontrol, spraying, hand weeding).
- **Logistics.** This includes prioritising actions where resources are limited, and determining if we need to achieve a certain goal (e.g. eradication of goats or control of ship rats and stoats), and the minimum budget per hectare required.
- **Coordination.** Develop a strategy for communicating and coordinating with adjacent landowners.

Border control

The best way to deal with pests and weeds is to make sure they do not establish. Everyone from government to individuals has a role to play. Individuals have an important role in border management at two levels. First, most new incursions into New Zealand are first reported by ordinary citizens who find something strange and hand it in to their regional council or to MAF. Second, people are also the main method by which new plants and animals arrive in an area, e.g. from escapes from gardens or by transport and liberation of animals – Himalayan thar (*Hemitragus jemlahicus*) and wallabies (probably *Macropus rufogriseus*) have been liberated (but subsequently destroyed) on the Peninsula in recent years.

Eradication

Three critical conditions must all be met before eradication is a serious option³: (1) immigration must be zero, (2) all the pests must be put at risk, and (3) they have to be killed or removed faster than they can replace their losses through breeding. These conditions might be met for some pests over the whole Peninsula (e.g. feral goats) or for some local populations where the pest or weed is distributed in patches (e.g. feral pigs or local weeds such as Chilean flame creeper (*Tropaeolum speciosum*) and Chilean potato vine (*Solanum crispum*). Experience suggests it is easier to eradicate pest animals than weeds, partly because plants often have seed banks and can disperse more easily.

³ Parkes 1993

Sustained control

Sustained control is a more complex strategy than eradication because it requires much more knowledge about the interaction between pests and their resources (the things we value) than is needed for eradication. This is because we have to know how few pests are few enough so that the conservation goal is achieved. If we do not kill enough pests, often enough, over a suitable area, the conservation goal may not be met. Conversely, if we overachieve and kill more than is needed, this can be expensive and wasteful.

2 The weedy invasion

Conservation weeds are those plants that seriously inhibit the maintenance or restoration of healthy native vegetation on land where such protection and regeneration are the desired goals.

A few facts about weeds nationally:

- There are now about the same number of introduced plant species growing wild in New Zealand as there are native plant species.
- Only 7 species of invasive weeds have been successfully eradicated from New Zealand.
- Weeds cost farmers, growers and foresters, tens of millions of dollars every year in herbicides and in lost production.
- Over 75% of the weeds of conservation were deliberately introduced to New Zealand as garden plants.
- There are over 24,700 introduced plants growing in gardens and nurseries in New Zealand; 10% of these will naturalise (establish in the wild), and 10% of these will become serious pests.
- Humans = weed problems. People bring in new plants that escape; rubbish is dumped in bush reserves; and the expansion of coastal subdivisions and lifestyle blocks exacerbates the spread of pests.
- If left uncontrolled, pest problems expand exponentially. It costs \$3 per hectare per year to control young wilding pines, compared to \$1500 for 25 year old trees.

Weeds are a key threat to 33 of the 37 threatened plant species on Banks Peninsula - three times more than any other single threat listed.

However, given half a chance, native plants are thoroughly competitive against most of the exotics. They've held their own pretty well against amazing odds. Out of some 300 exotic vascular species more or less fully wild on the Peninsula, relatively few seriously threaten the maintenance and regeneration of native vegetation. However, these few can be a serious threat if left unchecked.

2.1 Nipping weeds in the bud – prevention and early detection of weed establishment

The best way to manage weeds is to ensure they do not establish on the Peninsula. There are at least 70 New Zealand weeds not currently on the Peninsula, but many of these absentees would do well on Banks Peninsula such as heather, horsetails, and coltsfoot. Therefore it is important to avoid having these plants in gardens and to keep an eye out for any that jump the fence, and deal to them or report their presence (see details below).

The National Pest Plant Accord identifies pest plants that nursery and garden centres will not sell, and that regional councils and government agencies will remove at the owner's request from private gardens⁴.

Some weeds have established as small or scattered populations, but are still early in the invasion process. This is a critical window of opportunity to stop them or even eradicate them. For these species, sightings are very useful.

Please report sightings of the below invasive weed species if seen growing in the wild:

Vines: Chilean flame creeper (flame flower, flame nasturtium); climbing asparagus (asparagus fern); climbing spindleberry (oriental bittersweet, can also be a shrub); Madeira vine (mignonette vine); moth plant (kapok vine, cruel plant); smilax (bridal creeper); or bomerea.

Shrubs: wild thyme (thyme), Darwin's barberry

Wetlands, waterways, estuaries, damp areas: beggars' ticks, horsetail (only rough); purple loosestrife; phragmites (common reed), spartina (cord grass)

Fresh water: alligator weed; egeria; hornwort (coontail); parrot's feather (Brazilian milfoil, water milfoil); entire marshwort (marshwort, floating heart), lagarosiphon (oxygen weed)

Report any plants that seem out of place. Plants can be sent to Landcare Research or CCC for identification if in doubt.

Weed photos and identification:

- Weedbusters website⁵
- CCC internet weed guide⁶ and weed of the month⁷
- Weedbusters Plant Me Instead for Canterbury and Otago book⁸
- *An Illustrated Guide to Common Weeds of New Zealand* (1998) Bruce Roy *et al.* New Zealand Plant Protection Society.

Weed sightings or advice

- The Canterbury Potential Pest Plants list⁹
- For potential weeds email weeds@ccc.govt.nz with sightings
- For weeds on DOC land contact the Weed Surveillance Officer, Canterbury Conservancy, Department of Conservation, Christchurch. Phone 03 371 3719 (Email: apaltridge@doc.govt.nz).
- For other lands report weed sightings to Environment Canterbury, weeds@ecan.govt.nz or ring the Potential Pest Line (03) 363 9380.
- Or use the Weedbusters weed sighting form¹⁰

For more information:

- The Canterbury weed guide includes a very useful calendar for surveillance and control of weeds¹¹
- Weedbusters – for weed control information, activities, news, and resource centre

⁴ National Plant Pest Accord plant list <http://www.biosecurity.govt.nz/pests/surv-mgmt/mgmt/prog/nppa/list>

⁵ Weedbusters website www.weedbusters.org.nz

⁶ Weed pictures www.ccc.govt.nz/Parks/TheEnvironment/weedguide_pictures.asp

⁷ Weed of the month http://www.ccc.govt.nz/Parks/TheEnvironment/weedguide_weed_of_the_month.asp

⁸ Available from DOC and ECan

⁹ Potential pest plants list

<http://www.ecan.govt.nz/Our+Environment/Pest+Plants+and+Animals/Potential+Pest+List/1Pest+List.htm>

¹⁰ Weedbusters weed sightings form www.weedbusters.org.nz/weed_info/sighting.asp

¹¹ Weed calendar <http://www.ccc.govt.nz/Parks/TheEnvironment/weedguide.asp>

2.2 Dealing with the dirty dozen

Twelve weeds are serious enough to suggest that you eliminate them, if you can, from the land you look after. These 'dirty dozen' are outlined in detail in Appendix 1. There are also other species that may be a problem depending on circumstance (see Appendix 2).

Of the 'dirty dozen', four are common on Banks Peninsula. They are (in order of nastiness): old man's beard clematis, sycamore, yellow passionfruit, and grey willow. The other eight are much less common, but for that very reason some prompt action now might prove all the more productive; slow them down before they take off. These are: banana passionfruit, Japanese honeysuckle, wandering willie, smilax, yellow ginger, selaginella, Darwin's barberry, and khasia berry (*Cotoneaster simonsii*) (see Appendix 1 for details of each species).

How do these plants manage to be nasty? A few examples: old man's beard clematis, smilax, Japanese honeysuckle and the exotic passionfruit vines smother regenerating bush. Sycamore is a shade-tolerant, quite tall hardwood tree so it easily invades disturbed or regenerating bush, displacing native canopy trees; fortunately its winged seeds don't travel very far. Wandering willie (also known as tradescantia) and selaginella can smother shady forest floors, inhibiting native ferns and seedlings. Grey willow is an aggressive invader of native wetland vegetation which it overtops, shades and kills.

But beware the pitfalls. Don't mistake native clematis for old man's beard; they all look very similar in seed (see Appendix 1 for details). Rare native brooms can be mistaken for exotic yellow broom. An exotic fern (male fern), spreading insidiously across the Peninsula, could look very like the native gully fern to those who know a little but not enough.

Another warning: by their very nature weeds are adept at taking advantage of disturbance. Sometimes you can make things worse by attempting to destroy them and ending up making things better for the weeds. Sometimes, although it seems at first contrary to common sense, leaving things undisturbed means that eventually unwanted plants will be naturally out-competed. The motto is: know your weeds, their identity and behaviour, the likely outcomes of attempting control or patiently doing nothing.

2.3 MODULE 1: Protecting bush remnants

2.3.1 Threats to forest patches

Some weeds can invade intact native forests and either smother the trees (e.g., old man's beard) or smother the ground and prevent native seedlings from regenerating (e.g., tradescantia / wandering willie). However, most healthy forests on the Peninsula are quite resistant to invasion by major weeds, unless they are disturbed by browsing animals, wind-throw or fire.

Animal pests are a serious threat to biodiversity in the region. They impact vegetation, threatened plants, invertebrates, lizards, and birds. Some bird species have been reduced in range by animal pests as recently as this last decade. In bush remnants, removal priorities are: browsers/grazers (deer, goat, pig, livestock), possum, and finally rats.

Fire is the most catastrophic threat to these forests, particularly at drier sites or those surrounded by gorse. A fire in the Armstrong Reserve in 1984, for example, destroyed almost all the cedar saplings that were regenerating in the area.

2.3.2 Managing bush remnants

Step 1: Eradicate critical weeds (e.g. the 'dirty dozen')

Step 2: Remove browsers and gazers

- Eradicate wild animals such as goats, deer and pigs.
- Fence out domestic stock. A good fence allows understorey plants to regenerate in forest fragments. In Waikato, fencing increased the number of native plants and decreased the number of exotic plant species in kahikatea remnant forests.¹²

Step 3: Be aware of fire risks and minimise these where possible

Step 4: Control other pests and weeds

- Control possums and rats
- If resources allow, consider also controlling mustelids, cats, and mice

Step 5: Manage the edges and adjacent habitats

- Forest edges, which are 'artificial' when we have only remnant patches, are physically and biologically different from forest interiors. Trees on edges can die from the effects of wind and altered moisture regimes. In such cases restoration of transitional vegetation might be needed. Make sure to avoid species like sycamore and ash which can invade the forest.



Photo 2 Forest remnant where a stock fence has allowed development of 'edge' vegetation

Further reading

Bergin, D.O.; Pardy, G.; Beveridge, T. 1988. Planting to restore or extend native forest remnants. *New Zealand Tree Grower* 90(2): 44–47.

Janssen, H.J. 2004. Bush vitality. A visual assessment kit. Horizons Regional Council.

Smale, M.C.; Ross, C.W.; Arnold, G.C. 2005. Vegetation recovery in rural kahikatea (*Dacrycarpus dacrydioides*) forest fragments in the Waikato region, New Zealand, following retirement from grazing. *New Zealand Journal of Ecology* 29: 261-269.

¹² Smale *et al.*, 2005

2.4 MODULE 2: Rocky outcrops – hotspots of native biological diversity



Photo 3 Typical examples of rocky montane (above 550 m) outcrop habitats on Banks Peninsula (photos by S. Wiser).

Why are rocky outcrops important?

Basalt outcrops, a characteristic habitat on Banks Peninsula, have a suite of species that are adapted to this habitat and, in addition, often provided a refuge for these natives. Susan Wiser, Rowan Buxton and others have studied the flora on 39 of the higher-altitude (above 550 m) rocky outcrops scattered across the Peninsula, and recorded 352 vascular plant species of which 272 are native species. This represents more than one-third of the flora found on Banks Peninsula concentrated into less than 5% of its total area.

At least 33 of the 126 species botanist Hugh Wilson lists as rare on Banks Peninsula are present in this habitat type. The flora of rocky outcrops is more diverse than the surrounding habitat types (e.g. native forests, shrubland, tussock grassland, or improved pasture).

There is a high level of uniqueness of the flora (particularly for herb and fern species) on montane rocky outcrops with 63 plant species found only in this habitat type. An interesting community found on the scree or talus slopes under many rocky bluffs consists of a secondary forest of deciduous native trees – tree fuchsia (*Fuchsia excorticata*), ribbonwood (*Plagianthus divaricatus*), and kowhai (*Sophora microphylla*). New Zealand only has 10 species of native deciduous plants so a 'forest' of them is unusual.

Rocky outcrops also contain a high number of comparatively rare native species including six of the eight plant species found only on Banks Peninsula, as well as many species classified as rare or vulnerable, and generally restricted to this habitat.

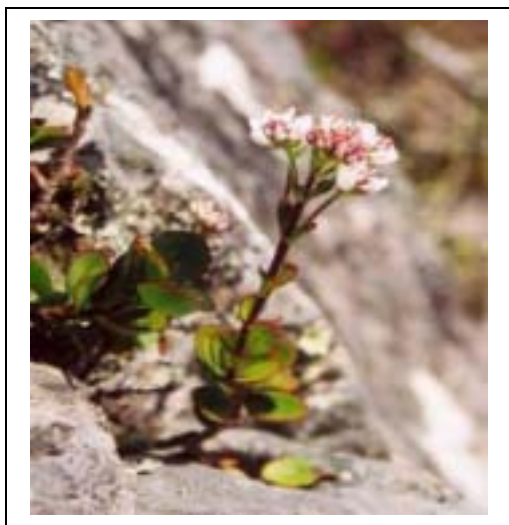


Photo 4 Banks Peninsula hebe (*Heliohebe lavaudiana*) (photo by R. Buxton)

Two threatened species, the Canterbury gecko (*Hoplodactylus* aff. *maculatus* 'Canterbury') and spotted skink (*Oligosoma lineocellatum*), are found in montane rocky outcrops. Although the other three lizard species present on Banks Peninsula may also occur occasionally in montane rocky outcrops, this is not their preferred habitat.

The Banks Peninsula tree weta (*Hemideina ricta*) has been found on montane rocky outcrops, including Stony Bay Peak, although it is likely that they only occupy refuges amongst rocks in situations where they face a shortage of refuges in trees or logs. Two lichen-feeding beetles which may occur only on Banks Peninsula (*Artystona wakefieldii* and *A. rugiceps*) are known from rocky outcrops.

2.4.1 Threats

Broad scale herbicide use: The use of herbicides to control weeds often results in the loss of native plants on rocky outcrops, especially when sprays are used.

Weeds: Certain weeds specialise in invading rocky habitats. For example, in the lower altitude rocky outcrops on the Port Hills, boneseed (*Chrysanthemoides monilifera*), boxthorn (*Lycium ferocissimum*), wallflower (*Cheiranthus cheiri*), spur valerian (*Centranthus ruber*), *Cotoneaster* spp., pig's ear (*Cotyledon orbiculata*), fennel (*Foeniculum vulgare*), miner's lettuce (*Claytonia perfoliata*), Californian poppy (*Eschscholzia californica*), and the ferns (*Polypodium vulgare*) and male fern (*Dryopteris filix-mas*) are of increasing concern and have the potential to spread to the rest of the Peninsula unless checked.

Some introduced grasses form thick swards that swamp small herbaceous native plants species such as the highly endangered and endemic Banks Peninsula forget-me-not.

Gorse, broom, and wilding pines (in that order) are the main woody weeds that can invade and 'overwhelm' montane rocky outcrops. However, this may be in areas that were historically covered in native forest. In this case, allowing the outcrop to regenerate to native forest may be an option for management.

Animals: Domestic stock usually access only the surrounding fringe of montane rocky outcrops, but in these areas and in the talus slopes under many bluffs, they can cause

significant damage. On the steeper slopes typical of most montane rocky outcrops, only animals that can climb moderately well present a threat. These include feral goats, possums, stoats, and ship rats and mice.

Fire: Habitat destruction by fire is a threat to some (but not all) rocky outcrops, particularly those surrounded by gorse or other woody weeds.

2.4.2 Recommended management

1. **Avoid herbicide use on rock outcrops** if at all practical, or use very carefully to avoid damage to native species.
2. **Set clear goals.** For example, maintain the status quo when the outcrop has an open habitat of native grasses, herbs and shrubs, OR encourage more native woody shrubs and trees when the outcrop or its surrounds is covered with woody weeds. The management options might depend both on the current state of the vegetation and that surrounding the rocky outcrop. Management of weeds and pests is not always predictable, so a monitoring process and adaptive management can be a wise course of action. It may be advisable to seek expert advice.
3. **Consider fencing to exclude domestic stock**, especially if there is a fringe of native vegetation or if you wish to create one and where grazing to control exotic grass is not essential. This may lessen the spread of some weed seeds from wool or dung. Report any feral goats to Dave Hunter on 03 325 1215 or cell phone 0274 374 4743.
4. **Pick a strategy for weed control.** This may not be easy; however a few options are outlined below. (See also Appendix 3 for principles of weed management.)
 - For outcrops that are dominated by native plants the careful control of key weeds may be advisable.
 - If the outcrop is dominated by native plants, but surrounded by gorse or broom, the simplest option may be to fence out stock and allow native vegetation to eventually regenerate and shade out the weeds.
 - Control of the suite of other weeds that invade rocky outcrops is something we will have to learn how to do better. Options range from hand weeding to attempts to manage the successional processes by encouraging native species that will out-compete them. CCC manages a number of rocky outcrops on the Port Hills, see section 4.2.3 for a list of the weed species they target.
5. **Consider covenanting these areas.** Assistance with fencing and advice may be available through the Banks Peninsula Conservation Trust or the QE II National Trust.
6. **Control key pests** such as possums, mustelids and rats (see Appendix 5).

The natural succession option

A strategy to replace gorse and broom with native vegetation
(see ECan leaflet E04/75)

Old stands of gorse or broom that have not been controlled for more than 10 years will suppress grasses, add nitrogen to the soil, and allow native woody plants to germinate. If left alone, the natives will supplant the weeds.

Conditions:

1. An exemption from the rules of the RPMS must be sought from ECan
2. Herbivores such as domestic stock, feral goats and other herbivores (possums, rabbits, hares) should be removed or controlled.
3. Biocontrol agents for gorse and broom may speed the succession to native plants.
4. Seed sources of native plants should be within 10 km of the site so that birds can transport them, or local planting may be required.
5. The best sites are wetter (1200 mm rain per year) and cooler (east, south or west facing) sites close to seed sources. (However, native plant regeneration has been successful in areas with 800 mm or less rain where local seed sources are available and stock has been excluded.)

Further reading

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3 Animal pests

Animal pests can be managed in various ways. Some can be eradicated or prevented, others require ongoing control.

3.1 Preventing potential pests

New mammal pests such as Bennett's wallabies or chamois are only likely to arrive on the Peninsula through illegal liberations. This may be difficult to prevent, so surveillance, reporting, and prompt eradication is essential. Similarly, invertebrate pests (particularly ants) are certain to arrive at Lyttelton on ships, or spread from the rest of New Zealand. Again, good surveillance and prompt action is the best response.

Domestic stock (sheep, cattle, llama/alpacas, horses, goats, and pigs) and pets (cats and dogs) may also affect biodiversity values when they are not properly restrained or managed.

3.2 The eradication option

Feral goats, red and fallow deer, and feral pigs can be eradicated from the Peninsula. Consensus by agencies and landowners is a prerequisite to eradication. Concerted action, as with the current feral goat eradication project, is required to achieve this goal.

3.3 The pests with backbones - vertebrate pests of native biodiversity

Of all the introduced species of animals in New Zealand, there are 15 mammals and 23 birds with wild populations on Banks Peninsula. In addition, there are two species of exotic frogs, and five species of exotic fish (Appendix 4).

Pest animals affect native biodiversity by competition, and directly by eating them. Which of these widespread animal pests is worst depends on what you are most interested in protecting, but overall possums and ship rats probably have the most effect on native biodiversity, followed by mustelids (ferrets, stoats and weasels) and cats. However, hedgehogs eat large numbers of native insects, so may have a larger impact than has often been appreciated.

A species by species account of vertebrate pests is contained in Appendix 5.

3.4 MODULE 3 – Pest control for penguins

Two species of penguin nest on Banks Peninsula: white-flipped penguin (*Eudyptula minor*) (listed as 'endangered' by the International Union for the Conservation of Nature) and hoiho or yellow-eyed penguin (*Megadyptes antipodes*) which is endemic to New Zealand and listed as a threatened species on the mainland of New Zealand¹³.

3.4.1 White-flipped and little blue penguin

White-flipped penguins were once much more common around the Peninsula, and as recently as the 1950s, they were still nesting on most headlands, and around the foreshore of Akaroa Harbour. White-flipped penguin numbers have been declining, with colonies disappearing very suddenly. In surveys of four colonies with more than 50 nests between 1981 and 2000, one disappeared and the nests in the others declined by over 70%.¹⁴



Photo 5 White-flipped penguin (photo F. Schmechel)

Mammalian predators have been the main cause of these declines. Challies & Burleigh (2004) estimated that mammalian predators had access to 50% of the colonies and noted evidence of

¹³ McKinley 2001

¹⁴ Challies & Burleigh 2004

such predation at 41% of these. Ferrets are thought to be the key predators, although feral cats, stoats, and dogs account for some deaths. At sea, the birds face their natural predators as well as entanglement in nets and flotsam.

A complete survey of the coastline was commissioned by DOC between 2000 and 2002. Nesting birds were found at 68 places (Fig. 1), a total of 2112 nests were counted (with an estimated 5,870 birds).¹⁵

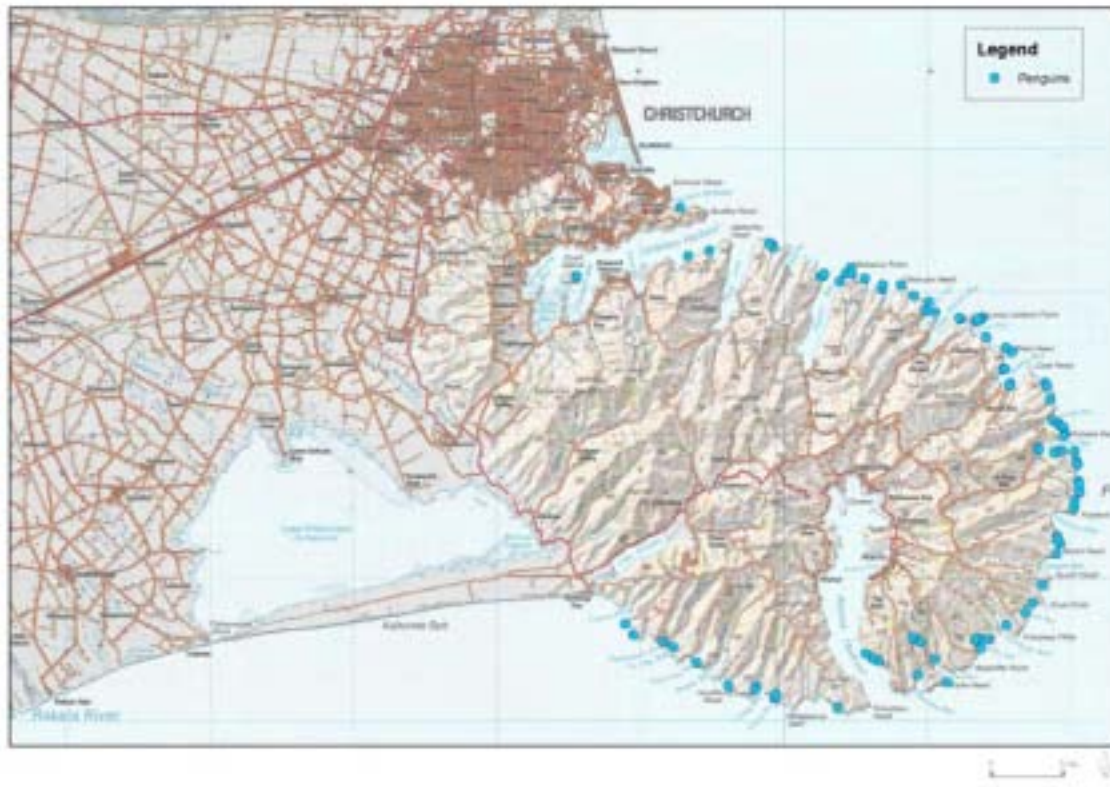


Figure 1 Location of known white-flippered penguin nesting sites, Banks Peninsula.

3.4.2 Yellow-eyed penguin

In 1997, there were estimated to be 6,000 to 7,000 birds in the total population of yellow-eyed penguins¹⁶ with only 600-650 pairs breeding on the South Island – mostly on Otago Peninsula. There are only 20-30 birds on Banks Peninsula and this probably represents the limit of their natural distribution.

¹⁵ Challies & Burleigh 2004

¹⁶ McKinley 2001



Photo 6 Hoiho or yellow-eyed penguin

Yellow-eyed penguins lay eggs above ground in thick vegetation between early September and early October, and incubate them for 40 to 51 days. The chicks do not fledge for 15 or 16 weeks and go to sea in February/March. The adults are also ashore even when not breeding during their moult between August and April.

3.4.3 Current predator management

White-flipped penguins are vulnerable to introduced mammalian predators when they are ashore. This is particularly so for adults during the peak of their moult in February/March, and for chicks before they fledge and go to sea in November to January.

A number of landowners, DOC, and a school group are trapping to protect colonies. Predator trapping started at Stony Bay in 1988 and at Flea Bay in 1991 by the local landowners. More recently DOC, CCC and ECan have supported and expanded these efforts (Fig. 2).



Figure 2 Location of predator traps around penguin nesting sites on eastern Banks Peninsula. By local landowners (red dots in Fig. 2) and by DOC along the main ridges around both Flea and Stony Bays (green dots in Fig. 2).



Photo 7 The main culprit – the ferret

Benefits of predator trapping

One hundred penguin burrows at Flea Bay have been monitored since 2001. Since then, less than 10% of chicks were predated or disappeared. Similarly, no adult birds were found killed by predators during checks during the moult in 2005. In total, the numbers have increased from an already impressive 717 in 2000/1, to 893 breeding pairs in 2004/5.

In just a couple of years, a colony at Stony Beach has increased from 77 to 84 pairs after trapping commenced. In the east Akaroa Heads area, a colony in the area which had trapping in place, saw an increase from 47 to 74 nests in 2005/6, while two large colonies of 139 and 83 nests with no trapping, dropped to 68 and 21 nests respectively during that same period.

At Le Bons Bay, the local school is trapping to protect the local penguins. Numbers at the beach have increased from a single nest in 2001/2 to five in 2006/7, and at the south harbour entrance they increased from 23 to 43 nests. Similarly, at Quail Island, due to predator control work and restoration efforts by the local Trust, numbers have jumped from seven nests in 2001/2, to between 19 and 27 over the last four breeding seasons (2003/4-2006/7).

There are collateral benefits for other species affected by predators. For example, extension of traps to the Stony Bay headland added to the ongoing concerted efforts of the local landowner, allowed the remnant colony of only 2 pairs of titi (*Puffinus griseus*) recorded nesting in 1997 to increase to 14 pairs in 2007.¹⁷

3.4.4 Protecting penguins

Which sites are best?

Sites adjacent to the current predator-control sites (Otanerito Bay and around into Akaroa Harbour). The control methods available require frequent inspection and rebaiting of the traps. Therefore, all else being equal sites where it is easiest to gain access will be more efficient than remote sites.

How should it be done?

The DOC 250 trap has passed the National Animal Welfare standards and is at least as effective as other traps on the market. The optimal layout of traps seems to require intensive control at the nesting colony, plus protection in-depth by a wide buffer of traps inland (see Fig. 2).

When should it be done?

Chicks are most vulnerable before they fledge and go to sea, and adult penguins are most vulnerable during their moult. Thus, predator control from spring through to early autumn offers the optimal protection. However, ferrets are hard to trap in winter and spring, and trapping in summer kills mostly adult ferrets, which allows juvenile ferrets to more easily replace them.

Therefore, maximum and extensive trapping effort in the late summer and autumn each year, will achieve maximum kills and serve to limit the breeding population of ferrets for their next breeding season in the following October-November. Intensive trapping adjacent to the penguin breeding colonies may be required (even if less efficient) during the spring and summer.

Collection of trapping effort and kill rates should be used to fine tune these best guess recommendations.

Who should do it?

Local residents near penguin colonies have the best chance to sustain the intensity of trapping required if they have some support. However, it is not the number of predators trapped but the number left that counts. So a systematic and ongoing commitment to the task is required, and groups should consider starting at a scale they can handle to be effective.

Further information

If you are interested in the results of the 2000/1 penguin survey for your area and/or protecting penguins on or near your property contact Anita Spencer, DOC ranger (email aspencer@doc.govt.nz or 03 371 3703) or the Banks Peninsula Conservation Trust.

Challies, C.N.; Burleigh, R.R. 2004. Abundance and breeding distribution of the white-flipped penguin (*Eudyptula minor albosignata*) on Banks Peninsula, New Zealand. *Notornis* 51: 1–6

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¹⁷ Grove and Schmechel 2008

McKinley 2001. Hoiho (*Megadyptes antipodes*) recovery plan. *Threatened Species Recovery Plan No. 35*. Department of Conservation, Wellington, 26 p.

Schmechel, F. 2004. Possibilities for enhancing populations of weka, tui and titi on Banks Peninsula and Canterbury. Department of Conservation, Christchurch, 50 p.

3.5 MODULE 4 – Pest control for tui and kereru

Sadly, tui disappeared from Banks Peninsula about 20 years ago, due to a variety of reasons including habitat loss, introduced predators, and possibly disease. The last birds to be seen in any numbers, were around Akaroa. Only single birds, or very occasionally two birds, have been reported since then. To flourish, tui need trees, flowers, and insects. Tui are keen nectar feeders. This food is more than 70 per cent of their diet at peak times of the year. Fruits and insects are also important. Ecologist Hugh Wilson, of Hinewai, has confirmed there is now enough year-round food available on Banks Peninsula for tui.

Kereru or New Zealand native pigeon (*Hemiphaga novaeseelandiae*), have been steadily decreasing as a result of habitat loss. Predation by introduced mammals has also had a significant impact on kereru. Whalers and early settlers to Banks Peninsula recorded large flocks of kereru within Lyttelton Harbour. The whalers gave Pigeon Bay its name because of the large flocks of kereru frequenting the bay. In various studies possum and rats have been found to be significant predators of kereru nests and chicks and numbers have rebounded when these pest animals are controlled. Cats have been documented killing adults on Banks Peninsula.

Management

- Provide good habitat - regenerating mixed hardwood forest, protected from grazing animals, offers good food and nesting territories.
- Gardens may help significantly with tui tucker as tui are known to travel a long way to good nectar sources at the right time of year.
- Remove grazers and predators - priorities for removal are (in order of priority):
 - 1) goats, deer, cattle, sheep, and pigs
 - 2) ship rats and possums
 - 3) cats and stoats

More information

Visit the tui website¹⁸ or contact the tui project coordinator Heidi Stevens (322 4714) or BPCT coordinator (Rachel Barker, 329 6340).

Visit the Kaupapa Kereru website¹⁹

3.6 Introduced birds

Introduced birds have not been seen as serious pests for biodiversity in New Zealand, however they may be in some instances. Thrushes are the main predator of juvenile *Powelliphanta* snails in forests in Marlborough²⁰.

About 38 cockatoos remain in the Kaituna/Prices Valley area. The regional council keeps a watchful eye on them. Canada geese are a pest to farmers when they eat grass and foul their pastures, and Fish and Game conducts culls to limit their numbers. The rook is included in the RPMS and has been eradicated from Banks Peninsula.

¹⁸ Tui restoration website www.tuisong.org.nz

¹⁹ Kaupapa kereru website: www.inet.net.nz/~stevensh/

²⁰ Parkes *et al.* 2004

Concern has been expressed nationally about the impact of magpies on other birds. It is an aggressive bird that harasses other birds (and people). A study in Waikato removed over 500 magpies from each of five 900 ha areas and compared the changes in the number of birds in these areas with numbers in areas where no magpies were removed. The control reduced magpies by 62% and allowed small (but significant) increases in kereru, but not in tui or fantails – the latter declined²¹. The authors noted these less-than-spectacular benefits and suggested the agencies would be better off spending their money controlling critical pests such as ship rats. However, control of magpies at Bottle Lake Forest Park may have facilitated the re-establishment of bellbirds.



Photo 8 Magpie (Photo: J. Innes)

3.7 Other vertebrates

Two species of exotic Australian frogs are found on Banks Peninsula, the whistling frog (*Litoria ewingi*) and the golden bell frog (*Litoria raniformis*). Their impacts on native animals are unknown, but probably minor. They may present a disease risk if anyone ever attempts to restore native frogs to the area.

Brown trout (*Salmo trutta*), chinook salmon (*Oncorhynchus tshawytscha*), perch (*Perca fluviatilis*), and goldfish (*Carassius auratus*) are present on Banks Peninsula. While trout have significant impacts on native fish and aquatic insects²², they are valued by anglers.

3.8 The invisible kingdom - insect pests of native biodiversity

New Zealand has about 1600 species of introduced invertebrates, a few of which are actual or potential serious pests for native plants and animals – mostly ants and wasps. About 1500 out of 19,000 insects are introduced, 19 of about 200 earthworms, and 5 of about 30 freshwater molluscs.

On Banks Peninsula, the two species of wasps (*Vespula germanica* and *V. vulgaris*) are listed in the regional council's RPMS Biodiversity Pests. This means the council will assist community groups with nest destruction (a short-term palliative to reduce the nuisance caused by wasps) and support research on biocontrol (to date unsuccessful). Argentine ants (*Linephtema humile*) have established in Christchurch.

²¹ Innes *et al.* 2004

²² Townsend 1996

4 Current pest and weed control on Banks Peninsula

A large number of landowners and community groups, as well as agencies such as the Department of Conservation, Regional Council, and Christchurch City Council are involved in controlling weeds and pest animals around Banks Peninsula. Control of weeds or pest animals adjacent to these areas may be more effective, as reinvasion is less likely from the neighbours. Below is some information on just some of these. The number is growing all the time.

4.1 Private landowners, trusts and community groups

A large number of groups and individuals are involved in pest control (both plant and animal) on Banks Peninsula (Fig. 3). Below (in alphabetical order) are just some of these.

Since the inception of this report, a group of landowners have begun significant pest control in the upper Akaroa Harbour area. In addition, there is a group in Lyttelton looking after Reserve 68 and the Whakaraupo Reserve. Most of the runanga on the Peninsula have stream restoration projects. In Little River a group is looking after the stream and controlling boxthorn.



Figure 3 Some of the locations where pest and weed control is undertaken. Many more are now underway.

4.1.1 Groups with a primary focus on biodiversity

Banks Peninsula Conservation Trust

The trust aims to coordinate conservation activities on the Peninsula. It does so via a series of sub-groups that:

- Help people who want to protect land through a covenanting process;
- Coordinate volunteers to control weeds and plant native species.

Cloud Farm

The owners of Cloud Farm protect native vegetation and encourage its regeneration. They are attempting to control gorse on three rocky outcrops particularly to ensure the survival of *Heliohebe lavaudiana* and control gorse along tracks and boundaries (about 80 hours effort per year). Cloud Farm also belongs to the Purple Peak Possum Collective, a group of neighbours who collaborate to control possums, and spend about 50 hours effort each year to do so.

Governors Bay Landcare Group

The group aims to protect and increase the bush at Governors Bay and its diverse populations of plants, birds, and insects. They also have social goals to encourage community cooperation and learning. They undertake weed control (old man's beard, hawthorn, cotoneaster, and banana passionfruit) in the Zephyr Valley QEII covenant (over 200 hours) and encourage weed control on private land. They have also held community workshops on animal pest control.

Hinewai / Maurice White Native Forest Trust

The trust aims to restore indigenous vegetation to enhance the botanical, biodiversity, genetic conservation, and wildlife of the area for its beauty, scientific value, heritage, and recreational enjoyment.

The management style is 'minimum interference management', i.e. to allow natural succession in the vegetation to take their course. In particular, gorse and broom are seen as exotic nurse canopies that will eventually be native forest succession. However, they do control gorse and broom along tracks and tenure boundaries and attempt to eradicate some weeds such as *Pinus radiata*, sycamore maple, old man's beard, *Cotoneaster* spp., wandering Jew, hawthorn and cherry plum for about 400 hours effort per year. Feral goats were eradicated between 1987 and 1999 (Parkes 2004) and possums are controlled by continuous trapping, some spotlight shooting, and by poisoning (the latter under training programmes run by Target Pest for National Trade Academy credits). They do not target mustelids or feral cats because they believe (probably mistakenly) that control of predators might increase rat densities. Hedgehogs are trapped as by-catch of the possum programme. In all, about 900 hours effort is used on pest control each year.

Kaituna Valley Group

The group has an interest in weed and pest control in the catchment of the Kaituna Stream and to date has begun with a working day (14 people) controlling weeds in the Kaituna Reserve.

Kaupapa Kereru

This project focuses on kereru and sponsors research into the distribution, density, ecology, and threats to the birds. Kaupapa Kereru also aims to work with runaka and the wider community to raise their awareness and interest in the wider conservation issues.

Otamahua/Quail Island Ecological Restoration Trust

The trust aims to restore the indigenous vegetation and fauna on Quail Island, and provide a refuge for locally extinct or rare and endangered species of Banks Peninsula. They spend about 750 hours, plus many volunteer hours, in attempts to eradicate or control weeds (e.g. boneseed, boxthorn, gorse, broom, and thistles) and pests (ship rats, hedgehogs, stoats, and rabbits). The Trust operates 70 Fenn-trap stations on Quail and King Billy islands and the adjacent mainland, and about 600 bait stations with Talon baits for rodents – all checked weekly. This takes >500 hours per year.

Pohatu Penguin Protectors

The main aim of this group is to protect the wildlife, stream, marine, and archaeological values in Pohatu (Flea Bay) with particular focus on protecting white-flipped penguins and yellow-eyed penguins. The group operates 90 traps to control feral cats, ferrets, and stoats over about 90 ha, and has killed several hundred predators (Table 1). The group also conducts rabbit control and rats are controlled over smaller areas to protect insects and lizards – in all, about 800 hours effort per year.

Table 1 Number of predators killed each year by the Pohatu Penguin Protectors

Pest	1997/8	1998/9	1999/0	2000/1	2001/2	2002/3	2004/5	2005/6	2007/8
Ferret	19	30	20	10	4	4	0		
Stoat	1		7	2	6	20	65	45	28
F. cat	36	28	26	30	22	18	22	12	8
Weasel				1	3	6	5	2	3

The Queen Elizabeth II Trust

The QE II Trust is a national trust established 'to encourage and promote the provision, protection, and enhancement of open space for the benefit and enjoyment of the people of New Zealand.' The role of the trust is to establish formal covenants over those areas and monitor their condition (including the need for and outcomes of weed and pest control).

On Banks Peninsula, there are over 54 existing covenanted areas (Fig. 4), comprising 777 ha in total, and nine further covenants approved, but not registered, comprising about 575 ha (February 2008). Each covenant area is visited roughly every two years for monitoring purposes, which includes an assessment of weed, pest, and other threats. The trust maintains a database of detailed monitoring and other records in relation to each covenanted area.



Figure 4 Location of QE II reserves on Banks Peninsula as of 2006. The numbers grow yearly.

Trust staff undertake some incidental control work (in the course of other duties), but the onus is on the private landowner to carry out any necessary weed and pest control under the Regional Pest Management Strategy. Many covenanters control a range of weeds and pests well beyond the scope of the RPMS, simply from a desire to 'look after their patch'. QE II Trust maintains a 'threats and other details' database in relation to its covenanted areas (Appendix 2).

Upper Akaroa Harbour group

A number of local landowners from Robinsons Bay to Onewae and beyond, are coordinating their efforts to control animal pests such as possum, stoats, and hedgehogs to enhance native plants, birds, and lizards. They are monitoring bush bird numbers and many are also involved in restoration planting.

4.1.2 Groups with a variety of aims, including biodiversity enhancement

Akaroa Heritage Park Trust

The trust aims to encourage the planting and preservation of trees, particularly in Akaroa but also over the Peninsula, and to encourage walkways throughout the Peninsula. They use volunteer labour (about 40 hours per year) to control weeds such as gorse, broom, blackberry, and thistles, and will control possums, stoats, and rabbits as needed in the reserve they manage at Akaroa.

Cass Bay Reserves Committee

The committee aims to improve and enhance the reserves and walkways in Cass Bay (near Lyttelton) and to restore the native flora and fauna. They treat broom and gorse as nurse crops under which they plant native species, i.e. the Hinewai approach to restoration, but control gorse along tracks (about 35 hours of effort per year). Open grassland areas are maintained by grazing, with the stock excluded from the restoration areas by fences.

Diamond Harbour Community Association

The association promotes the wider interests of ratepayers in the Diamond Harbour area, which includes some local control of weeds (about 10 hours effort per year) such as broom and boneseed, around the community hall the association manages. Individual members also control weeds on council reserves adjacent to their properties.

Summit Road Society

The society aims to enhance, preserve, and protect the natural environment, beauty and open character of the Port Hills for people to enjoy. They manage their own reserve (Ohinetahi Bush) as a QE II covenant. Volunteers control weeds such as banana passionfruit, old mans beard, cherry, and barberry, and undertake pest control using bait stations with Talon (for possums and rats) – generally as a follow-up to ECan's actions.

4.1.3 Groups with a primary focus on production

Banks Peninsula Pest Management Liaison Committee

Pest liaison committees are formed under the RPMS and have responsibilities to advise ECan on its pest and weed operational and budget matters. Its members are elected and include farmers and other landowners and interested individuals. The Banks Peninsula area has retained a rating system to fund control of pests under the RPMS, and largely focuses on pests with an economic impact – gorse, broom, nassella tussock, nodding thistle, and rabbits. However, they also support initiatives against biodiversity pests such as magpies and old man's beard. The committee was part of the investigation into expanding and continuing possum control across the whole peninsula.

They have the ability to coordinate some actions as their meetings (3 or 4 per year) include observers from DOC, CCC, Federated Farmers and Landcare Research. The chair is also represented on the Animal Health Board's Canterbury committee and attends the Conservation Forum meetings.

4.2 Agencies

A number of agencies with land on Banks Peninsula invest considerable time and resources into controlling weeds and pest animals. Control adjacent to these areas will benefit from the work being done and vice versa. The direction for this control work is determined by legislation and plans (see Appendix 2 for more details).

4.2.1 Department of Conservation

DOC manages 41 reserves on the Peninsula (Fig. 5) and controls a range of pests and weeds in many of these, as well as on lands of other tenures (see Table 2). This work includes control towards eradication of Darwin's Barberry on the Peninsula.



Figure 5 Public conservation lands managed by the Department of Conservation.

Table 2 Pest and weed control conducted on Banks Peninsula by the Department of Conservation. (DOC invested approximately over \$100,000 in control work in 2004/5.)

Pest/weed controlled	Where	What is done
Darwin's barberry	15 sites	Survey and control
Chilean flame creeper	Wainui Reserve	Control
19 weed species	Hay Scenic Reserve	Control
Multiple weed species	Lyttelton Reserve	Control
Multiple weed species	Kaitorete Spit	Control
RPMS weeds	26 sites	Comply with RPMS on DOC land
Feral goats	Whole peninsula	Contribute to goat eradication project
Possums	20 reserves	Annual control
Mustelids	Flea & Stony Bays, Purau, Godley Head, Otanerito/Long Bay, Akaroa Harbour near Nikau Palm Gully	Protect white-flipped penguins
Predators	e.g. Stony and Tumbledown bays, Kaituna River (for Grebes)	Support for Ngai Tahu kereru, titi, pingao projects
Multi-species	Quail Island	Control of hedgehogs, mustelids, rodents
Rabbits	Control as needed on DOC land	Comply with RPMS on DOC estate
Domestic stock	All reserves	Fence reserves

4.2.2 Environment Canterbury

ECan is assisting other agencies in several projects including: eradication of feral goats, control of predators and possums in the Port Hills (from Gebbies Pass to Evans Pass), and in the control of predators in the eastern bays to protect penguins. ECan also funds control of white-edged nightshade, nassella tussock, Darwin's barberry and banana passionfruit, and the surveillance of many weeds and cockatoos. The Environment Canterbury Regional Pest Management Strategy (2005) is the guiding plan for regional council pest control enforcement and assistance. ECan is also involved in boneseed control on Banks Peninsula and the Port Hills.

A new rating scheme was introduced in 2007 to control possums. The object is to maintain possum numbers below a 10% RTC (Residual Trap Catch). At this level, it is unlikely that TB will re-establish in a feral population. It currently only applies on the part of the Peninsula, east of Gebbies Pass.

4.2.3 Christchurch City Council

A variety of ecosystems, including podocarp/hardwood forest, tussock grasslands and rock outcrops are managed by the Christchurch City Council in their Port Hills reserves (Fig. 6). Each of these ecosystems have different plant pest threats and altogether the council spends around \$150,000 per year controlling weeds and pest animals. The priorities and objectives of control for each of these threats are outlined below.



Figure 6 Reserves managed by Christchurch City Council (excluding Misty Peaks, Kaitorete Reserve, and Forsyth Reserve)

Podocarp/hardwood forest

The key threats to the podocarp/hardwood forest remnants are:

- | | |
|--|--|
| - old mans beard | - barberry (<i>Berberis glaucocarpa</i>) |
| - banana passionfruit | - wandering willie |
| - darwin's barberry | - periwinkle |
| - italian buckthorn | - aluminium weed |
| - khasia berry (<i>Cotoneaster simonsii</i>) | - ivy |
| - holly | - sycamore |
| - japanese honeysuckle | - spindleberry |
| - hawthorn | - cherry |
| - pine species | - chilean glory creeper |
| - cotoneaster species | |

Old mans beard, banana passionfruit and Darwin's barberry

Infestations of these species are confined to specific reserves; Sugarloaf, Barnett Park and Otahuna. Each of the infestations are currently under a 5 year control programme, with the long-term goal of eradicating these species within the reserves and to prevent re-invasion. Plants establishing beyond the infestation areas are removed immediately.

Italian buckthorn, khasia berry and holly

Infestations of Italian buckthorn, khasia berry and holly occur in Victoria Park. A control programme is in place for these infestations and seedlings beyond the infestations are removed immediately.

Other species

All other species listed that occur in/or adjacent to reserves with forest ecosystems are controlled as time allows. Species with greatest potential to spread (e.g. Japanese honeysuckle and Chilean glory creeper) and species with greatest threats to long-term viability

of forest ecosystems (e.g. wandering jew, periwinkle, aluminium weed, Japanese honeysuckle, Chilean glory creeper) will be given priority.

Rock outcrops

The key threats to the rock outcrops that are known to be present in/or adjacent to the reserves, are listed below in approximate order of priority:

- gorse (if managed for long-term maintenance of rock outcrop habitat)
- broom (if managed for long-term maintenance of rock outcrop habitat)
- boneseed
- spur valerian
- pigs ear
- fennel
- polypodium fern
- wallflower
- californian poppy
- ivy
- hawthorn
- boxthorn
- *Cotoneaster conspicua*

Many of the Port Hills rock outcrops are in succession through woody scrub, mainly gorse and broom, to forest - particularly those on the inner Lyttelton harbour flanks. Plant pests will not be managed on these outcrops unless: they are a long term threat to forest ecosystems (e.g. hawthorn, pines, other species listed in forest ecosystems plant pest list); or if there are plant pests (e.g. spur valerian and other species listed in the rock outcrop plant pest list) putting nationally threatened plant species at risk, such as button daisy (*Leptinella nana*) and the Lyttelton forget-me-not (*Myosotis australis* var. *lytteltonensis*).

A number of rock outcrops on the Port Hills are currently being managed to maintain the rock outcrop vegetation including Scarborough Bluffs above Evans Pass Rd, Heathcote Bluffs, Castle Rock, Bridle Path Bluffs, The Tors, Witch Hill. The aim is to protect threatened plant populations such as the rare blanket fern (*Pleurosorus rutifolius*) and Lyttelton forget-me-not, outstanding prostrate kowhai (*Sophora microphylla*) communities, several regionally endemic species such as the Banks Peninsula hebe (*Heliohebe lavaudiana*), Banks Peninsula blue tussock (*Festuca actae*), Banks Peninsula hebe (*Hebe strictissima*) and a diverse range of other rock outcrop plants.

The control objectives for these rock outcrop habitats are to control all weeds in the above list on the outcrop itself and in a 20 m buffer around the outcrop. Priority attention will be given to regular weed control immediately around threatened plant populations. This control work has been taking place since 2001 and is ongoing as time and budget allows.

Tussock grasslands

The key threats to the tussock grasslands that are known to be present in/or adjacent to the reserves with this ecosystem, are listed below in approximate order of priority:

- nassella
- broom
- gorse
- boneseed
- hawthorn
- boxthorn
- Montpellier broom
- sweet brier
- grey willow - streams
- rank exotic grasses, especially cocksfoot

Grazing is essential to manage exotic grass growth and tussock vigour. Biannual grubbing of nassella tussock and chemical control of woody weeds are part of the ongoing maintenance programme of the grasslands.

The CCC also controls, or supports control of a number of pest animals in its reserves as listed in Table 3.

Table 3 CCC control of animal pests

Pest animals	Where	What is done
Feral goats, pigs and deer	All CCC Reserves	Contribute to goat eradication project. Monitoring and reactive control to deer and pigs in all CCC reserves
Possums	10 reserves	Ongoing trap and poison lines
Mustelids	Misty Peaks	Support for white-flipped penguins
	Summit road line	Traps along entire Summit Road corridor Kiwi to Gebbies Pass
	Godley Head	Support for white-flipped penguins
Predators	Kennedy's Bush programme	Blanket control over 140ha (traps and bait stations every 100m) to control possums, mustelids, rats and cats.
Rabbits	Control as needed on CCC land	Comply with RPMS on CCC estate
Domestic stock	All reserves	Fence reserves to exclude stock

5 What more needs to be done about weeds and pests?

A lot is done to manage weeds and pests on the Peninsula, but a lot more can and needs to be done to better coordinate the attack, to get rid of those weeds and pests that can be eradicated, to stop others spreading, and to reduce the impacts of those that are here to stay.

There are several models that might be used to better coordinate pest and weed control on Banks Peninsula.

5.1 Single pest or weed species plans

The simplest way to coordinate actions is to focus on a single pest or weed species and get everyone to agree to manage it over all or part of the Peninsula. Current models for the whole peninsula include the feral goat eradication plan and the attempt to eradicate some of the conservation weeds described earlier in this document (e.g. Darwin's barberry).

5.2 Sharing resources

A second way to better coordinate pest and weed control activities is simply to share equipment and labour (a good example of this is the Governors Bay Landcare Group).

5.3 Working together at important places

Recently there has been a move towards a site-based management system where all the key threats to the values at important sites are managed.²³ The site-based approach allows the benefits to be maximised at the selected sites, but is expensive. Examples of this approach on Banks Peninsula are Quail Island and 'the Wild Side' (Flea and Stony Bay areas).

²³ Stephens *et al.* 2002

5.4 Managing multiple pests and weeds

Some suites of pests are linked as predators and prey, or as competitors, so that control of one sometimes has effects on the others and consequences for native species. The complexity of these interactions can be summarised in a food web (Fig. 7), but the nature of the interactions and the changes to the web when we intervene with control of one or more of the species remains challenging for researchers. Managers need to be aware of the issues and should either control the whole group of pests or be aware of potential problems when only one is targeted and be prepared to act against others if there are adverse consequences.

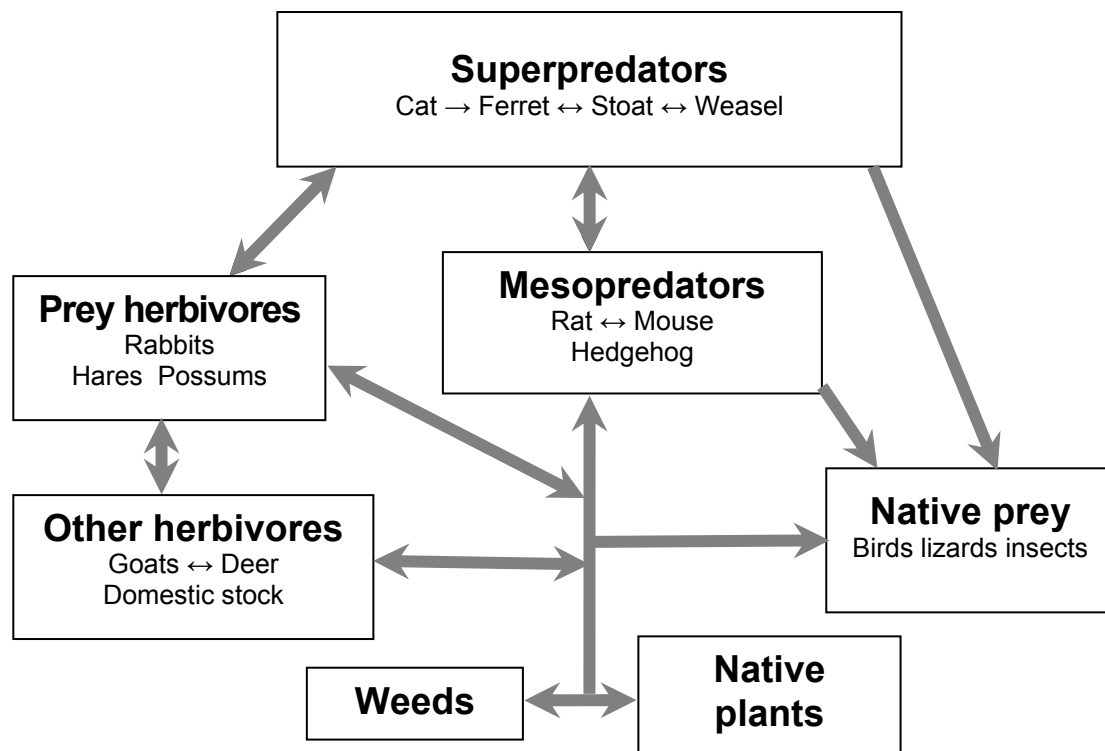


Figure 7 Key trophic links among the Banks Peninsula pests.

Some key links include:

1. Mice and rats may compete, so that removal of ship rats usually leads to an increase (often temporary) of mouse numbers.
2. Mice and ship rats are primary prey of stoats; therefore, rodent numbers drive stoat numbers. In beech forest, stoats and other predators do not affect rat numbers, partly because the rats breed in response to food availability before the stoats breed in the spring. In more complex forests, there is some evidence that stoat control may allow rat numbers to increase, but this may be affected by interaction between ship rats and possums.
3. Possums and ship rats appear to compete for food and possum control sometimes allows rats to increase.²⁴
4. There are competitive effects between small predators such that more weasels are caught in traps when stoats are removed.

²⁴ Sweetapple *et al.* 2002, Sweetapple & Nugent 2007

5. The sustained control of rabbits by RHD has had flow-on effects on their competitors (hares and possums) and predators (ferrets and feral cats). These effects were not so evident when rabbit control was by poisoning, presumably because the toxins also killed the other species or the effects on rabbits were short-lived. Hare numbers increase when rabbits are reduced to very low levels. Possum numbers may also increase, although this may be due to changes in possum behaviour as much as an immediate increase in the population. Predator numbers decrease as their primary prey declines.
6. Where they have a choice, red deer do not like to live in the same areas as feral goats. The planned eradication of feral goats from the Peninsula may increase the risk that deer will spread.
7. Weed control may be needed after browser control, particularly if weed species are likely to come away quicker than desirable natives.
8. Following weed control, it may be necessary to prevent other weed species from establishing by control work, mulching/shading out weeds or restoration planting.

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Appendix 1 – The Dirty Dozen

Please note – if using herbicides read all instructions carefully and be careful to avoid spray drift and take special care near water and desirable species.

Additional information on identification and control of weeds is available on the Weedbusters website (www.weedbusters.co.nz).

Old man's beard clematis (*Clematis vitalba*)

Description: *Clematis vitalba* (old man's beard) is a fast growing, deciduous climber. Seedlings have one to three leaflets and the mature plant has five leaves. The flower appears in summer and early autumn, is creamy white in colour and perfumed. The characteristic feathery seed heads give this climber its name and appear from autumn to spring. The vines have six strong longitudinal ribs. Older stems have pale brown stringy bark with longitudinal furrows.

Similar species: Native clematis is three leaved, flowers from spring to early summer, seeds in late summer and has a smooth vine. Old man's beard can be distinguished because it is deciduous (loses its leaves in winter), and has 5 opposite leaflets per stem.

Distribution: Old man's beard occurs in scattered populations on the Peninsula, particularly on the Port Hills.



Photo A1.1 Old man's beard in flower and seeding (*Photos: A. Paltridge*)

Why is it a problem?

It smothers and kills all plants to the highest canopy, and prevents the establishment of native plant seedlings. Moves readily into established forest over canopy and by layering.

It grows rapidly, forming dense, heavy, permanent masses that dominate canopy of any height. Stems layer profusely, and it produces many long-lived seeds if exposed to frost. It's tolerant of cold, moderate shade, damp, wind, salt, most soil types, and damage.

Seed is spread by water or wind, and both seed and stem fragments are spread in dumped vegetation.

Old man's beard is listed in the National Pest Plant Accord and is thus banned from sale, propagation and distribution. It is a 'containment plant' in the Regional Pest Management Strategy (RPMS) and is under active management by agencies and landowners to eradicate or control it.

Control

The best time to control old man's beard is during the summer months.

It is vital that areas treated are re-inspected over several years, and if necessary re-treated because plants may resprout and seeds may germinate.

Option 1: Cut and treat stumps.

- Trace all vines back to the ground and clear a small area around each base.
- Cut the stems at ground level.
- Paint the stumps with a strong dose of any of these herbicides. Glyphosate (e.g. Roundup) 200ml per litre, or Metsulfuron-mthyl (e.g. Escort) 5 g per litre of water, or Tordon Brushkiller at 100 ml per litre, or Triclopyr (e.g. Grazon) at 100 ml per litre, or Banvine at 200 ml per litre, or Vigilant gel.
- Leave the cut stems to dry so they do not touch the ground in case they take root, and dispose of cut-away segments in a landfill.

Option 2: Spray foliage

- Spray with Glyphosate (e.g. Roundup) at 20 ml per litre with 'Penetrate' in spring and summer.

Option 3: Non-chemical control

- Digging out the plant will only work if ALL the roots are dug out, otherwise it just resprouts.

Sycamore (*Acer pseudoplatanus*)

Description: Sycamores are deciduous trees with opposite, 5-lobed leaves, small flowers in clusters and typical winged seeds

Distribution: Sycamores are widespread on the Peninsula. Sycamores have been eradicated from four sites on the Peninsula and are under being controlled at least a further three places.



Photo A1.2 Sycamore (Photo: A. Paltridge, DOC)

Why is it a problem?

Sycamores potentially rival wildling pines as an invasive tree species in New Zealand as they seed prolifically, can germinate through pasture grasses and under native canopies, and can extend above native treelines in alpine areas.

Sycamores are grown as specimen and garden trees and while they are not listed as a plant pest in Canterbury, people should take care not to plant them where their seedlings can spread.

Control

Seedlings can be hand-pulled but this is merely holding the line unless the parent trees are killed. Trees can either be cut down and the stumps treated with herbicides as they will re-sprout, or the tree killed standing with herbicides. The latter can be best where safety is not an issue because the dead tree can provide a better habitat for site restoration.

Option 1: Cut tree down and treat the stump with herbicide

- Paint the edge of the cut stump with undiluted glyphosate (e.g. Roundup), Vigilant gel or Metsulphuron-methyl (e.g. Escort) at 20g per litre.

Option 2: Bore shallow holes in the tree and fill with herbicide

- Drill holes around the base of the trunk no more than 100mm apart and fill the holes with undiluted glyphosate (e.g. Roundup) or Metsulphuron-methyl (e.g. Escort) at 20g per litre.

Banana passionfruit (*Passiflora spp*)

Description: Banana passionfruit is an evergreen climber with 3-lobed, hairy leaves and large pink flowers. The fruit are up to 12 cm long and yellow or orange when ripe.

Distribution: Banana passionfruit is widely scattered as a garden escape. Banana passionfruit is being controlled in some places on Banks Peninsula.



Photo A1.3 Banana passionfruit (photo: J Miles & M Campbell)

Why is it a problem?

The plant smothers native vegetation and stops the light from reaching seedlings and so stops plants regenerating in forests.

Control

Option 1: Dig plants out. Plant can resprout from fragments so the whole plant has to be removed and composted, burnt, or sent to a landfill.

Option 2: Cut and the stump treated with a herbicide. Metsulphuron-mthyl (e.g. Escort) 1g per litre of water, Tordon Brushkiller 100ml per litre of water or Banvive (200 ml/L) are recommended.

Option 3: If the plant cannot be cut, spray the foliage with Triclopyr (e.g. Grazon 6 ml per litre of water plus a penetrant). Passionfruit can be controlled from spring right through to the end of autumn.

Grey willow (*Salix cinerea*)

Description: Also known as pussy willow, shrub willow, sallow. Grey willows are deciduous shrubs or small trees with catkins that appear often before the leaves sprout in spring. The leaves are shiny on upper side, alternate, oval and hairy on their underside. Stems are grey or greenish-grey and hairy, or reddish to dark purple and are not brittle. Flowers (Sept-Oct) appear as separate male and female cylindrical catkins (no petals). Seeds are spread by the wind.

Crack willows have longer leaves that are not hairy underneath.

Distribution: Grey willow or pussy willows is an invasive tree in swamps and along stream and lake margins. They are found at a few places on Banks Peninsula but have the ability to invade many new sites if not managed.



Photo A1.4 Grey Willow (photos: J Boow, ARC)

Why is it a problem?

Grey willows dominate favoured sites and exclude native plants. They also alter the hydrological regime in swamps and streams.

Grey willow is an 'unwanted organism' listed in the Plant Pest Accord and can, with determination, be eradicated from Banks Peninsula. Uncontrolled populations of grey willow are known from the western side of Akaroa Harbour.

Control

Option 1: Willows can be killed by cutting the tree down and treating the stumps with herbicide, or for large trees, by drilling holes in the trunk (one hole, 2 cm deep every 10 cm of trunk) and filling the holes with glyphosphate (e.g. Roundup) until it stops draining away.

Note: Disposal of the whole plant is necessary if the cutting method is used as willows can resprout from fragments, and burning or transfer to landfills rather than composting is required for disposal.

Option 2: Spraying the whole tree when it is in full leaf with glyphosphate (e.g. Roundup) at 15 ml per litre of water, plus a penetrant.

Option 3: Seedlings can be uprooted and left to dry.

Chilean flame creeper (*Tropaeolum speciosum*)

Description: Chilean flame creeper flowers in late spring through to April and has fleshy blue fruits.

Distribution: This weed is common in the Morice Settlement and Wainui Scenic Reserves on Banks Peninsula.



Photo A1.5 Chilean flame creeper (photo: A. Bill)

Why is it a problem?

Flame creeper can smother native forest and scrub.

Chilean flame creeper is classed as an unwanted organism and is listed on the National Pest Plant Accord. The plants are difficult to kill and its seeds are dispersed by birds. Together these traits mean that surveillance for spread and ongoing checks at control sites are needed if

eradication is to be achieved on the Peninsula. Control is being attempted on most known populations.

Control

Flame creeper is extremely difficult to kill, and repeated treatment of infested sites is required to make sure the vines are dead and to deal with seedlings.

Option 1: Cut or break the vines off, dig up the roots and paint them with Vigilant gel.

Option 2: Sprinkle Tordon 2G granules around the area where the vines root. Note: This method is likely to kill any trees or shrubs close to the treated area, use with caution.

Option 3: Spray the whole plant in spring or summer with Organic Interceptor at 200ml per litre and spray regrowth with Tordon Brushkiller at 50ml per litre.

Notes: this is a DOC 'weed led' species on Banks Peninsula – please report sightings to DOC who will undertake control.

Darwin's barberry (*Berberis darwinii*)

Description: Darwin's barberry is prickly evergreen shrub up to 4 m tall. It has small, dark, holly-shaped leaves and bears large numbers of yellow-orange flowers in the spring with green fruits that turn dark purple when ripe. The stems also have spines. The European barberry is deciduous and has oblong red fruit.

Distribution: Darwin's barberry is an invasive shrub native to South America and is now patchily distributed on the Peninsula.



Photo A1.6 Darwin's barberry (photo: A. van den Bos)

Why is it a problem?

This hardy shrub can grow under forest canopies where it out-competes native saplings and shrubs. It also happily grows in open habitats and so alters the regeneration processes where land is reverting to scrub and affects the productive grazing potential of pastures.

Darwin's barberry is listed under the Plant Pest Accord. The weed is widespread and not all populations are as yet under control. Thus, if eradication is to be achieved good surveillance

and reporting of new plants and prompt control is needed. All the known populations are being controlled on the Peninsula (Fig. 6).

Control

Option 1: Individual plants can be cut and the stumps treated with a herbicide (Glyphosate, Metsulphuron-methy or Tordon).

Option 2: Small plants and seedlings seedlings can be hand-pulled.

Option 3: Plants can be killed by spraying with Tordon Brushkiller at 6ml per litre plus a penetrant.

Notes: this is a DOC 'weed led' species on Banks Peninsula – please report sightings to DOC who will undertake control.

Additional information

Department of Conservation 2003. Darwin's barberry – one wicked weed. Fact sheet November 2003.

Tradescantia (*Tradescantia fluminensis*)

Description: Also known as wandering willie. Tradescantia likes damp, shaded places. It has oval leaves, 3-6 cm long with pointed tips, and has small, 3-petalled flowers in summer.

Distribution: Wandering willie is known from several places on the Peninsula.



Photo A1.7 Tradescantia (photo: R.P. Ellis)

Why is it a problem?

Tradescantia can completely smother the ground under forest canopies so that nothing else can establish.

Eradication is possible but difficult. It is being controlled at all know locations in reserves.

Control

Option 1: Eradication by hand weeding is possible for small infestations, but as the plant can grow from small fragments the whole lot must be removed and disposed of. Composting is not a good way to do this as it is a tough plant and likely to survive even that, so burning or removal with household rubbish is recommended.

Option 2: Spraying with Triclopyr (e.g. Grazon) at 6ml per litre with a penetrant appears to be the most effective herbicide and works all year round, although spraying in spring is recommended. A good coverage of spray is essential and for deep mats of the weed, several treatments may be required as the top layers die. When the Wandering willie is growing among rank grass, removal of the grass with a glyphosphate herbicide is recommended before the Triclopyr is used against the weed.

After either manual or herbicide control, follow up will be needed every 2 to 3 months until the site has been clear for at least two visits.

Additional information

McLuggage, T. 1998. Herbicide trials on *Tradescantia fluminensis*. Conservation Advisory Science Notes 180. Department of Conservation, Wellington, NZ.

Cotoneaster / Khasia berry (*Cotoneaster simonsii*)

There are several species of Cotoneaster (*Cotoneaster spp.*) that are of concern on Banks Peninsula.

Description: Cotoneasters are shrubs or small trees. Khasia berry (*Cotoneaster simonsii*) has alternate leaves 2.5 cm long, white or pale pink flowers and glossy orange-red or scarlet egg-shaped fruit.

Distribution: There are scattered populations on the Port Hills and between Little River and Akaroa of various species. A couple species are just taking off.



Photo A1.8 Cotoneaster (*Photo: K. McCoombs*).

Why is it a problem?

Cotoneasters are tough plants that can tolerate a wide range of conditions including drought, damp, hot, cold, salt and shade. They can form dense stands that crowd out other species. Long-lived, it produces plentiful, highly viable fruits that are readily spread by birds.

The top priority is to eliminate the population of Khasia berry (*C. simonsii*) along the Summit Road above Le Bons. This is the species that probably has the greatest potential to run rampant on the Peninsula. The other major current infestation is of *C. microphyllus* in the 'Claydon Block' reserve on the Lyttelton side of Mount Pleasant. It is a low, almost prostrate shrub, well-established in shrubland. *C. glaucophyllus* is rampant in parts of Nelson such as Golden Bay and could really take off on Banks Peninsula. It's barely naturalised on the Peninsula so could be stopped in its tracks.

Control

Small plants can be pulled or dug out, but adults have to be either cut at the base and the stump treated with herbicide or sprayed. Repeated checks of infested sites are needed because birds are likely to have spread the seeds around adult plants. Control is best done between November and autumn.

Option 1: Spray with metsulphuron-methyl (e.g. Escort) at 5g per litre plus penetrant.

Option 2: Cut at the shrub down near ground level and treat the stump with Vigilant gel or glyphosate (e.g. Roundup).

Smilax or bridal creeper (*Asparagus asparagoides*)

Description: Smilax is a perennial vine with twisted, wiry stems. It has fleshy tubers and a single oval 'leaf' at each node on its stems. It has small pale green flowers from July-August and red berries, each with up to 8 small black seeds.

Distribution: Smilax is only known to occur at a few sites around Banks Peninsula and Christchurch.



Photo A1.9 Smilax (Photo: A. Paltridge).

Why is it a problem?

Smilax can smother native plants in a wide range of habitats.

Smilax can be difficult to eradicate once widespread so it is important to report any plants on the Peninsula so its establishment can be prevented. It is an unwanted organism and listed on the Plant Pest Accord.

Control

Option 1: Newly established infestations can be dug out providing care is taken to find all the tubers.

Option 2: Larger infestations can be treated with herbicides in spring and summer but follow up spraying at 6 monthly intervals may be required. Spray with mixture of mesulphuron-methyl (e.g. Escort) 1g per litre, plus 20ml per litre of glyphosate (e.g. Roundup) plus LI 700 spraying oil at 5ml per litre.

Notes: DOC are investigating this, please report all sightings to DOC.

Japanese honeysuckle (*Lonicera japonica*)

Description: Japanese honeysuckle is a vigorous ground vine or climber that will typically be seen winding its way up host plants or forming dense clumps along the roadside or on forest margins. In cold areas it loses its leaves over winter. It is easily recognised by its tubular and sweetly-scented flowers, ageing from cream to yellow-cream from September through to May. Glossy black berries, from 5-7 mm long, are also noticeable from October to June. The stems are purplish and covered in fine hairs.

There are several other species of honeysuckle which are commonly cultivated, and which don't cause significant problems. However, Hall's honeysuckle (*Lonicera halliana*) is simply another name for Japanese honeysuckle, so any plants with this name should be avoided.

Similar species: other honeysuckle species. To distinguish Japanese honeysuckle from other honeysuckle species - Japanese honeysuckle flowers turn completely yellow in colour when they are open and fully developed.



Photo A1.10 Japanese honeysuckle

Why is it a problem?

It is a rampant plant, smothering all vegetation beneath. As it can reproduce from dumped plant material (stem fragments) and also through seed dispersed by birds, honeysuckle has naturalised in most areas.

Japanese honeysuckle is classed as an unwanted organism and is on the National Pest Plant Accord list. It is banned from sale, propagation and distribution in New Zealand.

Where is it a problem?

Japanese honeysuckle will grow in a range of situations but risk areas are forest margins, wetlands and stream banks.

Japanese honeysuckle (*Lonicera japonica*) has been recorded and controlled in the Hay Reserve.

Control

Stumps resprout so frequent follow-up required to ensure eradication.

Option 1: Dig out (all year round). Leave on site to rot down.

Option 2: Cut down and paint stump (all year round): or glyphosate (100ml/L) or metsulfuron-methyl 600g/kg (1g/L) or triclopyr 600 EC (100ml/L) or Yates Hydrocotyle Killer (500ml/L).

Option 3: Spray (spring-summer): metsulfuron-methyl 600g/kg (5g/10L) or triclopyr 600 EC (30ml/10L) or Yates Hydrocotyle Killer (15ml/L).

Alternatives to plant:

Try the native vine – *Clematis paniculata*.

Yellow ginger (*Hedychium flavescens*)

Description: This plant is a non-woody ginger-scented perennial growing to 2.5 m tall, with massive taro-like rhizomes that are long and shallow-rooted and that grow over each other to form deep beds. Each rhizome segment (4 x 10 cm) usually produces an aerial stem each year. These stems grow to 2.5 m and are erect. Leaves (50 x 10 cm) are alternate and shiny, and point upwards. Flower heads (15 x 10 cm) with fragrant cream-coloured flowers in clusters are produced in May to June. However, no fruit is produced.

Similar species: Yellow ginger is not as common as Kahili ginger and is a smaller plant with more slender upright leaves.

Distribution: This species is not naturalised on Banks Peninsula but if seen should be eradicated if possible or reported.

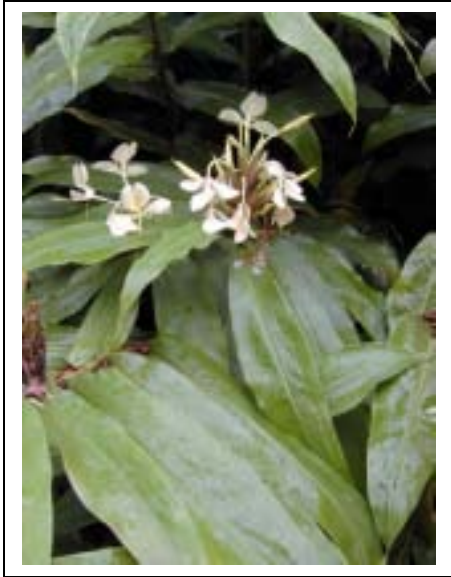


Photo A1.11 Yellow ginger (Photo: Forest & Kim Starr)

Why is it a problem?

Yellow ginger is long-lived and fast-growing, and forms deep rhizome beds. The plant spreads relatively quickly, by vegetative regeneration of rhizomes, especially on downhill and downstream sloping sites. Rhizomes resprout from any fragment, and can survive for years away from soil. They can also survive crushing and immersion in the sea. No seed is produced so virtually all spread is the result of human activity, such as dumping garden waste.

Yellow ginger will spread into well shaded areas of the forest and displace lower tier plants of the community. This greatly impairs the regeneration and proper functioning of the forest in this area.

Control

Eradication can be easily achieved.

Option 1: Cut down and paint stump (all year round): cut above pink 'collar' at base and apply or glyphosate (250ml/L) or metsulferon-methyl 600g/kg (1g /L). Leave stems and leaves to leave on site to rot down.

Option 2: Dig or pull out small plants (all year round). Do not compost, leave on site to rot down or hang rhizomes in trees, as they survive indefinitely. Dry them out and burn them, or dispose of them at a refuse transfer station.

Option 3: Spray dense patches away from roots of vulnerable species (all year round): metsulferon-methyl 600g/kg (5g/10L knapsack). Add penetrant in winter. Don't replant sprayed sites for 6 months.

Selaginella (Selaginella kraussiana)

Description: A creeping fern-like plant with tiny, green leaves that lie flat along the stem. Stems are slender and irregularly branched. Roots produced at the nodes of stems. Rounded cones up to 1cm long contain spores.

Similar species: selaginella looks very similar to many native mosses, liverworts and leptinella species. Banks Peninsula has a number of rare and threatened leptinella species such as *Leptinella minor* and *L. nana*. Please do not confuse these native species with selaginella.



Photo A1.12 Selaginella (photo: R. Boow, ARC)

Why is it a problem?

Selaginella forms dense carpets along the ground, preventing native seedlings, ferns and mosses from establishing. This creates an increase in light gaps, allowing more aggressive weeds such as exotic vines to establish.

Selaginella is very easily spread by tiny fragments and spores, allowing it to be spread by soil and water movement, livestock, machinery and on footwear, to new places where it may be difficult to control.

Where is it a problem?

Selaginella is shade tolerant and requires wet or damp soil to grow in. It prefers to grow along stream banks, forest floors, shade houses and ferneries. Selaginella has been sold commercially in the past so it can be found scattered throughout New Zealand. Now it is no longer able to be sold, propagated or distributed within the country.

Control

Selaginella is a difficult species to control, requiring regular follow-up visits until the site is clear.

Option 1: If you have selaginella growing in your garden or pot plants, hand weed the area, taking care not to spread stem fragments or spores. Appropriately dispose of the material. Do not compost.

Option 2: Large areas can be sprayed with an appropriate herbicide. Use all herbicides in accordance with the manufacturer's instructions and ensure no herbicide comes into contact with other plants, the soil and waterways.

APPENDIX 2 - WEEDS AND PEST PLANTS OF BANKS PENINSULA

- Wilson - plants of concern listed in publications by Hugh Wilson.
 NPPA - Species that appear on the National Pest Plant Accord List.
 RPMS- P - Progressive control,
 C - Containment control,
 B - plants listed under the RPMS Biodiversity Pests section.
 DOC- Weeds listed under various DOC control plans.
 CCC - Weeds listed under Port Hills (CCC) control plans.
 QEII - Weeds controlled in QEII covenants on Banks Peninsula.

Key for CCC list.

+ Weeds of concern. Currently being controlled.

* Weeds of limited extent. Currently being controlled.

X Weeds of concern known to be present. Not currently controlled. Extent unknown.

QEII Covenants

Any weed or pest control needs to be justified by the circumstances of each individual covenant. What may be essential in one covenant, may be counter-productive in another. For instance gorse may be a beneficial nurse crop if the aim is to allow succession towards a forest ecosystem, however gorse would be unwanted in most tussock-grassland or rock outcrop ecosystems. Thus aims will vary with circumstances.

For each covenant, a weed or pest's prevalence, impact, priority for control, control aim, and the success of that aim are regularly recorded.

Weeds and pests are allotted one of the following control aims:

- Eradication (where the complete and sustained elimination of that pest or weed within the covenant is realistically achievable),
- Sustained Control (where elimination is not feasible but numbers can and need to be periodically reduced to less damaging levels),
- Containment (where a pest or weed is prevented from spreading), or
- Monitoring (where the control of a threatening weed or pest is simply not feasible, or to ascertain whether it is becoming significantly problematic).

Common name	Species	Wilson (1999; 2002)	NPPA List	RPMS	DOC	CCC	QEII
Arum lily							+
Ash	<i>Fraxinus excelsior</i>	+					+
Banana passionfruits	<i>Passiflora</i> spp.	+	+			+	
Barberry	<i>Berberis glaucocarpa</i>	+				X	+
Blackberry	<i>Rubus echinatus</i> , <i>R procerus</i>	+					+
Boneseed	<i>Chrysanthemoides monilifera</i>		+	B	+	+	+
Boxthorn	<i>Lycium ferocissimum</i>				+	*	+
Brier							+
Broom	<i>Cytisus multiflorus</i>			C	+	*	+
Broom	<i>Cytisus scoparius</i>			C	+	+	+

Common name	Species	Wilson (1999; 2002)	NPPA List	RPMS	DOC	CCC	QEII
Californian poppy	<i>Eschscholzia californica</i>					*	
Cape daisy	<i>Arctotheca calendula</i>					X	
Cape ivy	<i>Senecio angulatus</i>	+				X	
Chilean flame creeper	<i>Tropaeolum speciosum</i>	+	+		+		
Chilean glorycreeper	<i>Eccremocarpus scaber</i>					*	
Chilean mayten	<i>Maytenus boaria</i>					*	
Cherry							+
Cocksfoot							+
Common polypody	<i>Polypodium vulgare</i>					X	
Cotoneaster	<i>Cotoneaster species</i>					*	+
Currant							+
Darwin's barberry	<i>Berberis darwinii</i>	+	+		+	*	
Elderberry							+
Elm							+
Eucalypts							+
Fennel	<i>Foeniculum vulgare</i>					*	
Foxglove							+
German ivy	<i>Senecio mikanoides</i>	+				X	
Gorse	<i>Ulex europaeus</i>			C	+	+	+
Grey willow	<i>Salix cinerea</i>	+	+			*	
Hawkweeds	<i>Hieracium spp.</i>			B		X	
Hawthorn	<i>Crataegus monogyna</i>	+			+	+	+
Hemlock							+
Holly	<i>Ilex aquifolium</i>					*	
Hoheria	<i>Hoheria sexstylosa</i>						+
Holly							+
Inkweed							+
Italian buckthorn	<i>Rhamnus alaternus</i>					*	
Ivy							+
Japanese honeysuckle	<i>Lonicera japonica</i>	+	+			+	+
Khasia berry	<i>Cotoneaster simonsii</i>					+	
Lodgepole pine	<i>Pinus contorta</i>					*	
Macrocarpa							+
Male fern	<i>Dryopteris filix-mas</i>	+				X	
Marram grass	<i>Ammophila arenaria</i>				+		
Mexican daisy	<i>Erigeron karvinskianus</i>					*	

Common name	Species	Wilson (1999; 2002)	NPPA List	RPMS	DOC	CCC	QEII
Monterrey pine	<i>Pinus radiata</i>	+		B	+	*	
Montpellier broom	<i>Teline monspessulana</i>			C	+	*	
Nassella tussock	<i>Nassella trichotoma</i>			PC	+	+	
Old man's beard	<i>Clematis vitalba</i>	+	+	B	+	+	+
Passionfruit	<i>Passiflora pinnatistipula</i>	+					+
Periwinkle	<i>Vinca major</i>	+				*	+
Pigs ear	<i>Cotyledon orbiculata</i>					X	
Pines							+
Portugal laurel							+
Rowan							+
Spanish heath	<i>Erica lusitanica</i>				+		
Spartina	<i>Spartina anglica</i>				+		
Spindleberry							+
Spur valerian	<i>Centranthus ruber</i>					+	
Sweet brier	<i>Rosa rubiginosa</i>					*	
Sweet cherry	<i>Prunus avium</i>	+				*	
Sycamore maple	<i>Acer pseudoplatanus</i>	+				*	+
Tradescantia	<i>Tradescantia fluminensis</i>	+	+		+		+
Thistles							+
Tree erica	<i>Erica arborea</i>					*	
Tree lucerne	<i>Chamaecytisus palmensis</i>				+		
Tree lupin	<i>Lupinus arboreus</i>					*	
Variogated thistle	<i>Silybum marianum</i>					+	
Walnut							+
Willow							+

Current pest and weed plans and strategies that include Banks Peninsula

Canterbury Regional Council 1998. *Regional pest management strategy (1998)*. Report 98(6), 94 p.

Christchurch City Council 2004. *Christchurch naturally*. The biodiversity strategy. Christchurch City Council, Christchurch, 75 p.

Department of Conservation 2002. *Kaitorete Spit resources and management report*. Department of Conservation, Canterbury, 47 p.

Department of Conservation in press. *Animal pest management and monitoring strategy*. Department of Conservation, Christchurch.

Environment Canterbury 2002a. *Regional pest management strategy biodiversity pests*. Report No. R02/06, 71 p.

Environment Canterbury 2002b. *Review of regional pest management strategy (1998)*. A discussion document. Report R02/7, 50 p.

- McCombs, K. 2005. *An updated overview of CCC weed plans (Jan 2005)*. CCCECO 05/01, 23 p.
- Norbury, D.; Warburton, B.; Webster, R. 2001. Long-term monitoring of mammalian pest abundance in Canterbury. Landcare Research Contract Report LC0001/144, 92 p.
- Parkes, J. 2005. *Banks Peninsula feral goat control strategy*. Department of Conservation, Christchurch, 23 p.
- Thomas, M. 2005. *Improved vertebrate pest control in Port Hills reserves*. Report to the Christchurch City Council, 19 p.

Pest Status in Canterbury

The Biosecurity Act enables Environment Canterbury to eradicate or manage pest plants and animals as specified in regional pest management strategies (RPMS).

The categories of plant pest used are:

Total control plant pest

A high level of control that aims to eradicate the plant from the region. Species that have been declared "total control plant pests" can not be sold, propagated or distributed.

Progressive control plant pest

Staged control is aimed at eventual eradication through reduction of propagule sources. Species that have been declared "progressive control plant pests" can not be sold, propagated or distributed.

Containment control plant pest

Control is aimed at ensuring that the species does not spread in range. Species that have been declared "containment control plant pests" can not be sold, propagated or distributed.

Unwanted organisms

Species that have been declared "unwanted organisms" can not be sold, propagated or distributed. A Regional Council can also spend money on their control if eradication is feasible.

The RPMS also lists pests and weeds that affect biodiversity values (but these species have no enforceable rules for control). Pest animals in this section include wasps, possums, ferrets, stoats, weasels, feral cats, and feral goats. Weeds listed in this section of the strategy include boneseed, Darwin's barberry, banana passionfruit, flowering current, and several wilding trees.

Although red and fallow deer and feral pigs are included in the RPMS, control occurs only in targeted areas under the powers of the Wild Animal Control Act.

How the agencies decide when, where, why and how to spend your money on pests

All introduced mammals in the wild are legally defined and their management facilitated under two main Acts, the Conservation Act 1987 (and its subsidiary Act, the Wild Animal Control Act 1977) and the Biosecurity Act 1993. Other pests and weeds may be legally defined as pests in National or Regional Pest Management Strategies (under the Biosecurity Act 1993), which allows for funding by levies or rates. Any landowner or agency managing land (e.g. CCC) may control pests or weeds as they like, although most public agencies would do so under some planning process if they are spending public funds. A list of all pest and weed management plans and strategies that impinge on Banks Peninsula is given in above.

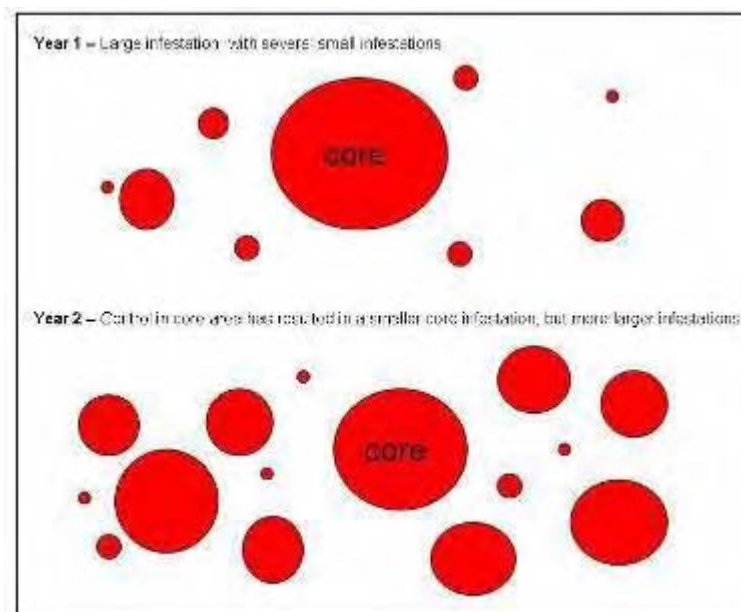
National Pest Management Strategies (NPMS) exist only for the management of bovine tuberculosis, and so direct control of those wild animals that are maintenance hosts for this disease (i.e. possums and perhaps ferrets). Bovine Tb in feral animals was eradicated from Banks Peninsula in about 1999 after major possum control operations. The Animal Health Board (AHB) will declare the Peninsula area Tb free in 2007/08 and then withdraw its funding into vector control.

APPENDIX 3 - SOME PRINCIPLES OF WEED MANAGEMENT

Plant pests under the RPMS strategy are divided into those for which eradication is feasible and desirable ('total control plant pests'), those for which eradication is the aim but that cannot be achieved in the short-term ('progressive control plant pests'), those for which the aim is to stop spread ('containment control plant pests'), and those that are pests elsewhere but are not present in Canterbury ('surveillance plant pests').

Controlling weeds is not a simple task in many cases and it is easy to waste a lot of effort. Managers should consider the following:

- What will happen if they do nothing? Sometimes a weed is ephemeral and perhaps only appears soon after a site is disturbed but will disappear once other plants take over.
- The presence of a seed bank, the life of the seeds in it, and the conditions under which they will germinate. For example, a seed bank will determine the time frame within which an eradication campaign must be achieved – if new plants are allowed to flower and add new seeds to the seed bank then eradication may be difficult.
- Dispersal and its mechanisms will determine the scale of operations against weeds.
- The consequences of the control method used. For example: Weed managers often use the MOLD principle, the Method of Least Disturbance, to minimise adverse consequences of their control. For example, disturbance might encourage seed banks of the target and other weeds to germinate, or removal of one weed might allow another to invade and merely take its place.
- How to attack an infestation? Start with the outliers and don't bite off more than you can manage! Satellite infestations have the greater potential to spread so the rule is to keep weed-free areas free of weeds, start with the outliers and then tackle the core areas.



Potential effects of misdirected weed control in core areas

Weed control methods include mechanical (weeding, grubbing, and cutting), chemical (spraying with herbicides), biocontrol, and habitat manipulation. The best method or, more often, combination of tools depends very much on the weed species and circumstance.

Mechanical control: Trees can be ring-barked, drilled and poisoned (e.g. pines) or felled (and poisoned if they can resprout from the base), shrubs can be grubbed or shaded out (e.g. for

gorse or nassella tussock), while herbs can be hand weeded (e.g. for manageable patches of tradescantia).

Chemical control: Rule one is to seek advice about the best herbicide for the target weed and rule two is to follow the label.

Weed biocontrol: Classical biocontrol involves releasing a natural enemy, usually an insect or a fungus, that attacks the weed and either kills it, reduces its ability to seed, or debilitates the plant so that it is less successful. Biocontrol agents take time to establish, spread, and increase and will not eradicate the weed. Nevertheless, they are useful against some species that are not easily controlled by other means.

Weeds on Banks Peninsula for which biocontrol agents are available or planned.

Weeds species	Biocontrol agents	Success to date	Present on Banks Peninsula
Old man's beard (OMB)	OMB fungus OMB leaf miner OMB sawfly	Common and widespread Common and widespread Establishment not yet confirmed	Yes Yes No
Gorse	Colonial hard shoot moth Pod moth Seed weevil Soft shoot moth Spider mite Thrips	Released Common and widespread Common and widespread Becoming common Common and widespread Limited distribution	Yes Yes Yes Probably Yes Not known
Broom	Broom psyllid Broom seed beetle Broom twig miner Leaf beetle Foliage moth Gall mite	Currently dispersing Common and widespread Common and widespread Under trial Under trial Under trial	Yes Yes Yes
Hawkweeds	Gall midge Gall wasp Hieracium rust Root hover fly Plume moth Crown hover fly	Established at some sites Established at some sites Common and widespread Limited release Limited release Under trial	Not known Not known Not known No No
Darwin's barberry	Looking for potential agents		
Tradescantia	Looking for potential agents		
Banana passionfruit	Testing several insects Recently rejected a fungus		
Japanese honeysuckle	Start search for potential agents in 2006/07		
Nassella tussock	Testing several pathogens		
Boneseed	Leaf roller Rust fungus	Releases to begin soon Exploring potential	
Grey willow	Feasibility study prepared		
Chilean flame creeper	Feasibility study being prepared		

APPENDIX 4 - EXOTIC ANIMALS FOUND ON BANKS PENINSULA

Species	Distribution	Main habitat
MAMMALS		
Possum (<i>Trichosurus vulpecula</i>)*	Widespread	Most habitats
Rabbit (<i>Oryctolagus cuniculus</i>)*	Patchy	Grassland (Fig. 1)
Feral goat (<i>Capra hircus</i>)*	Patchy (Fig. 3)	Most habitats
Ship rat (<i>Rattus rattus</i>)*	Widespread	Mostly in forest
Stoat (<i>Mustela erminea</i>)*	Widespread	Most habitats with rodents
Ferret (<i>Mustela furo</i>)*	Patchy	Mostly grassland with rabbits
Feral cat (<i>Felis catus</i>)*	Widespread	Most habitats
Hare (<i>Lepus europaeus</i>)	Patchy	Grassland
Norway rat (<i>Rattus norvegicus</i>)	Local	Usually commensal
Mouse (<i>Mus musculus</i>)	Widespread	Most habitats
Weasel (<i>Mustela nivalis</i>)	Unknown	Most habitats with mice
Hedgehog (<i>Erinaceus europaeus</i>)	Widespread	Mostly in grassland
Red deer (<i>Cervus elaphus</i>)	Local (Fig. 4)	Mostly in forest/scrub
Fallow deer (<i>Dama dama</i>)	Local (Fig. 4)	Mostly in forest/scrub
Feral pig (<i>Sus scrofa</i>)	Local (Fig. 5)	Most habitats
BIRDS		
Blackbird (<i>Turdus merula</i>)	Widespread	Most habitats
Black swan (<i>Cygnus atratus</i>) ¹	Local	Lakes
Californian quail (<i>Callipepla californicus</i>)	Widespread	Grassland/scrub
Canada goose (<i>Branta canadensis</i>)	Local	Lakes and edges
Chaffinch (<i>Fringilla coelebs</i>)	Widespread	Most habitats
Cirl bunting (<i>Emberiza cirlus</i>)	Widespread/rare	Most habitats
Goldfinch (<i>Carduelis carduelis</i>)	Widespread	Most habitats
Greenfinch (<i>Carduelis chloris</i>)	Widespread	Most habitats
Hedgesparrow (<i>Prunella modularis</i>)	Widespread	Most habitats
House sparrow (<i>Passer domesticus</i>)	Widespread	Commensal
Little owl (<i>Athene noctua</i>)	Widespread	Most habitats
Magpie (<i>Gymnorhina tibicen</i>)	Widespread	Mostly farmed areas
Mallard duck (<i>Anas platyrhynchos</i>)	Widespread	Waterways
Pheasant (<i>Phasianus colchicus</i>)	Widespread	Scrub/grassland
Redpoll (<i>Carduelis flammea</i>)	Widespread	Grassland
Rock pigeon (<i>Columba livia</i>)	Widespread	Open habitats
Rook (<i>Corvus frugilegus</i>)	Eradicated	Farmland
Skylark (<i>Alauda arvensis</i>)	Widespread	Grassland
Starling (<i>Sturnus vulgaris</i>)	Widespread	Grassland
Sulphur-crested cockatoo (<i>Cacatua galerita</i>)	Kaituna/Prices Valley	Most habitats
Thrush (<i>Turdus philomenos</i>)	Widespread	Most habitats
Turkey (<i>Meleagris gallopavo</i>)	?	
Yellowhammer (<i>Emberiza citrinella</i>)	Widespread	Most habitats
AMPHIBIANS		
Whistling frog (<i>Litoria ewingi</i>)	Widespread	Ponds
Bell frog (<i>Litoria raniformis</i>)	Widespread	Ponds
FISH		
Brown trout (<i>Salmo trutta</i>)	Limited	Lakes
Chinook salmon (<i>Oncorhynchus tshawytscha</i>)	Limited	Streams
Perch (<i>Perca fluviatilis</i>)		
Goldfish (<i>Carassius auratus</i>)		

APPENDIX 5 - PEST ANIMALS BY SPECIES

Feral goats (*Capra hircus*)

Distribution and density: Feral goats can thrive in all habitats, but reach highest densities in areas with a mixture of grassland, scrub, and forest. Banks Peninsula provides ideal habitat for goats.

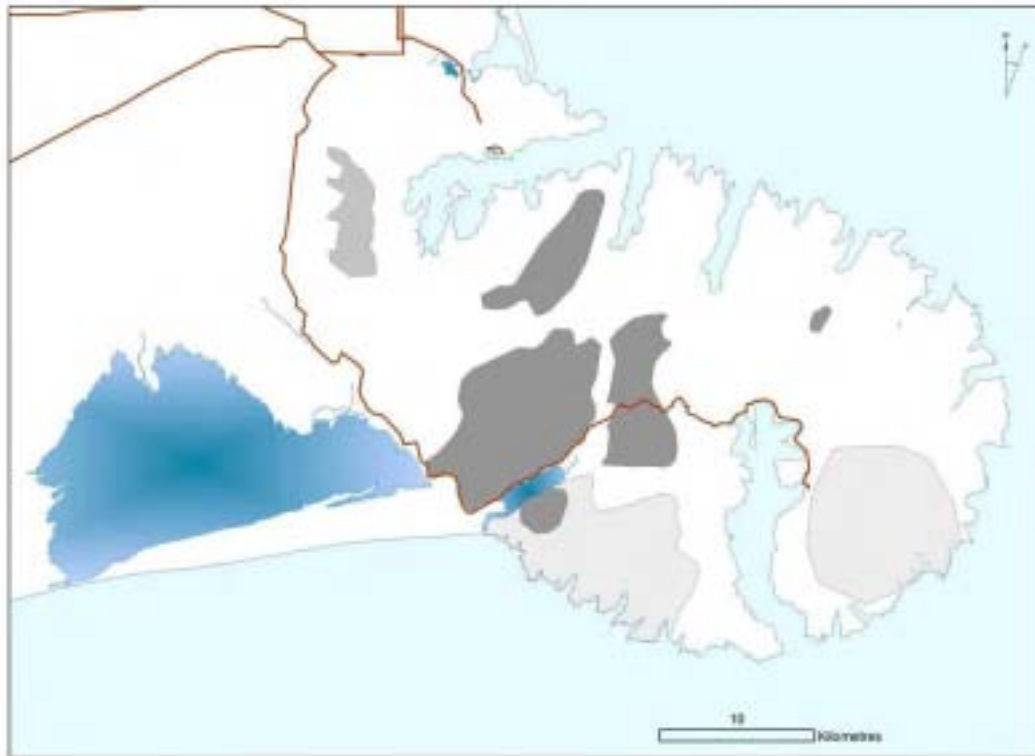


Figure A5.1 Current and recent distribution of feral goats on Banks Peninsula. Goats have been eliminated from the lightly shaded areas in the east. Control was undertaken more recently in the central and Port Hills blocks which are in a 'mop up' phase.

Impacts on biodiversity: Goats are agile animals and can gain access to all but the steepest bluffs on the Peninsula. They damage individual plant species but perhaps their main impact is to alter the plant successions that are so important on Banks Peninsula. Browsing by goats will change the composition of native forest understoreys and eventually the structure of the forest itself, and their selective browsing in woody scrub habitats (both native and weedy) will either slow their reversion to native forests (the native successional species such as mahoe and broadleaf are highly palatable to goats), or alter the composition of the final vegetation community.

Impacts on production: Feral goats compete with livestock when at high densities, and their removal is needed before land uses such as plantation forestry is possible. Feral goats also share some diseases and parasites with domestic animals.

Current management: Fortunately feral goats can be eradicated and the problem solved – provided that domestic goats are managed effectively, i.e. banned or fenced and escapees dealt with. A recent survey identified nine domestic goat herds on the Peninsula (Parkes 2005). The current eradication campaign has removed feral goats from the eastern half of the Peninsula, reduced them to remnant populations in the centre, and is beginning the attack on those on the Port Hills - over 1500 goats have been shot in this area in 2006 (Fig. 8).

Control methods: There are well-proven methods to control feral goats (aerial and ground shooting) that are already in operation on the Peninsula (Parkes 2005).



Photo A5.1 Feral billy goats (Photo: Landcare Research)

Skilled hunters are best, particularly if there are many goats or they are in difficult places, because goats are smart animals and any that escape initial control are very cunning and hard to get subsequently. The skilled hunters attempt to kill all the target animals at first encounter and use appropriate methods (a helicopter or hunters with trained dogs) to do this.

Monitoring methods: Because eradication is the aim, the monitoring issue on the Peninsula is presence/absence, rather than how many goats. There is a hotline for reporting sightings of feral goats (Ph. 03 325 1215; Dave Hunter) so that the animals can be dealt with by Target Pest. Landowners can deal with any goats themselves but it is recommended that they use this hotline to get the professional hunters to do the work rather than attempt to shoot the animals themselves.

Information on feral goat control:

Parkes, J. 2005. Feral goat. Pp. 361–382. In: King, C.M. (Editor). *The handbook of New Zealand mammals*. Oxford University Press, Melbourne, Australia.

Red and fallow deer (*Cervus elaphus* and *Dama dama*)

Distribution and density: Deer prefer grassland and tussock habitats but with access to forested areas as shelter, although they can thrive in all habitats. There are wild populations of red deer and fallow deer on the Port Hills (Fig. 9). Current numbers of both species are low, probably less than 100 animals in total following control of red deer (by aerial poisoning and shooting in the early 1990s as part of the bovine Tb control campaign) and by ground hunting of fallow deer in recent years. Red deer are farmed on the Peninsula, and escapes from these farms present an ongoing risk that new wild herds will establish.

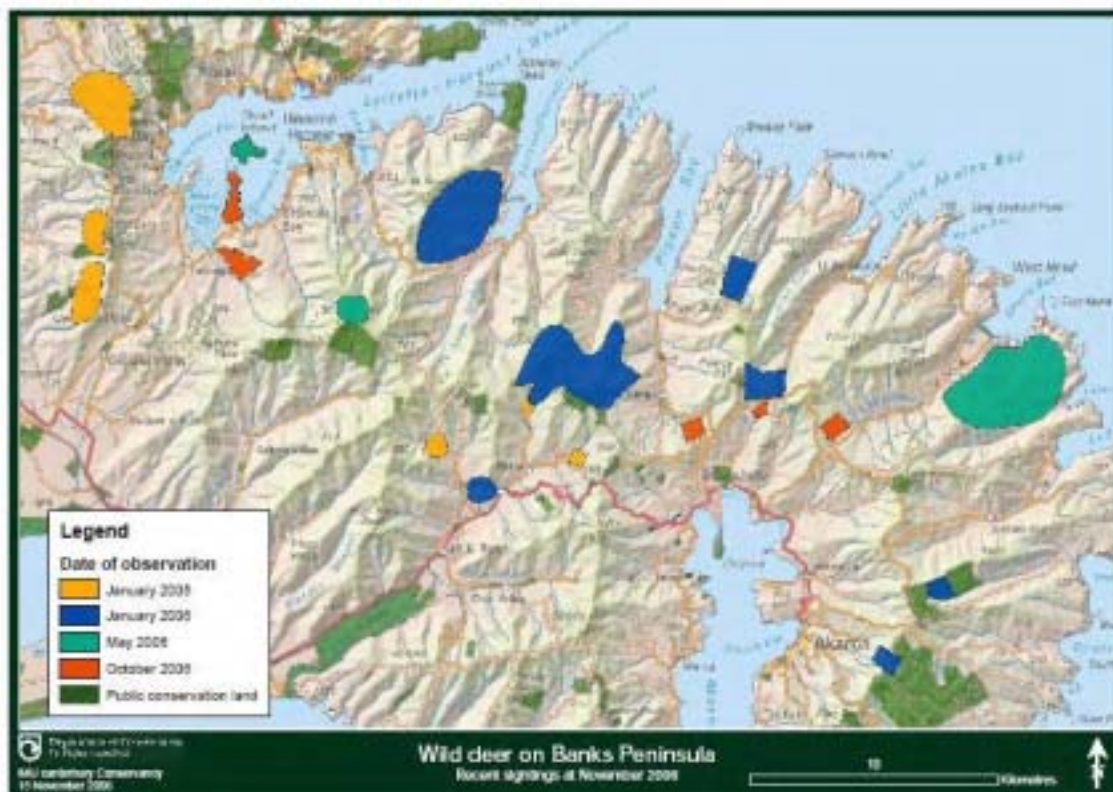


Figure A5.2 Distribution of wild red and fallow deer on Banks Peninsula.

Impacts on biodiversity: Like feral goats, deer impacts are largely in the way their feeding alters plant communities by removal of understorey plants in forests (Nugent 2005).

Impacts on production: Deer can act as reservoirs and transmitters of bovine Tb, although they do not sustain the disease by themselves in the wild. Nevertheless, deer are thought to have been the key initial link that established the disease in possums in New Zealand (Nugent 2005) so present a risk in areas where Tb has been eradicated.

Current management: The current populations of wild deer could technically be eradicated from the Peninsula (as has been achieved for small, new herds in Northland) although there may be opposition to doing this by some landowners. Current management is largely by recreational hunting, and any attempt to follow the plan used for goats would require considerable negotiation with landowners and hunters.

However, we should at least stop deer spreading on the Peninsula. Surveillance and prompt action against escaping deer has successfully removed all but one herd of recent populations in Northland (Fraser *et al.* 2003). Red deer appear easier to eradicate than fallow deer – many small red deer herds have been removed, but attempts to eradicate fallow deer in Taranaki and on D'Urville Island have failed (Fraser *et al.* 2003).

Management of the risks from deer farms (and goat farms) can be proactive or reactive – the balance depending on the actual risks and causes of escapes and on the costs to deal with them. The Department of Conservation is developing some proactive policies, specifying where deer may be farmed and ensuring fences are of an adequate standard especially in areas where wild deer are not present (DOC 2005). But of course some animals will always escape and a reactive plan to report such events (via a hotline) and prompt action to recapture or kill the escapees is required.

Control methods: Aerial and ground hunting (often with trained dogs) are the standard methods to control deer, although natural-foliage-bait poisoning can be used in special cases. The standard methods are sufficient to deal with the problems on the Peninsula.

Monitoring methods: Faecal-pellet counts (e.g. Forsyth 2005) or catch-per-unit-effort data (Fraser & Nugent 2003) can be used to measure deer density indices and trends in numbers. However, as with goats, if eradication is the aim then presence/absence is the measure required.



Photo A5.2 Fallow buck and doe (*Photo: Landcare Research*)

Information on deer control:

Forsyth, D.M. 2005. Protocol for estimating changes in the relative abundance of deer in New Zealand forests using the Faecal Pellet Index (FPI). Landcare Research Contract Report LC0506/27.

Fraser, K.W.; Nugent, G. 2003. Deer control operations in the Murchison Mountains. Landcare Research Contract Report LC0203/178.

Nugent, G. 2005. Red deer. Pp. 390–401. In: King, C.M. (Editor). *The handbook of New Zealand mammals*. Oxford University Press, Melbourne, Australia.

Nugent, G.; Asher, G. 2005. Fallow deer. Pp. 429–439 In: King, C.M. (Editor). *The handbook of New Zealand mammals*. Oxford University Press, Melbourne, Australia.

Feral pigs (*Sus scrofa*)

Distribution and density: Feral pigs have been liberated on the Peninsula by hunters in recent years. Low densities have been reported in the area shown in Fig. 10.

Impacts on biodiversity: Feral pigs have two potential impacts on native biota. First, they are omnivores whose diet includes a large proportion of invertebrates. Second, they obtain these invertebrates and the roots and rhizomes of plants by rooting the soil. In areas in the Conway Hills in North Canterbury for example, about 5% of the total area shows evidence of rooting. The ecological consequences of these impacts are largely unknown.

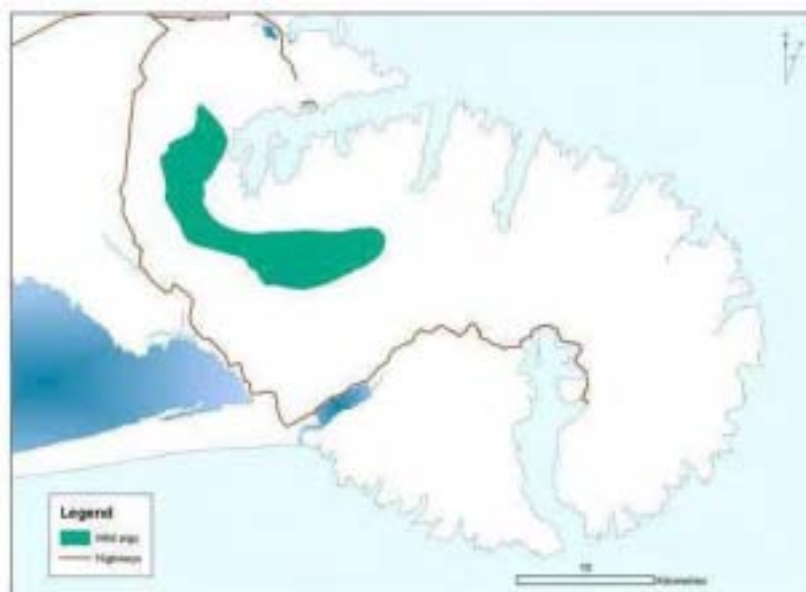


Figure A5.3 Distribution of feral pigs on Banks Peninsula.

Impacts on production: Illegal liberations of feral pigs are a serious risk for reintroducing Tb to the Peninsula as a high proportion of pigs in places like North Canterbury are infected. Feral pigs can also be a nuisance to farmers by rooting pasture and killing lambs.

Current management: It would be possible to eradicate feral pigs from the Peninsula, although an ongoing surveillance and reaction strategy to deal with new arrivals would be necessary. Current management is largely by recreational hunters and any attempt at eradication would require their cooperation, otherwise new animals will continue to be released.

Control methods: Trapping, aerial shooting, and ground hunting using dogs to find the pigs are standard methods to control pigs.

Monitoring methods: There are no simple methods, although changes in kill rates can give short-term measures of changes in density. However, pig densities can fluctuate naturally so care needs to be taken in interpreting such indices.

Information on pig control:

McIlroy, J.C. 2005. Feral pig. Pp. 325–335. In: King, C.M. (Editor). *The handbook of New Zealand mammals*. Oxford University Press, Melbourne, Australia.

Possums (*Trichosurus vulpecula*)

Distribution and density: Possums are almost ubiquitous on the Peninsula but reach highest densities in forest and scrub habitats. Possums are now at relatively low densities where control is conducted.

Impacts on biodiversity: Possums have a wide range of impacts on biodiversity values (Montague 2000). They damage and can kill trees, shrubs, and herbs (both native and introduced). The patterns of damage are complex and vary for the same plant species between places and between individuals at the same place. For example, possums kill most fuchsia and mistletoes in many places, but on Banks Peninsula both fuchsia and mistletoes are common although apparently just as palatable as these species elsewhere (Sweetapple & Nugent 1999).

Possums are also predators and eat birds' eggs and chicks and insects. For example, possums were responsible for 6% of predation on keruru nests in Northland (Pierce & Graham 1995).

Impacts on production: Possums can damage plantation trees and soil conservation plantings, and can locally damage crops such as swedes. In pasture, they prefer clovers and herbs to grasses and are not usually serious competitors with livestock. Their main impact to production values is as the main wildlife vector of bovine tuberculosis (Tb) (Livingstone 2000). The disease was present on Banks Peninsula until the late 1990s, but has been successfully eradicated. Currently the Peninsula is still classed as a 'Vector Risk Area' and the Canterbury Regional Animal Health Committee continues to survey at-risk wildlife, especially in the east of the Peninsula, to be sure there is no Tb present. There may be a case for ongoing control of possums on the Peninsula to reduce the risk of Tb re-establishing in wildlife and domestic stock should it return via the arrival of infectious domestic stock or the illegal liberation of animals such as feral pigs or deer.



Photo A5.3 Possum and back young (*Photo: K. Drew*)

Current management: Possums cannot be eradicated from the Peninsula but their numbers can be reduced and held at very low densities by sustained control. Possum numbers do not fluctuate naturally as much as rodent and rabbit populations so the best control strategy is to reduce the population to a low level and then apply maintenance control to keep numbers down.

Where possums are controlled to protect highly vulnerable ecosystems or threatened species, a strategy of continuous or annual control (a 'press' strategy; Hickling 1995) is recommended.

Possum control over the entire Banks Peninsula Pest District in rural areas commenced in 2007 on a four year cycle beginning at the south-western bays. For areas with high ecological values vulnerable to possums, and for urban areas, supplemental possum control would be advantageous.

Control methods: There are a number of effective control methods for possums and the best one will vary according to who you are (only licensed people can use some toxins), your preferences, the frequency of control required, and what you are trying to protect over what scale. For the 'press' strategy, control tools such as trapping with periodic use of Feratox® encapsulated cyanide is recommended over relatively small areas. Trapping alone may leave a significant number of untrappable possums in the residual population.

Aerial poisoning using 1080 baits is usually recommended for large-scale initial control of possums. The method has the advantage of killing rodents and some mustelids, but is difficult

to apply over much of Banks Peninsula with its mosaic of land uses and tenures. It can only be used by government agencies or their agents.

An excellent source of information is the 32 page booklet 'Private land owners guide to possum control. Practical tools and techniques for controlling possums on private land' by the National Possum Control Agencies, Wellington, website: www.npca.org.nz.

Monitoring methods: A trap-catch index method developed for the National Possum Control Agencies is the approved standard method for giving an index of possum density or percent kill from before-and-after control operations.

An alternative method using an index based on possum interference with WaxTag® is being developed for use especially where trapping may put native birds such as kiwi and weka at risk – not a problem as yet on the Peninsula. Training is required to interpret the bite marks on the WaxTags. The method has been recommended for use by CCC in the Port Hills (Thomas 2005).

Additional information on possum control:

- Hickling, G.J. 2005. Action thresholds and target densities for possum pest management. Pp. 47–52. In: O'Donnell, C.F.J. (Compiler), Possums as conservation pests. Proceedings of a workshop on possums as conservation pests, Christchurch. Department of Conservation, Wellington. Montague, T.L. 2000 (Editor). The brushtail possum. Biology, impact and management of an introduced marsupial. Manaaki Whenua Press, Lincoln, 292 p.
- NPCA 2001. Users' guide to legislation relating to possum control. National Possum Control Agencies, Wellington, 79 p www.npca.org.nz
- NPCA 2004. Possum population monitoring using the trap-catch method. National Possum Control Agencies, Wellington, 30 p www.npca.org.nz
- NPCA 2005. Protocol for low-density possum monitoring using the WaxTag® method. National Possum Control Agencies, Wellington, 22 p www.npca.org.nz
- Cowan, P.E. 2005. Possum. Pp. 64–77. In: King, C.M. (Editor). *The handbook of New Zealand mammals*. Oxford University Press, Melbourne.

Rabbits (*Oryctolagus cuniculus*)

Distribution and density: Rabbits prefer light soils, drier areas, and grasslands at lower altitudes on the Peninsula (Fig. 11). Rabbit numbers fluctuate with the seasons, especially since the arrival of rabbit haemorrhagic disease (RHD).

In the areas on the Peninsula rated for rabbit control under the Canterbury Regional Pest Management Strategy (RPMS), rabbits have generally been held at low and stable densities of about 2 rabbits per spotlight kilometre since 2000.

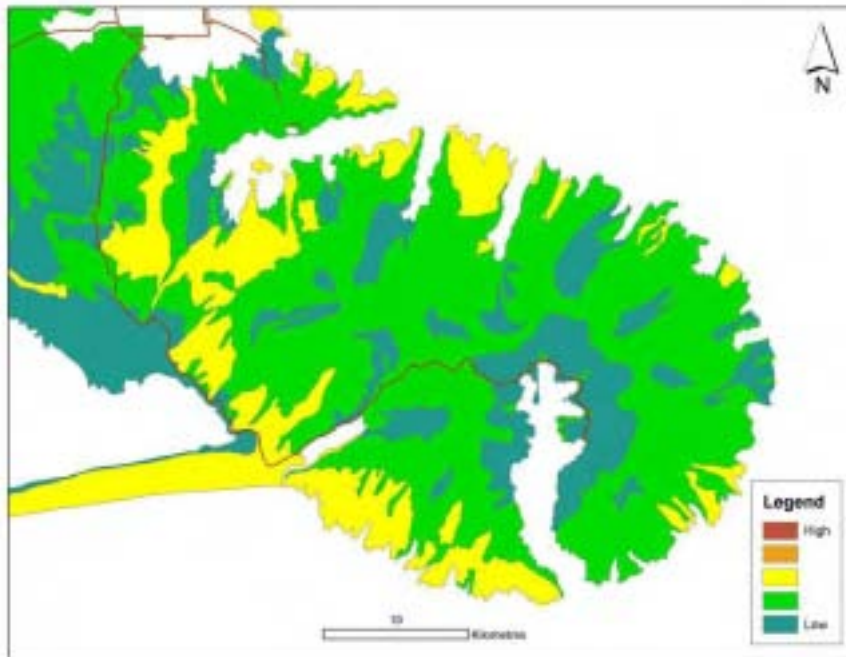


Figure A5.4 Ranking of land according to its potential to support rabbits. Rabbit proneness is based on soil type, vegetation, and climate. The Peninsula does not have habitats that support the extreme densities of rabbits found in the drier inland parts of Canterbury, Otago, and Marlborough.

Impacts on biodiversity: Rabbits are responsible for the decline of plants such as pingao (*Desmoschoenus spiralis*) and the native prostrate broom (*Carmichaelia appressa*) on Kaitorete Spit (Courtney 1983), but elsewhere on the Peninsula their specific impacts are not known.

Rabbits have indirect impacts on native fauna because they are primary prey of predators that are 'rabbit specialists' such as ferrets and feral cats. The density of these predators usually depends on the density of rabbits (the reverse is not usually true). The native animals (e.g. penguins, other birds and lizards) are secondary prey because the predators do not rely on them as food. Thus, rabbits (and rodents) drive the abundance of predators and are safe from extinction because as their numbers drop so do the numbers of predators. However, the rarer native secondary prey get caught in the crossfire – they get eaten as bycatch by the predators and can get driven to extinction (Sinclair 2004).

Impacts on production: Rabbits can reach densities of 30 per hectare in highly prone habitats, and cause severe degradation of the vegetation and soil leading to reduced ability of the land to support domestic stock. Rabbit burrowing on the loess soils of the Peninsula can lead to local erosion.

Current management: Rabbits cannot be eradicated from the Peninsula, so sustained control is the only widespread option. ECan rates peninsula landowners according to the proneness of their land (see Fig. 12) and then controls rabbits using conventional methods if they exceed set densities, i.e., where RHD is less successful. Rabbits can be fenced out of high-priority areas.

The fluctuations in rabbit numbers and the presence of RHD mean that decisions on whether to add conventional control are more complicated than in the past. Rabbits breed from June through to February, but most young are produced during the spring (Norbury & Reddiex 2005). Numbers can get quite high over late spring and early summer before the usual annual RHD epidemic in autumn (Parkes *et al.* 2002). However, it is not so easy to shoot or poison rabbits in the spring and summer, and in any case most will die in the next RHD epidemic. So unless the impact of the peak population is intolerable, the best strategy is to wait until after the

RHD epidemic and then poison or shoot the survivors during the winter to reduce the number of rabbits surviving to breed during subsequent years.

Control methods: Rabbit numbers can be reduced by traditional means (shooting and poisoning) and by the biological control from RHD. Baits containing RHD virus are available from ECan for small-scale use as a biocide to deal with hotspots of rabbits.

The RHD virus arrived on the Peninsula in 1997/98 and has been present every year with epidemics that usually occur each autumn. Attempts to start epidemics using baits impregnated with the virus have usually failed (D. Hunter, Target Pest, pers. comm.), except in the autumn when natural epidemics are expected anyway. However, using RHD baits as a biocide (i.e. one bait per rabbit) is an option to control local populations of rabbits. In this case, the RHD-baits work much like ordinary toxic bait, as any susceptible rabbit that eats one will die. Problems can arise when a high proportion of rabbits that have survived a natural epidemic do so because they have caught the disease and survived. These individuals (but not their offspring) are immune for life.



Photo A5.4 Rabbit (Photo: Landcare Research)

Monitoring methods: The standard way to measure rabbit densities or the effect of control is by counting rabbits along a set route at night using a spotlight (Caley & Morley 2002). This method gives good measures of trends in numbers provided like is compared with like, i.e. the routes are measured under similar weather conditions, at the same time of year, and there has been no major change in the height of the vegetation.

The McLean's scale is an alternative method to estimate relative densities of rabbits based on scoring rabbit sign (dung, scratchings in the soil, rabbits seen). It requires trained observers to be consistent (Norbury *et al.* 2001).

Information on rabbit control:

Norbury, G.; Reddiex, B. 2005. Rabbit. Pp. 129–147. In: King, C.M. (Editor). *The handbook of New Zealand mammals*. Oxford University Press, Melbourne, Australia.

Rabbit Manager's Fact Pack 1991. Ministry of Agriculture and Fisheries.

Ship rats (*Rattus rattus*)

Distribution and density: Ship (or black) rats are the most common rat in native habitats in New Zealand. Ship rats will be present in all forest and scrub habitats on the Peninsula. Their numbers appear to be relatively stable in mixed podocarp/hardwood forests (where they can reach densities of up to 6.2/ha; Innes 2005a), but fluctuate widely in beech forests. In beech

forests, ship rat numbers can remain very low (and almost undetectable) for many years and only increase when the beech seeds in a so-called mast year (Richardson *et al.* 2005).

Impacts on biodiversity: Ship rats are good climbers and major predators of native birds and invertebrates. They have been responsible for recent extinctions of birds such as mohua (*Mohoua ochrocephala*) in beech forests where the birds were already under threat from stoats (e.g. at Mt Stokes in Marlborough (Gaze 2001)). On Banks Peninsula, ship rats are likely to reduce the densities of all the common native (and introduced) birds, reptiles, and many insects, including the threatened Banks Peninsula tree weta (*Hemideina ricta*) (Sherley 1998), and limit the successful reintroduction of animals lost from the area.



Photo A5.5 Ship rat killing a fantail on its nest (photo David Mudge)

Impacts on production: Small.

Current management: Ship rats cannot be eradicated from the Peninsula and can only be removed entirely from behind rat-proof fences (e.g. the fence around Riccarton Bush). Their numbers can be controlled by trapping, poisoning in bait stations, or by aerial baiting – with increasing certainty. The tricky bit is deciding when to do it. Apart from some baiting against rats by the CCC on the Port Hills in Kennedy's Bush Reserve, little control is being attempted on the Peninsula.

Ship rats usually breed from mid-September through to late April in podocarp/hardwood forests but in beech forests (after seed masts) they breed on after April until the seeds germinate in spring and so reach high densities just when most birds are nesting and are most vulnerable.

In mixed forests, where rodent numbers are relatively stable from year to year, a continuous control strategy (using traps and/or bait stations) has worked in some North Island forests. However, this will waste effort in beech forests where rats are virtually absent for most of the time. In these forests, fluctuating densities and acute, but periodic, impacts make it difficult to know when to spend money attempting to control rats.

Control methods: On Banks Peninsula, kill-trapping and the use of toxins in bait stations are recommended. Kill-trapping using Victor professional snapback traps set at 50-m intervals in tunnels to protect birds (and lured with peanut butter, peanut butter/rolled oats, or with white chocolate buttons) can control rat populations that are not subject to large natural fluctuations (Saunders 2000), but cannot halt the eruption of rats after good seeding or fruiting events. In

the latter case, the use of toxic baits in bait stations or aerially sown is the only practical method of control.

Several toxins (all within bait stations) are available for rat control for use on Banks Peninsula where aerial baiting is not usually possible. Stations need to be set at no greater than 100 × 150 m apart.

Brodifacoum has the advantage of killing both rats and the predators that eat the rats, but it is persistent in the food chain (Spurr et al. 2005) and its regular use is not recommended.

First-generation anticoagulants, such as diphacinone and warfarin, require rats to eat bait for at least 5 days, so effort has to be made to ensure fresh bait is available at all stations for at least this period. These toxins are less persistent than the second-generation anticoagulants and are less toxic to birds – but are less effective against rats and ongoing use leads to genetic resistance in rodents.

Sustaining low densities of ship rats (and mice) is often a problem. The species have high rates of increase and our control tools all come with disadvantages. A recommended strategy for small areas is to use trapping as a first control tool and switch to bait stations only when monitoring indicates an eruption is likely. Brodifacoum is the best toxin to kill rats, but should only be used once every 3 or 4 years. If a second poisoning is warranted within that time, cholecalciferol, cereal 1080 baits, or a first-generation anticoagulant should be used.

Monitoring methods: The standard DOC method to monitor rats is by using tracking tunnels, particularly to assess whether the population is increasing and toxic baiting warranted.

Thomas (2005) recommends WaxTags as an index of possum and rat abundance (NPCA 2005) and recommends control once 10% or more of the tags are bitten by either species over 7 nights.

Information on ship rat control:

Department of Conservation 2005. Animal pests best practice. Available from DOC quoting the 'Hamro' code below.

1. Using tracking tunnels to monitor rodents and stoats. Hamro-66179
2. Rat control – aerial application of 1080 cereal bait. Hamro-77826
3. Rat control – 2nd generation anti-coagulants in bait station. Hamro-62378
4. Rat control – bait stations using 1080 cereal baits. Hamro-62490
5. Kill trapping for rat control. Hamro-62306
6. Rat control – 1st generation anticoagulants in bait stations.

Innes, J. 2005a. Ship rat. Pp. 181–197. In: King, C.M. (Editor). *The handbook of New Zealand mammals*. Oxford University Press, Melbourne, Australia.

NPCA 2005. Protocol for low-density possum monitoring using the WaxTag® method. National Possum Control Agencies, Wellington, 22 p www.npca.org.nz

Ferrets (*Mustela furo*)

Distribution and density: Ferrets specialise in eating rabbits so are found in highest numbers where these primary prey are present.

Impacts on biodiversity: Birds are common secondary prey items in the diet of ferrets and they are perhaps the key threat to white-flipped (*Eudyptula minor albosignata*) and hoiho (*Megadyptes antipodes*) penguins on Banks Peninsula (McKinley 2001) (see the module on penguins). They also prey on other ground-nesting birds (including petrels and oystercatchers) and on lizards (Clapperton & Byrom 2005).

Impacts on production: Ferrets have a high prevalence of bovine Tb and may be involved in the maintenance of the disease in wildlife in places like North Canterbury where their densities may exceed 4/km².

Current management: Ferrets cannot be eradicated from Banks Peninsula but can be controlled. Active trapping occurs around penguin breeding colonies in the eastern peninsula.

Ferrets are hard to trap in winter/spring, and trapping in spring and summer tends to kill adults and thereby improve juvenile survival as the latter rapidly disperse (in February-March) into the home ranges vacated when resident adults are removed. Ferrets generally only produce one litter each year in October–November. Therefore, it seems best to conduct widespread control of ferrets after the juveniles have dispersed (i.e. in the late autumn) and so attempt to limit the population size when birds such as penguins are producing chicks in early November. Control during the spring is inefficient but might be best focussed around penguin nesting areas.

Control methods: DOC recommends using the DOC 250 trap, which has passed National Animal Welfare guidelines. Traps are set in a tunnel or under a cover to reduce non-target risks, and lured with meat or hen eggs (the latter if stoats are also targeted).

Other traps are available (see the link to different manufacturers' traps on the Landcare Research website on ferrets listed below), but none are as effective or humane as the DOC 250 trap.

Monitoring methods: As with stoats, trapping rates are only a crude measure of ferret numbers and DOC recommends using tracking tunnels as the way to monitor ferrets (see Hamro-66179).

Information on ferret control:

Blair, D. 2005. Mustelid trapping field guide. Yellow-eyed Penguin Trust, Dunedin, 27 p.
www.yellow-eyedpenguin.org.nz

Clapperton, B.K.; Byrom, A. 2005. Feral ferret. Pp. 283–292. In: King, C.M. (Editor). *The handbook of New Zealand mammals*. Oxford University Press, Melbourne, Australia.

Department of Conservation 2005. Ferret control – kill trapping. Hamro-61526 and Hamro-86136.

Landcare Research 2005. Ferrets. www.landcareresearch.co.nz/research/biosecurity/



Photo A5.6 Feral ferret (*Photo: Grant Morriss*)

Feral cats (*Felis catus*)

Distribution and density: Feral cats are widespread on the Peninsula but are most common where rabbits occur. There is no information on their densities on the Peninsula, but on farmland in the Hawke's Bay, there were between 3 and 5.6 cats/km² (Langham & Porter 1991).

Impacts on biodiversity: Rabbits or rats are important food for feral cats and largely determine the density of cats on the mainland. This leaves native birds and reptiles as secondary prey and the vulnerability that goes with that status. Cats are significant predators of ground-nesting birds and especially of lizards (Gillies & Fitzgerald 2005).

Impacts on production: Small.

Current management: Feral cats cannot be eradicated from the Peninsula and control is always complicated by the unknown contribution of semi-domestic cats in sustaining feral populations. Feral cats are trapped as part of the penguin protection operations in the eastern peninsula and to support Ngai Tahu's kereru protection operations. Perimeter traps around the CCC Kennedy's bush reserve also target cats moving into and out of the reserve.

Control methods: Cats can be shot, but trapping is the main control tool currently available. Traps that catch the cats alive such as leg-hold or cage traps have to be checked daily, but approved traps (e.g. the Timms Trap and the Steve Allan trap) that kill the cat can be left without daily checks.

Monitoring methods: There are no methods to monitor cat numbers or trends after control other than kill-rates that can be used routinely by managers.



Photo A5.7 Feral cat (Photo: Landcare Research)

Information on cat control:

Gillies, C.; Fitzgerald, B.M. 2005. Feral cat. Pp. 288–318. In: King, C.M. (Editor). *The handbook of New Zealand mammals*. Oxford University Press, Melbourne, Australia.

Stoats (*Mustela erminea*)

Distribution and density: Stoats are found almost everywhere on the Peninsula and their densities fluctuate with the season and over time according to their primary food (rodents) availability.

Impacts on biodiversity: Stoats are good climbers and a major threat to native birds, especially those that nest in holes – in fact all such species (e.g. mohua, kaka (*Nestor meridionalis*), kakariki (*Cyanoramphus* spp.) are now absent from the Peninsula and are unlikely to be restorable without control of stoats (and ship rats). Stoats also kill most other small- to middle-sized birds and so affect their abundance. They may also kill penguins, although they are not thought to be the critical predators of these birds (Challies & Burleigh 2004).

Impacts on production: No direct impacts known.

Current management: Stoats cannot be eradicated from the Peninsula but can be controlled either directly by killing them in traps or by secondary poisoning of their rodent prey, or indirectly by controlling their primary prey and depriving them of food – which is usually as difficult and expensive as killing the stoats themselves. Stoats are currently trapped along the Port Hills and in areas where penguins nest in the eastern peninsula.

The biology of stoats and their prey means managers must intervene with control at the optimum timing and scale. Stoats give birth to a single litter in mid- to late-October, and the litter size and their survival is related to the supply of their primary prey and other food such as birds, lizards, fish, invertebrates, rabbits, hares, and possums. The young disperse in early February and rapidly recolonise any areas made vacant by control efforts. They have large home ranges, often of 100–300 ha.

Their impact on native animals can be seasonally acute (e.g. on hole-nesting birds during their breeding season or on penguin chicks) and especially when this coincides with peak stoat densities in the spring and summer. Impacts can also be chronic and spread over the whole year (e.g. on lizards or kiwi chicks).

Stoat control is very expensive as it has to be done at either a large scale to deal with stoats' mobility and high rates of immigration, or very intensively to kill resident stoats and immigrants as they arrive in the operational area. Control is made even more difficult in their breeding season when adult females are very hard to trap. All female stoats (including young in the nest) are pregnant in spring so killing the polygynous adult males over this period has no effect on subsequent population eruptions.

Two general recommendations are possible. First, where the impact of stoats is acute and seasonal, it might be best to concentrate control efforts to just before and during the period of prey vulnerability. Second, where the impact of stoats is chronic throughout the year (but may fluctuate between years according to stoat numbers), it might be best to focus control during late winter and early spring before the season of births to try to limit the subsequent breeding pulse.

Control methods: Stoats can be trapped using DOC's new stoat trap (the DOC 200). If both stoats and ferrets are targeted, then the DOC 250 trap should be used. Fenn traps are still used but these do not meet National Animal Welfare Advisory Committee's guidelines for kill traps and are likely to be phased out.

The traps should be set in a tunnel or cover to guide the stoat and keep out non-target birds. Paired traps in each tunnel significantly improve kill rates. The trap should be lured with fresh rabbit meat, fresh white whole egg, or freeze-dried rat, and checked at intervals depending on the expected life of the lure.

Stoats are also killed when their primary prey are poisoned with 1080 or with brodifacoum.

Monitoring methods: Trap-catch rates are only a crude measure of changes in stoat numbers. Single estimates may also provide false information on the size of the residual (post-control) population which is likely to be trap-shy.

DOC recommends using tracking tunnels to monitor stoat numbers or the effectiveness of control (see Hamro-66179).



Photo A5.8 Stoat (*Photo: Landcare Research*)

Information on stoat control:

Blair, D. 2005. Mustelid trapping field guide. Yellow-eyed Penguin Trust, Dunedin, 27 p.
www.yellow-eyedpenguin.org.nz

Department of Conservation 2005. Using tracking tunnels to monitor rodents and mustelids. Hamro-66179.

King, C.M.; Murphy, E.C. 2005. Stoat. Pp. 252-270. In: King, C.M. (Editor). *The handbook of New Zealand mammals*. Oxford University Press, Melbourne, Australia.

Hedgehogs (*Erinaceus europaeus*)

Distribution and density: Hedgehogs are widespread and common on Banks Peninsula although there are no estimates of their densities.

Impacts on biodiversity: Hedgehogs are insectivores, and presumably have an adverse effect on the Peninsula's invertebrate fauna, but they will eat nearly anything they can catch. They are significant predators of the eggs of ground-nesting birds (e.g. hedgehogs were responsible for 19% of predation of birds' eggs in braided river beds of the Mackenzie Basin in one study; Sanders & Maloney 2002).

Current management: Sustained control is the only option and hedgehogs are trapped in the predator control programmes to protect penguins.

Control methods: Hedgehogs can be controlled by trapping (Thomsen *et al.* 2000) or simply by catching them at night and killing them. There are no data on how effective these methods are at reducing hedgehog populations.



Photo A5.9 Hedgehog (Photo: Landcare Research)

Monitoring methods: Kill rates are an unreliable method of monitoring hedgehog numbers because new animals constantly disperse into any areas under control.

Information on hedgehog control:

Jones, C.; Sanders, M.D. 2005. Pp. 82–94. In: King, C.M. (Editor). *The handbook of New Zealand mammals*. Oxford University Press, Melbourne, Australia.

Thomsen, T.; Bowie, M.; Hickling, G. 2000. The potential for eradication of hedgehogs (*Erinaceus europaeus*) from Quail Island, Banks Peninsula. Report to DOC and the Quail Island Restoration Trust, 8 p.

Hares (*Lepus europaeus*)

Distribution and density: Like rabbits, hares prefer grassland habitats, but unlike rabbits they are equally at home in the taller grasslands at higher altitudes. In other places in New Zealand, the reduction in rabbit numbers caused by RHD has allowed hare numbers to increase, although they never reach the high densities of their smaller cousins.



Photo A5.10 Hare (Photo: Landcare Research)

Impacts on biodiversity: Like rabbits, hares can threaten native plants (they particularly prefer some of the native *Carmichaelia* spp. brooms) and are a nuisance to people trying to restore woody vegetation by planting seedlings as they have the annoying habit of snipping off small woody plants at the base.

Impacts on production: Hares damage amenity and plantation plantings. Otherwise their competition with stock and damage to crops is relatively minor.

Current management: Hares cannot be eradicated from Banks Peninsula so sustained control is the only option unless they are fenced out of priority areas. Hares are not targeted in any control on the Peninsula.

Control methods: Hares can be reduced where needed by spotlight shooting or poisoning. Boiled oats lured with molasses or rose oil with either 1080 or pindone have been used to control hares, traditionally in the summer and autumn.

Monitoring methods: Trends in hare densities can be assessed along the same spotlight routes used for rabbits.

Information on hare control:

Norbury, G.; Flux, J.E.C. 2005. European hare. Pp. 148–155. In: King, C.M. (Editor). *The handbook of New Zealand mammals*. Oxford University Press, Melbourne, Australia.
Rabbit Manager's Fact Pack 1991. Ministry of Agriculture and Fisheries.

Norway rats (*Rattus norvegicus*)

Distribution and density: Norway rats now largely live in towns and cities and are only patchily distributed in New Zealand forests. They burrow and are not good climbers. Densities on the Peninsula are unknown.

Impacts on biodiversity: Norway rats have major impacts on seabirds and insects on islands, and certainly had similar effects on the mainland when they were the most common rat species present through most of the 19th century – they were largely replaced by ship rats after about 1900 (Innes 2005b). It is possible that Norway rats near beach-side communities may eat the eggs and chicks of the white-flipped penguins that often nest in such places.

Impacts on production: Now limited, but a nuisance around houses.

Current management: Sustained control is the only option and control is largely restricted to commensal animals. Bait stations every 100m are throughout Kennedys Bush reserve

Control methods: Baiting with commercial rat baits or trapping with snap-traps are the common methods of control.

Monitoring methods: Trapping rates give a crude method of estimating changes in numbers.

Information on Norway rat control:

Innes, J. 2005b. Norway rat. Pp. 169–180. In: King, C.M. (Editor). *The handbook of New Zealand mammals*. Oxford University Press, Melbourne, Australia.

Mice (*Mus musculus*)

Distribution and density: Mice are widespread on the Peninsula. Elsewhere, mice can reach densities of tens per hectare in years when seed availability is high (Ruscoe & Murphy 2005).

Impacts on biodiversity: Mice can eat nearly all the seed produced in beech mast years and although that may not limit the regeneration of beech, similar predation on seeds of other species may limit their survival. Mice also kill small seedlings and eat invertebrates – with native spiders being a favoured food (Ruscoe & Murphy 2005).

Mice also have a significant indirect effect on ecosystems as they drive the numbers of stoats that are present in many ecosystems in New Zealand.

Impacts on production: Mice have limited impacts on production values in New Zealand, but are a nuisance in houses and food storage areas.

Current management: It is unclear whether any strategy will be effective in halting eruptions of mice, although aerial poisoning aimed at possums or rats does cause a temporary reduction in mouse numbers – but often followed by a short-lived increase to even higher densities and then a decline to normal numbers. Mice are not managed on the Peninsula – other than as commensal pests.

Control methods: Mice can be controlled by poisoning. Mice have been eradicated from islands using brodifacoum baits (e.g. Torr 2002) but have rarely been targeted in sustained control operations on the mainland because the toxin would have to be applied so frequently to maintain low densities. Zinc phosphide baits are used to control mice in crops in Australia.

Monitoring methods: Trapping rates and tracking tunnel indices can be used to give crude estimates of mouse abundance or trends in population sizes.



Photo A5.11 Mouse (Photo: Caroline Thomson)

Information on mouse control:

Ruscoe, W.A.; Murphy, E.C. 2005. House mouse. Pp. 198–215. In: King, C.M. (Editor). *The handbook of New Zealand mammals*. Oxford University Press, Melbourne, Australia.

Weasels (*Mustela nivalis*)

Distribution and density: Weasels are probably widespread on the Peninsula, but their densities are unknown, but probably low.

Impacts on biodiversity: Weasels eat small animals such as mice (their main prey), birds, reptiles and insects such as weta (King 2005b). Their impacts on such species on Banks Peninsula is unknown.

Impacts on production: None known.

Current management: Sustained control is the only option and weasels are caught in the predator trapping programmes to protect penguins.

Control methods: Weasels are killed in traps set for stoats and they suffer secondary poisoning when rodents or possums are targeted, especially with anticoagulant baits. The efficacy of these methods is unknown.

Monitoring methods: Trapping rates give a crude measure of abundance and trends in numbers.

Information on weasel control:

Blair, D. 2005. Mustelid trapping field guide. Yellow-eyed Penguin Trust, Dunedin, 27 p.
www.yellow-eyedpenguin.org.nz

King, C.M. 2005b. Weasel. Pp. 277–282. In: King, C.M. (Editor). *The handbook of New Zealand mammals*. Oxford University Press, Melbourne, Australia.



