

**Rabbit and hare control  
in the coastal environment of New Zealand  
- Review and Recommendations**

**D.E. Unsworth**

**Forest Research, Rotorua**

**February 2005**



# CONTENTS

<b>Recommendations</b>	3
<b>Introduction</b>	4
<b>Description and Habits</b>	4
European Rabbit	4
European Brown Hare	6
<b>Control Methods</b>	6
Rabbit Control	7
Hare Control	9
<b>Monitoring populations before and after treatment</b>	10
<b>Summary</b>	11
<b>Acknowledgements</b>	11
<b>Bibliography and References</b>	12
Websites	13
Recent research in New Zealand	14

# **Rabbit and hare control in the coastal environment of New Zealand - Review and Recommendations**

**D.E. Unsworth  
Forest Research, Rotorua  
2005**

## ***Recommendations***

- ***The need for rabbit and hare control should be assessed before any planting programme is set up. Good communication between all groups involved is essential for success.***
- ***Control operations should aim at a minimum kill of 90%. Effective control of rabbits and hares in the first operation will mean that follow-up treatment will be simpler.***
- ***Long-term commitment to sustained treatment is needed to prevent recurrence of the destruction of planted material.***
- ***Monitoring of rabbit and hare populations provides a sound basis for an effective programme. Coastal dunes are often areas of high public use, so understanding of the extent of the pest problem is important. Public perception of the risks associated with pest control methods may be exaggerated, but legitimate concerns must be addressed. A detailed operation plan must be put in place.***
- ***Continued monitoring and evaluation will identify the success of control operations and allow effective targeting of follow-up treatment.***
- ***Factors affecting plant susceptibility to rabbit and hare browsing are:***
  - *palatability, some species and specific plant parts being more attractive than others*
  - *density of the rabbit/hare population*
  - *availability of an alternative feed source*
  - *size of plants*
  - *planting season*
  - *camouflage provided by surrounding vegetation*
- ***Poisoning with Pindone-treated baits is the single most effective method for controlling rabbits. Other methods are listed which may be suitable for specific sites, and combination of two or more methods is recommended. All safety precautions must be observed.***
- ***Night-shooting is likely to be most effective for hares.***
  - *Poisoning is not an effective method of control.*
  - *Regular shooting is the main control method.*
  - *Well-placed snares can be effective.*
- ***Repellents can discourage browsing of new plantings by both rabbits and hares, but must be applied several times a year to protect new growth.***

## Introduction

Damage caused by rabbits (*Oryctolagus cuniculus*) and hares (*Lepus europaeus occidentalis*) is acknowledged to be a major factor in the decline of coastal sand dune vegetation, particularly on open dunefields and in foredune environments. It is also a major contributor to the failure or decreased performance of dune revegetation programmes.

A wide range of control methods for rabbits and hares has been developed. Some are suited to large-scale control programmes; others are only practical on a small scale.

This document reviews current information, much of it anecdotal, on methods for effective reduction of population numbers in the New Zealand coastal environment. The need for assessment of populations of rabbits and hares and methods for monitoring numbers before and after control operations is also reviewed. Recommendations are made about control operations that are practical and cost-effective for implementation by coastal landowners, community and interest groups and managing authorities.

## Description and Habits

### European Rabbit (*Oryctolagus cuniculus*)

Rabbits are not part of the indigenous fauna of New Zealand and are a declared pest, causing considerable physical and economic damage throughout the country.

Several introductions of rabbits between 1777 (by Captain James Cook) and the 1830s are believed to have failed to become established in the wild. From the 1830s to 1850s, many more animals were introduced from Europe to provide fur, meat and game and by the 1870s plagues were recorded around Carterton (Rabbit Biocontrol Advisory Group 1996).

Rabbit damage is often significantly under-estimated on dunelands where browsing is a major contributor to the failure of revegetation projects. Dune areas are a favourable habitat where populations have the potential to reach high numbers and have a devastating impact on plant life, especially indigenous vegetation. This has resulted in reduction of plant numbers, reduced vegetation cover and local loss of species.

Ideal rabbit habitat has a low number of natural predators (such as cats and ferrets), rainfall less than 1000mm/year, a sunny aspect, light, sandy, well-draining soil and short vegetation in the vicinity of adequate cover provided by warrens, scrub or logs. Rabbits are nocturnal, spending most of the daylight hours below ground. Colonies can be extensive and occupy many interconnecting burrows. Burrowing increases the potential for sand erosion. Rabbits do not always live in burrows and in dune areas may inhabit patches of low, heavy vegetation or nearby buildings. Adult rabbits have a home range of approximately 2 – 4 hectares, emerging at dusk to eat. The males make communal mounds to deposit their faeces (buck heaps). Signs of rabbit presence are these droppings (dark, oval-shaped, 8 – 10mm), damaged vegetation, scratchings and burrows.

Rabbits are prolific breeders and are able to produce 30-35 young (kittens) in a season. They become sexually mature in 3-4 months and their young may produce another generation in the same season. A single pair of rabbits can increase the population in 18 months by 184 individuals. The main breeding season is spring to late summer, but if conditions are right, rabbits will breed at any time of the year.



### Description

- Body colour is lightish grey/ brown with black flecks, a reddish neck and white underparts.
- Adult weight is 1– 2kg depending on age, sex and season.

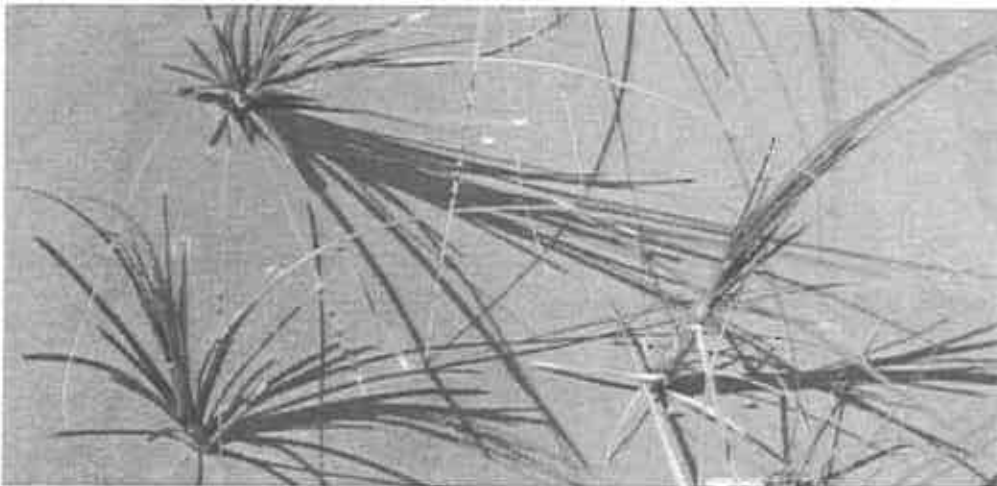
### Coastal distribution in New Zealand

- Rabbits are present in all coastal areas of New Zealand except along the coast between the Torere and Cape Runaway in the Eastern Bay of Plenty, a region bounded by steep ranges, wide rivers and narrow road bridges.
- Distribution is patchy with rabbit numbers fluctuating more than in pastoral areas. This is thought to be driven by differences in local climate.

### Preferred food sources

- In dune ecosystems rabbits will eat almost all plant species.
- They eat many native plants, selecting particular species over others. On the dunes, the faster-growing native sand-binders are preferred and browsing of the following has been noted, especially of young plants and new growth: (\* = most preferred)
  - \*shore spurge, *Euphorbia glauca*
  - \*pingao, *Desmoschoenus spiralis*
  - spinifex, *Spinifex sericeus*
  - sand tussock, *Austrofestuca littoralis*
  - pohuehue (wire vine), *Muehlenbeckia complexa*
  - tauhinu, *Ozothamnus leptophylla*
  - coastal toetoe, *Cortaderia fulvida*
  - cabbage tree, *Cordyline australis*
  - houpara (coastal fivefinger), *Pseudopanax lessonii*
  - karo (*Pittosporum crassifolium*)
  - pohutukawa, *Metrosideros excelsa*
- Rabbits will browse marram grass (*Ammophila arenaria*) though it is not a preferred food source.
- Seedlings and young plants are browsed preferentially. Nursery-raised plants are especially attractive possibly because they have a higher nutrient level than naturally regenerating plants. Nursery-raised plants may be browsed to ground level within 24 hours of being planted (Auckland Regional Council). On tree species, the bark and leaves are browsed.

Browsing by rabbits and hares is considered one of the greatest threats to pingao establishment and this poses a major threat to revegetation projects. Unsworth et al. (2003) demonstrated in a trial planting that pingao was more heavily browsed than spinifex and that plants in exposed locations were more vulnerable than those sheltered by surrounding vegetation.



*Pingao plants showing typical browsing damage. Note the cropped leaves.*

While light browsing does not kill the plant, it does restrict the plant's ability to survive in an already harsh environment. Sand-binding plants need to respond quickly to sand deposition in order to develop shoots and leaves above the sand surface and maintain processes such as photosynthesis. If the plant is heavily browsed and the central core of the plant severed, the plant will not survive. It appears young plants are particularly vulnerable. Once plants are tall or become dense, the rabbit damage seems to reduce markedly and becomes restricted to

new growth or runners around the edge of the clump. Pope (2002, pers. comm.) noted that older plants (after first flowering) are no longer palatable.

### **European Brown Hare (*Lepus europaeus occidentalis*)**

The European Brown Hare was introduced from Britain in 1851 and has now spread throughout most of New Zealand.

Hares mainly inhabit grassland and open country, including coastal sand dunes and can tolerate wetter conditions than rabbits. They are most active whilst feeding, from the evening through to early morning. Hares can travel up to 15km each night and can cause major damage in a single night.

Hares feed on numerous plant species, preferring new growth or seedlings. They have a habit of stripping bark and nipping off the tops of seedlings, often only removing the apical tip. Unlike rabbits, they are solitary animals. They do not build warrens, but rest in shallow depressions (known as 'forms') in grasses and scrub. They can often be seen during the day from May to early June. Female hares have 2 – 8 litters a year, with an average litter size of two. The breeding season extends from early July until mid March.

#### **Description**

Features distinguishing hares from rabbits:

- body colour is mainly a tawny yellowish-brown
- the top of the head is a mottled black and fawn
- the ears have light edges and black tips
- the belly is white
- the tail is white underneath and black on top
- hares run with a loping gait with their tail held down
- they have relatively long legs
- adult weight is 3-4kg with a more slender build than rabbits
- hares clip vegetation with a characteristic 45° cut
- droppings are larger, paler and more fibrous compared to those of rabbits, and scattered at random rather than in small piles
- footprints are distinctive where the large hind feet overreach the forepaws. The hind footprints are asymmetrically placed unlike those of rabbits, which are side by side.



#### **Coastal distribution in New Zealand**

Hares are present throughout the coastal areas of the North and South Islands with the exception of South Westland, Fiordland and an area from Auckland to about 80km north of the city. They are absent from all other New Zealand islands (Wong & Hickling 1999). Densities appear self-regulated and do not exceed three per hectare, unlike the high population explosions seen with rabbits (Flux 1990).

#### **Preferred food sources**

The hare diet reflects the composition of the vegetation in which they are living. In coastal areas their preference for certain plant species is thought to be much the same as that of rabbits. Hares may prefer the backdune species as they feed on a wide variety of shrubs and due to their larger size are able to reach higher into young trees. They eat the bark and tops and nip off the tips of young trees, often without eating them.

#### **Control Methods**

Control work should be carried out well before any dune planting is undertaken. The objective is protection of newly planted areas. This is important not only for plant life, but also for maintenance of the motivation of Coast Care groups and other volunteers, who usually carry out planting. Total eradication is not an option along mainland coastal areas as rabbits and hares will always colonise and recolonise areas when treatment ceases. The only effective

strategy involves long-term commitment to sustained control, with the greatest success coming from combination of two or more control methods. Initial control is relatively easy to achieve. Minimal but persistent follow-up treatment will then prevent any population build-up. Research has shown that even at densities as low as 0.5 per hectare, rabbits can cause severe damage to some plant species (Lange & Graham 1995).

Development of an effective control strategy should take the following points into account:

- Many different control methods are effective. Selection of the best method for a given dune site will require trial and error to find what works best under this particular set of conditions.
- Rabbit control is achieved efficiently and effectively through using a combination of control measures, not just one.
- Assessment of effectiveness in terms of reduced pest density and increased plant cover is a complex process that may require the assistance of professionals.
- Good communication between project members and partners, interest groups, and the local community is critical for the success of any control project. The problem should initially be discussed with the owners or agency managing the dune area to find out whether there are any objections. Levels of funding available for pest control must be considered.

### **Rabbit control**

The following are currently considered the most effective and/or the most common pest control methods used in dune areas for controlling rabbits:

#### **Pindone poisoning**

Successful poisoning involves collecting information, evaluation, and good thorough action. Monitoring is essential so that the quantity and placement of baits may be adjusted if required. Rabbit carcasses must be collected and properly disposed of to lessen the risk to non-target species.

Pindone, an anticoagulant, is a registered poison that is available from farm merchandising stores such as Wrightsons and comes in two forms, pellets and liquid. Pellets can be used in conjunction with a bait station, which is effective, safe and protective. This is the preferred option as it is undesirable to have poison pellets left lying in public areas. The liquid can be applied to good quality bait material such as carrots or oats. Carrots are the most suitable in the sand dunes and best results are achieved when rabbits feed on them the same day they are cut. Feeding at dusk ensures the carrots don't dry out, and stay fresh and attractive to rabbits for a longer time. Rabbits require two feeds of Pindone to die, often continuing to eat the bait after receiving a lethal dose. In urban or popular beach areas, the poison baits should be collected each dawn to reduce the chance of exposure to residents and their pets. In this case treating a small area of dune each night is advisable with subsequent bait laying concentrated where the greatest take was in the previous drop.

Pindone bait has an antidote, vitamin K1, which makes it well-suited to use in the urban or semi-urban coastal environment, where non-target animals such as domestic dogs are at risk. Even so, the public must be notified prior to poisoning operations through signs and leaflets that dogs should be kept away from baits and poisoned carcasses.

The best time of year for poisoning is early winter through to early spring. Reasons for this are:

- Rabbit haemorrhagic disease (RHD) and natural mortality will have reduced rabbit numbers
- Feed is at a minimum and rabbits are foraging for food
- This is not the main breeding season and rabbits are ranging over greater distances
- Young rabbits are old enough to emerge from the burrow and will eat the bait

Freezing and thawing will turn the baits to mush but frosts are not common on coastal dunes. Heavy rain or dew will affect the toxicity of the baits.

#### Example: Effective pindone control in the coastal Bay of Plenty.

The regional council (Environment Bay of Plenty) places warning signs, flyers and local newspaper notices to remind beach users and nearby residents to keep pets and young children out of the areas where poison will be laid. A contracted pest control company carries out the operation from July to October and focuses on stretches of rabbit-infested land near dunes that have been newly planted in native dune plants.

### **Exclusion fencing**

Rabbit-proof fencing can be used for small-scale planted areas that are 'hot spots' for rabbit browsing. Fences must be well-maintained. This is frequently difficult as fences are subject to burying or blowouts on mobile dunes. This allows rabbits access over buried or beneath undermined fences. Fences should be at least 80cm in height and made from 2.5-3.0 cm diameter wire mesh. The fencing must be anchored securely and must extend at least 20cm below ground level to deter burrowing. Fencing involves costly maintenance and can be unsightly.

In the form of netting cylinders, plastic sheaths or steel guards it can be useful for the protection of individual trees and shrubs in backdune areas.

### **Repellents**

Repellents can be placed around the plant base or sprayed on to foliage to discourage rabbit browsing. They must be applied several times a year, paying especial attention to new growth within 50 cm of ground level. Young plants will need repeat treatments for up to a year.

Repellents reported to be effective are:

- A mixture of 5 fresh eggs or 10g of egg powder (available from Zeagold Products, Auckland), 1L water and 25ml acrylic resin or paint applied to the plants as a foliar spray. The resin or acrylic paint functions as an adhesive for the egg yolk which is the active ingredient. A coarse droplet size and a maximum 50% covering of foliage is recommended, as the adhesive tends to block the plant stomata. This 'home-made' mixture is easy to prepare and easy to apply. Commercially available as 'Treepel', it is considered the most effective repellent for medium-risk sites, being convenient for re-application, especially in relatively accessible, small-scale plantings (Crozier 1988). Applications are effective for about 2 months. It has been used successfully by Horizons.mw.
- Options for repellents include:
  - Handfuls of blood and bone placed around seedlings
  - Salt licks placed at 20-50m intervals
  - A mutton fat/kerosene mixture (5:1) rubbed onto the plants. This is easy to prepare but can scorch foliage.
  - Fish-based liquid fertilisers (cheap, readily available, but difficult to apply and unpleasant to handle)
  - 'Possum Off' – A mixture of neem oil, chilli and garlic (effective, non-toxic and trialled successfully at Te Henga beach).
  - Plant Plus, a foliar spray sold in 1L and 5L containers. Emits odours analogous to those produced by predators such as dogs. Application is simple, but suitability for coastal plant species has not been tested.
  - Lime/sulphur wash
  - Naphthalene moth balls
  - 'Jeyes' fluid
  - 'Thiropel' fungicide (very effective, but tends to clog spray equipment and is potentially harmful to humans)
  - 'Thiroprotect' – a thiram-based repellent (a wettable fungicide)

Commercial preparations are available through garden centres and agricultural merchants.

#### Example: Successful use of 'Treepel' on coastal plantings by Serco Group NZ Ltd. in association with Rodney District Council

Young muehlenbeckia and pingao plants were treated with Treepel whilst still potted, up to two weeks before planting out. No detrimental affect on growth was apparent over this period. After planting, evidence of minor browsing was observed in spite of the presence of a high rabbit population. Untreated muehlenbeckia planted at the same time was heavily browsed. The Coastcare group made a second application and this prevented any further browsing. Treated plants established well.

### **Night shooting (spotlighting)**

Shooting has a limited effect on medium to high population levels and surviving rabbits become wary. Night shooting can be effective for light infestations in dune areas as there is often little vegetation cover. A systematic approach by an experienced operator is essential.



Disturbance caused by shooting may make rabbits less likely to take poison baits. In urban coastal areas shooting is not an acceptable control method.

Factors affecting night shooting are weather conditions, and the amount of moonlight - the darker the evening, the greater the number of rabbits seen in the open. The 'eye-shine' colour of rabbits is red-pink. Shooting in the same area on consecutive nights is less effective as rabbits quickly become light and gun 'shy'.

### **Burrow fumigation**

If burrows are present, fumigation is an effective follow-up to poisoning. It is best used in spring, as burrows blocked or destroyed will not be available for rabbits to re-infest, limiting their ability to successfully re-establish themselves. This method is particularly effective for controlling young rabbits because they do not wander far from the burrow and are normally difficult to poison or shoot.

Magtoxin, which produces phosphine gas, is the most user-friendly product available. Five tablets are placed deep in the burrow and the entrance is sealed with sand to contain the gas. Local regional council Pest Control Officers can provide further information about the application and availability of fumigants.

### **RHD (rabbit haemorrhagic disease) (formally known as RCD or rabbit calicivirus)**

This is a highly contagious virus disease that is specific to rabbits. It causes rapid development of blood clots and death ensues in about 30-40 hours. Although it is used overseas as a form of biological control, the inoculum has not been commercially available in this country since 2002. Environment Southland is seeking approval for the importation of RHD from Australia.

The virus was introduced illegally to this country in 1997. Although it reduced the abundance of rabbits in most parts of New Zealand, the extent of the decline has varied in space and time (Norbury 2001).

The RHD virus has a number of advantages as a control method:

- It is specific to rabbits
- It is a relatively cheap option for dense populations
- It does not involve poisons
- It can be used in built-up or heavily-used locations with no risk to humans or other animals.
- Vaccine protection is available for pets or farmed rabbits.

On the other hand, public perception of risk factors (whether justified or not) may yet prevent importation. Results appear to be inconsistent: populations may be reduced by 40 - 60 % but survivors are likely to be resistant. Secondary control measures such as poisoning and shooting may be needed.

### **Hare control**

The self-regulatory nature of hare populations poses problems with control planning, because individuals are widely scattered and have large territories. Populations are likely to build up quickly after initial reduction. Long-term monitoring is essential. Hares have an extensive feeding range and are reluctant to accept poisoned baits. **Poisoning is not an effective method of control for hares.** Hares are not susceptible to the RHD virus.

### **Shooting**

This is the main hare control method used in open country. It must be undertaken at regular intervals to prevent recovery of local populations. Night shooting is most effective, but at certain times, especially autumn and spring, hares can be seen during the day. They shelter during periods of high wind or heavy rain. 'Eye-shine' colour is red-pink, similar to that of rabbits, but the eyes are larger. Shooting is not acceptable in urban areas.

### **Exclusion fencing**

This can be used to protect small areas where hare infestation is relatively high. Netting fences must be at least 1 m high, tightly dug into the sand, with no gaps. Wire mesh 8 -10 cm in diameter is effective. Plastic guards can be used to protect individual plants. Hare protector devices that consist of two pieces of number eight wire pushed into the ground over-topping the seedling with expandable netting tube slid over the top of the u-bends are also useful.

### **Snares**

Hares travel in a series of jumps and have set runs. Snares can be effective when placed at access points around the area to be protected. They work well when set between the linked oval footprints. There is a legal requirement for all snares to be visited daily, immediately after dawn. For further information on making and setting snares, see the Greater Wellington Regional Council leaflet "How We Do It - Hare Control".

### **Repellents**

Hares can be deterred by repellents designed to render plants unpalatable and unattractive for browsing. New growth will be unprotected and applications must be repeated periodically. The same repellents should be used as for rabbits.

## **Monitoring populations before and after treatment**

Monitoring is the process by which regular assessments are made in order to record change over time. Methods used for assessment can be quite simple: the essential point is that they should be standardised and repeatable. The records can indicate and document trends and also the results of specific treatments. Monitoring is a useful decision-making tool. It can be time-consuming, but it will help to prevent failures and show whether further effort is justified. It therefore increases the cost-effectiveness of expensive treatment.

Some points to note are:

- The successful control of rabbit and hare populations depends on an understanding of behaviour and feeding patterns. Good quality information gathered before the commencement of a control programme can be used to improve the strategy and increase the probability of success.
- Monitoring must be on-going. Immediate follow-up action keeps areas rabbit-free. The longer the gap between the monitoring of rabbit populations and action, the more likely it is that rabbit numbers will again increase. This was demonstrated by Unsworth et al. (2003) in a trial where Pindone had been used prior to the planting of native sandbinders. No fresh rabbit browsing was evident within 3 months. After 10 months without further rabbit control, fresh rabbit browsing and droppings were extensive. The trial failed, rabbit browsing being identified as the major cause of plant loss. Labour and materials used in the rabbit control operation, also the resources required for setting up the planting trial were all wasted.
- Low-density rabbit populations should be assessed at intervals to find out whether numbers are static or increasing. Assessments should be made prior to the main breeding season (June - September) and immediate action should be taken if a population increase is indicated.
- Population assessment methods that can be used alone or in combination are:
  - Spotlight counts along straight lines of standard length, in order to reveal numbers and age classes.
  - Daytime inspection to estimate the amount of damage to vegetation and location of droppings. These give an indication of where rabbits or hares are feeding.
  - Warren monitoring to identify active burrows and provide warren/rabbit counts.
  - Gibb and McLean Scales for assessment of rabbit populations have been widely used by managing agencies and researchers. The Gibb scale measures the abundance of faecal pellets and the McLean scale is based on visual sightings. Both are assigned a rating from 1 (low) to 10 (extreme). Nowadays a combined scale rating from 1 to 8 is commonly used, called the Modified McLean Scale. This scale has quantitative definitions and is more repeatable. The scale should be used for pest management, compliance and enforcement purposes to identify areas requiring control rather than for showing trends.
- The managing agencies and community need to consistently apply a standard methodology to monitoring any particular coastal area, so that results are comparable over time. Standard methodology for monitoring rabbit or hare populations and damage to vegetation in coastal zones throughout New Zealand would lead to advances in control techniques and better understanding of infestation levels. Ability to provide monitoring records of a successful control programme may assist applications to funding bodies for resourcing future programmes.

### Example: Effective rabbit control at Te Henga (Bethells Beach)

Dune planting of both the foredune native sand-binding species and native backdune species has been an ongoing battle for the past decade for the Te Henga BeachCare Group. Research trial plots have had to be rabbit-fenced and the problems with fencing in this environment (vandalism, burial under sand) often made this control method ineffective. Short shooting operations had been carried out over a number of years by landowners and these were successful in temporarily reducing the rabbit population.

With assistance from the Auckland Regional Council's Biosecurity Unit, the BeachCare Group decided in winter 2002 to control the rabbits and attempt to reduce the rabbit population to zero as browsing of all plants, especially new seedlings, had been a severe on-going problem. ARC staff and BeachCare volunteers pre-baited the dunes with carrots. Contractors then carried out a poisoning operation using Pindone-treated carrots until there were no signs of rabbits. The Te Henga Beachcare Group now has a monitoring programme in place. Dunes are checked regularly for signs of rabbits and bait stations are kept ready for use when necessary. Initial control was easy to achieve. On-going control to keep the dunes rabbit-free will require consistent but minimal effort.

### **Summary**

Rabbits are high-profile pests throughout most of New Zealand. General information about their behaviour and advice about control methods is readily available to the public. Although rabbits are widely perceived to be the cause of major environmental and economic damage, their effect on coastal dune vegetation is grossly under-estimated. They browse on most plant species in the sand dune ecosystem, showing marked preference for new growth and seedlings. Rabbits destroy managed plantings and threaten conservation values. Even in low numbers they can cause noticeable damage to highly palatable plants such as pingao. Potential natural vegetative recolonisation of sand is continually suppressed by repeated browsing. Rabbits must be controlled so that remnant populations of many key coastal plants can recover and before any planting or other revegetation options are implemented.

Hare populations are more scattered and behaviour patterns are different from those of rabbits. Damage caused to coastal plants is probably less severe overall, but can be locally significant. There are gaps in our knowledge about the population size and diet of hares in the coastal areas of New Zealand. Hare signs (droppings, distinctive browsing damage) are often present in dunelands and hare foraging must have an inhibitory effect on the recovery and regeneration of colonising plant species.

There is a pressing need for community-led pest-control projects that use standard methods for collection of information about rabbits and hares on sand dunes. Ideally, a 'recipe book', showing how to set up a monitoring and control project based on the most effective methods should be made available from every coastal management agency.

Once rabbit/hare numbers are reduced, they must be kept at a low level. This can only be achieved through a carefully planned and integrated approach and dedicated commitment to a programme of regular surveillance and treatment. A flare-up even once in five years can set a revegetation project back to its starting point.

Total eradication of rabbits and hares from mainland coastal sites is impossible unless very expensive predator-proof exclosures are used. Reduction of populations to very low levels is a possibility. Systematic use of recognised control methods could have a major effect on the development of sand dune vegetation and the restoration of the natural character of New Zealand's coastal environment.

### **Acknowledgements**

The author gratefully acknowledges the support and input from the following individuals:

- Greg Corbett (Environment Bay of Plenty) for providing initial information and ideas.
- Ruth Gadgil, Elizabeth Miller, David Bergin and Greg Steward (CDVN, Forest Research) for reviewing and editing this report.

## Bibliography and References

- Cooke, B.J. 1991. Rabbits – indefensible on any grounds. *Search*. **22**, pp. 179-180.
- Copson, G., Whinam, J. 1998. Response of vegetation on subantarctic Macquarie Island to reduced rabbit grazing. *Australian Journal of Botany*. **46**, pp. 15-24.
- Corbett, G. 1997. OPC 36 – Papamoa Coastal Reserves Rabbit Control Programme. Internal Report 0280 01. Environment Bay of Plenty.
- Corbett, G. 2002. Rabbit control in high public use coastal environments- lessons learnt from the Papamoa Coastal Reserves. *Proceedings of the Coastal Dune Vegetation Network Conference 2002*. Palmerston North. pp. 79-82.
- Crozier E.R. 1988. Animal Repellents for Tree Seedlings. *FRI Bulletin 162 What's New in Forest Research*. Forest Research Institute, Rotorua.
- Crozier, E.R. 1989. Practical animal repellents for tree seedlings: a success story. *FRI Efficiency of Stand Establishment Operations, IUFRO Symposium 1989*. Bulletin No.156, pp. 172-177.
- Dam, P van. 2001. Status loss due to ecological success. Landscape change and the spread of the rabbit. *Eur J Social Sci*. **14**, pp.157-170.
- Drees, M., Olf, H. 2001. Rabbit grazing and rabbit counting. In: Houston JA, Edmondson SE, Rooney PJ (eds) Coastal dune management. Shared experience of European conservation practice. Liverpool University Press, Liverpool, pp. 86-94.
- Eason, C.T., Jolly, S.E. 1993. Anticoagulant Effects of Pindone in the Rabbit and Australian Brushtail Possum. *Wildlife Research*. **20**, pp. 371–374.
- Fletcher, D.J., Moller, H., Clapperton, B.K. 1999. Spotlight counts for assessing abundance of rabbits (*Oryctolagus cuniculus*). *Wildlife Research* **26**, pp. 609-620.
- Flux, J.E.C. 1990. Brown hare. pp.138-174 in King, C.M. (Ed.) *The Handbook of New Zealand Mammals*. Oxford University Press, Auckland.
- Frampton, C., Warburton, B.1994. Methods for monitoring rabbit populations: a review. Unpublished Landcare Research contract report LC 9394/77. 17p.
- Fraser, K.W. 1988. Reproductive biology of rabbits, *Oryctolagus cuniculus*, in Central Otago, New Zealand. *New Zealand Journal of Ecology* **11**, pp. 79-86.
- Fryer, R. 1992. Effective conventional rabbit control. *Rural Research* **156**, Spring.
- Gibb, J.A., Williams, J.M. 1990. European rabbit. *in* *The Handbook of New Zealand Mammals*. King, C.M. (ed), Oxford University Press, Auckland.
- Gibb, J.A., Williams, J.M. 1994. The rabbit in New Zealand. *in* *The European Rabbit: the history and biology of a successful coloniser*. Thompson, V., King, C.M. (eds), Oxford University Press, Oxford.
- Howard, W.E. 1959. The Rabbit Problem in New Zealand. NZ Dept. of Scientific & Industrial Research. Information Series – No.16.
- Lange & Graham 1995. *in* Williams K, Parer, Coman B, Burley J & Brayser M, *Managing Vertebrate Pests: Rabbits* Bureau of Resource Sciences and CSIRO.
- McGlinchy, A.T.1996. Revising the definition of the McLean Scale for rabbit population assessment. Landcare Research Contract Report: LC9596 / 104. Manaaki Whenua, Lincoln, New Zealand.
- Moller, H., Newton, K., McKinley, B. 1996. Day-time transect counts to measure relative abundance of rabbits (*Oryctolagus cuniculus*). *Journal of Zoology, London* **239**, pp. 406-410.

Morgan, D. R., Woolhouse, A. D. 1997. Predator odors as repellents to brushtail possums and rabbits. *In: Symposium: Repellents in wildlife management: August 8-10, 1995, Marriott Tech Center, Denver Fort Collins, National Wildlife Research Center.* pp. 241-251.

Norbury, G. 2001. Advances in New Zealand mammalogy 1990-2000: Lagomorphs. *Journal of The Royal Society of New Zealand* **31:1**, pp. 83-97.

Ramsey, D.S.L., Wilson, J.C. 1997. The impact of grazing by macropods on coastal foredune vegetation in southeast Queensland. *Australian Journal of Ecology.* **22: 3**, pp. 288–297.

Rabbit Biocontrol Advisory Group. 1996. Agriculture New Zealand, Christchurch.  
Leaflet - A Threat to Sustainable Management. A Hundred Years of Rabbit Impacts, and Future Control Options.  
Leaflet – Pests and Pest Control Methods: What does the public think?

Rotorua Branch of the Royal Forest and Bird Protection Society. 2003. Proceedings of the Pest Control Strategies Workshop – 1. Animals. Rotorua.

Stace, C.E. 1987. Evaluation of five methods to prevent rabbit browsing of tree seedlings. Internal Report No. 190, National Water and Soil Conservation Authority. Ministry of Works and Development, Aokautere, Palmerston North.

Stace, C.E. 1989. Santoft Rabbit Repellent Trials, 1987 & 1988. Internal Report No. 225, National Water and Soil Conservation Authority. Ministry of Works and Development, Aokautere, Palmerston North.

Sullivan, N., Eagle, A., Ferkins, C., Bergin, D.O., Gainsford, D. 2001. Early performance of spinifex trials and future research proposals, Te Henga (Bethells Beach), West Auckland. *Progress Report July 2001.* Forest Research, Rotorua.

Sullivan, N., Hix, S., Ferkins, C. 2002. Rabbit Control Programme Report for Te Henga / Bethells Beach. Auckland Regional Council & Waitakere City Council.

Sumption, K.J., Flowerdew, K.J. 1985. The ecological effects of the decline in rabbits (*Oryctolagus cuniculus*) due to myxomatosis. *Mammal Review* **15**, pp. 151-186.

Taranaki Regional Council. Hares. Use of Repellents. Animal Pest Management Programme. 2p pamphlet.

Unsworth, D.E., Jenks, G., Bergin, D.O., Miller, E.M. 2003. Revegetation trial above a foredune scarp using the indigenous sand-binders, spinifex and pingao, at Ohope, Bay of Plenty. Unpublished paper. Trial No. FR419/0. Forest Research, Rotorua.

Whatmough, J.A. 1995. Grazing on sand dunes: the re-introduction of the rabbit *Oryctolagus cuniculus* L. to Murlough NNR, Co. Down. *Biological Journal of the Linnean Society* **56** (Suppl.), pp. 39-43.

Wilkinson, R., Fitzgerald, G. 1997. Public perceptions of biological control of rabbits in New Zealand: Some ethical and practical issues. *Agriculture and Human Values* **14**, pp. 273–282.

Williams, C.K., Moore, R. 1991. Cost-effectiveness of combinations of rabbit control methods. Working Papers, 9th Australian Vertebrate Pests Control Conference, Adelaide, April, pp.119-23.

Wong, V., Hickling, G.J. 1999. Assessment and management of hare impact on high-altitude vegetation. Department of Conservation. *Science for Conservation* **116**. Wellington.

#### **Websites**

Auckland Regional Council

Fact sheet – Rabbits pestfacts

[www.arc.govt.nz](http://www.arc.govt.nz)

Biosecurity > Animal pests > Rabbits

Department of Conservation

[www.doc.govt.nz/Conservation/001-Plants-and-Animals/005-Threats-to-Pikao](http://www.doc.govt.nz/Conservation/001-Plants-and-Animals/005-Threats-to-Pikao)

Department of Primary Industries  
[www.dpi.vic.gov.au](http://www.dpi.vic.gov.au)  
Search; GO Information Series / Rabbits

Environment Australia  
[www.ea.gov.au/biodiversity/invasive/pests/rabbit.html](http://www.ea.gov.au/biodiversity/invasive/pests/rabbit.html)

Environment B.O.P. Bay of Plenty Regional Council  
Fact Sheet. Animal Pest pamphlet 01/98. Rabbit Policy. Monitoring and Control.  
Fact Sheet. Sustainable Options leaflet 02. Pest Animal Control. Rabbit Control in Urban Areas.  
Fact Sheet. Sustainable Options leaflet 04. Pest Animal Control. Effective Night Shooting to Control Rabbits.  
Fact Sheet. Sustainable Options leaflet AP01/98. Animal Pest Control. Use of Fumigants to Control Rabbits.  
Fact Sheet. Sustainable Options leaflet AP05/98. Animal Pest Control. Use of Poisons to Control Rabbits.  
Fact Sheet. Sustainable Options leaflet 07. Pest Animal Control. Control of Hares.  
[www.envbop.govt.nz](http://www.envbop.govt.nz) under land/pest animals/fact sheets.

Environment Southland.  
Factsheet. Understanding Rabbits and how to control them.  
[www.envirosouth.govt.nz/Publications/factsheets.aspx](http://www.envirosouth.govt.nz/Publications/factsheets.aspx)

Environment Waikato Regional Council.  
[www.ew.govt.nz/ourenvironment/pests/animals/rats.htm](http://www.ew.govt.nz/ourenvironment/pests/animals/rats.htm) (for hare information)  
[www.ew.govt.nz/ourenvironment/pests/animals/rabbits.htm](http://www.ew.govt.nz/ourenvironment/pests/animals/rabbits.htm)

Greater Wellington. Wellington Regional Council.  
'How We Do It' leaflet. Hare Control  
Pest Animals leaflet. Rabbits – Prolific Breeders  
[www.wrc.govt.nz/LM/ANIPESTS/RABBITS.HTM](http://www.wrc.govt.nz/LM/ANIPESTS/RABBITS.HTM)

Landcare Research New Zealand Ltd. Kararehe Kino Vertebrate Pest Research. Published by: Manaaki Whenua Landcare Research. Available electronically  
[www.LandcareResearch.co.nz/publications/newsletters](http://www.LandcareResearch.co.nz/publications/newsletters)  
- Rabbits – New Zealand's cute pest. Search Landcare Research website under 'information\_services/media'.

Northland Regional Council.  
Leaflet – 'Animal Pests 6'. Rabbits  
Leaflet - 'Animal Pests 9'. Hares.  
[www.nrc.govt.nz](http://www.nrc.govt.nz)  
Environment > Animal Pest Pamphlets

Otago Regional Council.  
Leaflet 'Keeping Rabbits Under Control'  
[www.orc.govt.nz](http://www.orc.govt.nz)

#### **Recent research in New Zealand**

- Barlow, N.D.; Barron, M.C.; Parkes, J. 2002: Rabbit haemorrhagic disease in New Zealand: field test of a disease-host model. *Wildlife Research* **29**, pp. 649-653.
- Caley, P.A.; Morley, C.G. 2002: Assessing growth rates of *European* rabbit populations using spotlight transect counts. *Journal of Wildlife Management* **66**, pp. 131-137.
- Norbury, G.; Heyward, R.; Parkes, J. 2002: Short-term ecological effects of rabbit haemorrhagic disease in the short-tussock grasslands of the South Island, New Zealand. *Wildlife Research* **29**, pp. 599-604.
- Parkes, J.P.; Norbury, G.L.; Heyward, R.P.; Sullivan, G. 2002: Epidemiology of rabbit haemorrhagic disease (RHD) in the South Island, New Zealand, 1997-2001. *Wildlife Research* **29**, pp. 543-555.
- Reddiex, B.; Hickling, G.J.; Norbury, G.L.; Frampton, C.M. 2002: Effects of predation and rabbit haemorrhagic disease on population dynamics of rabbits (*Oryctolagus cuniculus*) in North Canterbury, New Zealand. *Wildlife Research* **29**, pp. 627-633.

# Rabbit and Hare Control in New Zealand's Coastal Environment



Damage caused by rabbits (*Oryctolagus cuniculus*) and hares (*Lepus europaeus occidentalis*) is acknowledged to be a major factor in the decline of coastal sand dune vegetation, particularly on open dunefields and in foredune environments. It is also a major contributor to the failure or decreased performance of dune revegetation programmes.

Rabbits and hares are not native to New Zealand, but are present throughout most of the country. These introduced animals browse on most plant species in the sand dune ecosystem, showing marked preference for new growth and seedlings.

Rabbits can live in large colonies and have a serious effect on coastal vegetation, especially on open dune areas. They contribute significantly to failure or poor performance of dune revegetation programmes.

Hares have wide-ranging, scattered populations and different behaviour patterns from rabbits, but can cause significant localised damage to coastal plants. They clip vegetation with a 45° cut.

Total eradication is not an option along mainland



Figure 1: Rabbits often live in colonies and are prolific breeders, able to produce 30-35 young in a season.

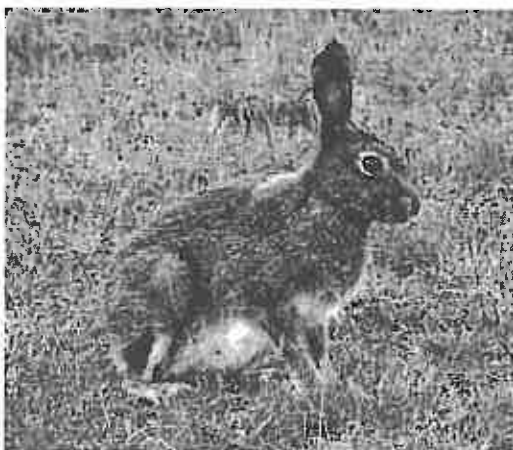


Figure 2: Hares are larger than rabbits, are more yellow-brown in colour, with a darker head and black-tipped ears. They have relatively long legs and run with a loping gait.

coastal areas as rabbits will always re-colonise when treatment ceases. Effective control of rabbits and hares requires a large percentage kill (90%) or the populations will very rapidly return to their original size.

The need for rabbit and hare control should be assessed before any planting programme is set up. Long-term commitment to sustained treatment is needed to prevent destruction of planted material.

Monitoring of rabbit and hare populations provides a sound basis for an effective programme. Continued monitoring and evaluation will identify the success of control operations and allow effective targeting of follow-up treatment. Good communication between all groups involved is critical for the success of any control project.

A wide range of control methods for rabbits and hares has been developed. Some are suited to large-scale control programmes, others are only practical on a small scale. Control may be most effective through use of a combination of control measures, rather than a single one.

A carefully managed programme of poisoning with Pindone-treated baits, from early winter to early spring, is the most successful method for controlling rabbits.

Exclusion fencing can be effective for small areas where frequent inspection and maintenance can be carried out, because burial or excavation by wind can allow animals access to the enclosed sites.

Repellents can discourage browsing of new plantings by both rabbits and hares, but must be applied several times a year to protect new growth. For control of hares, however, night-shooting is likely to be the most effective method.

Community-led pest-control projects, using standard methods for collection of information about rabbits and hares on sand dunes, could make a valuable contribution to protection and understanding of New Zealand's coastal dune vegetation.

D E Unsworth  
Coastal Dune Vegetation Network  
diana.unsworth@forestresearch.co.nz

Further information is available in a recent Coastal Dune Vegetation Network report, *Rabbit and Hare Control in the Coastal Environment of New Zealand - Review and Recommendations*, D E Unsworth, Forest Research, Rotorua, 2005. Available from greg.steward@forestresearch.co.nz