Karārehe Kino
Vertebrate Pest Research

Issue 10 June 2007

Landcare Research
Manaaki Whenua

ISSN 1175 - 9844

CONTENTS

Vaccination of Possums against Bovine Tb

Since 1994, conventional control of Tb vectors and herd management practices have resulted in an 86% reduction in the number of cattle herds in New Zealand being reported with Tb reactors. However, the distribution of Tb-infected possum populations has increased by 30–40% during the same period, and the Tb problem is far from resolved. Because of these compelling statistics, the Animal Health Board is contracting Landcare Research, AgResearch, and Immune Solutions, to develop a suitable product and strategy for vaccinating possums with BCG (Bacillus of Calmette-Guerin) vaccine. The vaccine could be used to further lower Tb incidence in possum populations where culling alone has been unable to eradicate the disease.

The latest step in this collaborative work has been to trial the effectiveness of an oral vaccine in a wild possum population. Oral vaccine delivery is much less straightforward than the intramuscular injection with BCG that humans receive. To ensure the vaccine is absorbed through the possum gut wall and remains active, the vaccine is incorporated into a digestible lipid matrix developed by Immune Solutions. Although the vaccine was administered by hand for this latest trial, more widespread delivery will be in baits from stations or aerial sowing.

Matt Lambeth

Administering oral BCG vaccine to an anaesthetised possum.

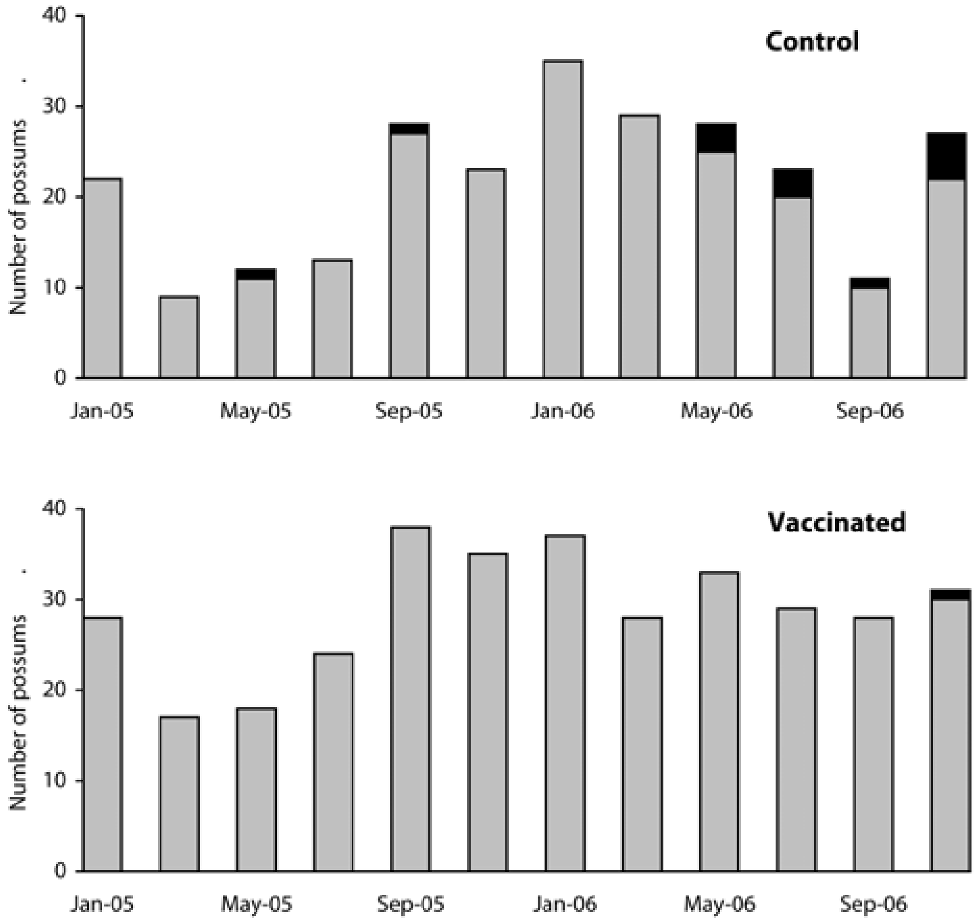

Fig. Number of control and vaccinated possums from Stream Grid either with (black bars) or without (grey bars) culture-confirmed Tb infection.

A vaccine field trial was carried out by Dan Tompkins and colleagues between November 2004 and November 2006, in wild possums on two sites in the Orongorongo Valley, Rimutaka Forest Park. Each of the ~16 ha sites ('CK Grid' and 'Stream Grid') had 150 cage traps. Surveys of possums conducted over the six months prior to the trial indicated the presence of Tb infection on both grids.

Initial vaccinations were carried out in November 2004. One individual each of 32 and 41 pairs of possums (matched by age, sex, and location) on the two grids was given the vaccine, and the other received nothing as the control. Over the following two years, animals were cage-trapped at two-monthly intervals, examined for Tb with all open lesions being swabbed and aspirates taken from closed lesions (where possible) for confirmation of infection by bacterial culture. Then the animals were released. At six, twelve, and eighteen months, any vaccinated animals recaptured were revaccinated, with new control and vaccinated animals entering the trial on both grids. At the end of two years (November 2006), both sites were trapped out and all possums necropsied.

Over the course of the two-year trial, Dan recorded insufficient natural infection of Tb on the CK Grid to allow a valid test of the vaccine (culture confirmed infection in only 3 of 184 animals). However, a significant protective effect of the vaccine was observed on the Stream Grid (Fig.), with 12 of 71 control animals (17%) being confirmed as infected, compared with only 1 of 51 vaccinated animals (2%). While all of the infected control animals had obvious Tb lesions in their lungs and/or lymph nodes, the one infected vaccinated animal (detected at necropsy at the end of the trial) had only small lesions in the liver. The larger number of control compared with vaccinated animals recorded on this site during the course of the trial reflected the need to introduce more animals into the control group to offset a greater mortality of unvaccinated control animals over the two years.

These results indicate that oral BCG vaccine prevented vaccinated animals from developing Tb on the Stream Grid. Now that vaccine efficacy in the field has been demonstrated, future vaccine development is likely to focus on refining a pelletised bait system that will allow reliable larger scale operations.

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(not shown)

Johne's Disease in New Zealand Wildlife

Johne's disease (JD) is a chronic wasting disease of ruminants caused by *Mycobacterium paratuberculosis.* It has long been widespread in cattle and sheep in New Zealand, and in recent decades it has emerged as a major problem in farmed deer. JD is hard to control because infected sheep and cattle can take several years to develop severe infections, yet apparently healthy animals can shed very large numbers of bacilli into the environment where they survive for many months. Wild animals in New Zealand may also infect livestock, as JD has been found in a wide range of wildlife overseas. In Britain, infected rabbits appear to infect cattle. The difficulty of controlling diseases in livestock when wildlife is also infected is well illustrated by the bovine tuberculosis (Tb) problem in cattle and deer in New Zealand. Tb is caused by a closely related bacterium to *M. paratuberculosis*, viz, *M. bovis*, and its widespread occurrence in possums and other wildlife is by far the greatest impediment to Tb control and eradication.

To determine whether wild animals are potentially important in the epidemiology of JD in New Zealand, Graham Nugent and colleagues surveyed wildlife populations for evidence of the disease on three infected deer farms in South Canterbury and Otago in 2004/05. Four hundred and twelve wild animals (mammals and birds) were necropsied, and the mesenteric lymph nodes and any suspect macroscopic lesions or tissue abnormalities of all mammals and part of the gastrointestinal tract of all birds were submitted for mycobacterial culture. Faecal material was subsequently cultured from those animals that produced a positive tissue culture.

Only three animals had culture-positive lesions or tissue abnormalities, with all others necropsied showing no visible sign of infection. Despite this, *M. paratuberculosis* was cultured from 74 of 380 wild mammals, and 4 of 32 birds, including hedgehogs (36% infected, n = 42), rabbits (26%, 113), possums (25%, 73), cats (17%, 23), hares (7%, 76), ferrets (7%, 44), paradise ducks (18%, 17) and black-backed gulls (20%, 5). No infection was detected in rats, stoats, Australasian harriers, magpies, spur-winged plovers, or starlings, but only five or fewer animals were surveyed for each of these species. These results indicate that *M. paratuberculosis* is likely to occur commonly in small mammals and in some birds in many parts of New Zealand, at least in those on or near heavily infected deer farms.

Adult rabbits, hedgehogs, and possums had significantly higher prevalences of JD than juveniles of the same species, indicating that these individuals either acquired the disease when mature or became infected as juveniles and carried the infection until adulthood. Prevalence varied between the wildlife species and also between the farms surveyed. This lack of consistency, and the differences in feeding habits of the commonly infected species, suggests multiple pathways for transmission of the disease agent to, from, and between wildlife, and that the relative importance of these pathways varies between farms.

It is also likely that all of the infected birds were shedding bacilli, as *M. paratuberculosis* was found in the gut of each of them. Faecal samples taken from mammals with infected lymph nodes were also positive in five hedgehogs and three rabbits, indicating that about one in eight mammals was shedding bacilli when they were killed. Coupled with the high prevalence of *M. paratuberculosis* infection in rabbits, hedgehogs, and possums, and the abundance of some or all of these species on the farms surveyed, the shedding of bacilli in faeces creates potential for transmission from wild animals to livestock. In addition, shedding of bacilli by wide-ranging birds, especially, could spread JD between widely separated farms.


G. Nugent

A yearling farmed deer infected with Johne's disease, killed because it was showing scouring and weight loss.

Combined with overseas evidence of the apparent transmission of JD from wildlife to livestock, the team's findings make it clear that infection in wildlife may add considerably to the difficulties in controlling the disease in New Zealand livestock. Conversely, it is also possible (despite the high prevalences of JD observed) that wild animals may simply be spillover or incidental hosts that are unimportant in the epidemiology of the disease. The key questions for the management of JD in New Zealand now are whether any species of local wildlife are able to maintain the disease independently of livestock, and whether free-ranging wild animals are important vectors of the disease.


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A culture-positive lesion in a mesenteric node of a hedgehog.

This work was funded by the Foundation for Science, Research and Technology.

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The Genetics of Possum Dispersal

Although the general movement patterns of possums are well known (Cowan & Clout 2000), their long-distance dispersal presents special problems in managing the spread of bovine tuberculosis (Tb). Traditional field-based methods such as mark-recapture and radio-telemetry are limited in their usefulness at such scales because the number of individuals required for study and recapture is large and hence expensive to obtain. An alternative approach is to use molecular (genetic) markers to gain insights into levels of dispersal across landscapes and the role that distance and habitat play in affecting that dispersal. If populations are genetically similar, then either there are high levels of dispersal and gene flow among them or the populations being studied have been separated for insufficient time for detectable genetic differences to accumulate. If populations are sufficiently distinct genetically, then it may even be possible to identify individuals that have dispersed from one population to the other.

This approach requires genetic markers that exhibit high levels of variation among individuals. Phil Cowan and colleagues from the University of Canberra developed three partial genomic libraries for the possum and tested a range of microsatellite loci (short repeats of DNA) developed for other marsupials. Primers (DNA fragments defining microsatellites) were designed and tested for 27 microsatellite DNA loci. Three of these primers provided strong genetic profiles with useful levels of variation and these were used along with six microsatellites previously developed.

About 60 possums were sampled from each of 31 sites around Wairoa, northern Hawke's Bay (Fig.1.) within and to the north of a buffer zone being established to contain a recent outbreak of bovine Tb in cattle. Sampling sites along the six transects were 2.9 to 53 km apart, which encompasses the likely range of dispersal movement by individual possums. In total, 1852 animals were sampled and 1790 provided identifiable genotypes – this is one of the largest, most comprehensive population genetic studies ever conducted on a medium-sized mammal.

Phil and his colleagues found levels of genetic variability comparable with those found previously in a possum population at Hawke's Bay, and higher than observed in South Island possums (Cowan et al. 2002). Overall levels of genetic structuring were in line with expectations for a rapidly expanding and colonising species. Local populations were increasingly genetically different the further apart they were (Fig.2.).

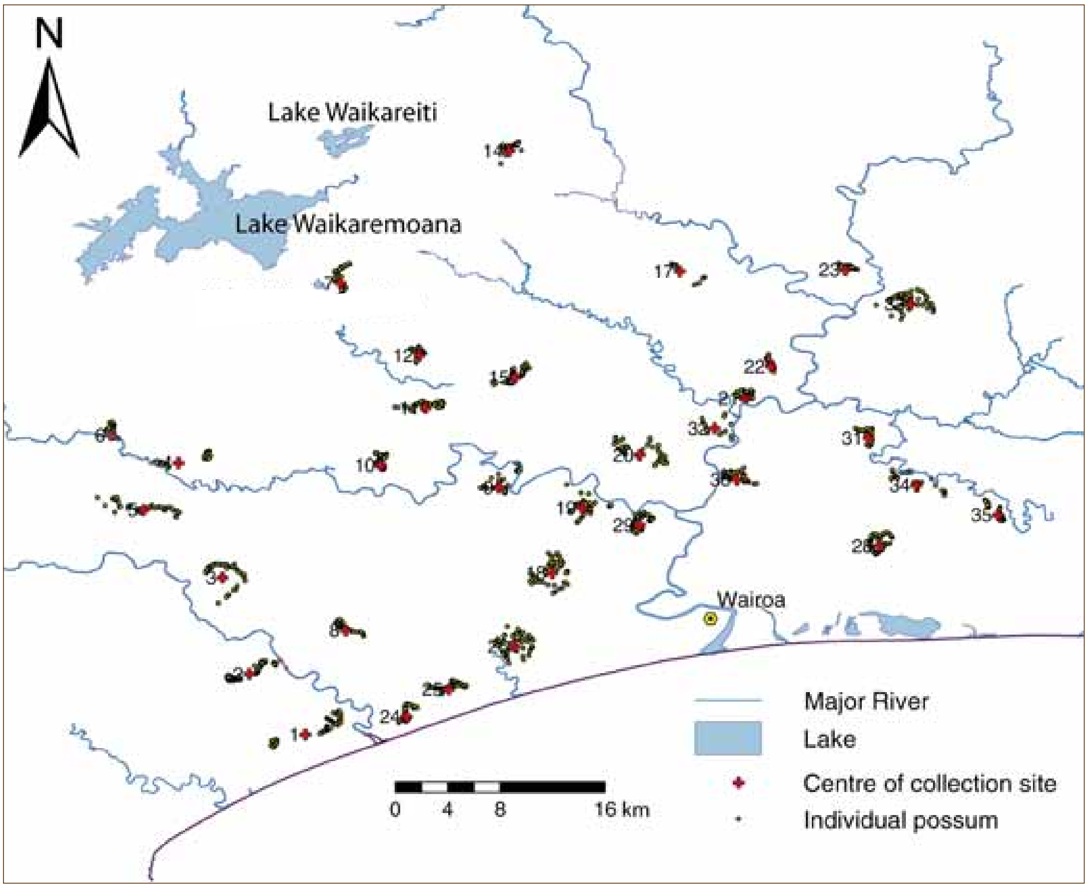

Fig.1. Location of the samples in Hawke's Bay, New Zealand. Sample sites were located along six transects running approximately south-west to north-east.

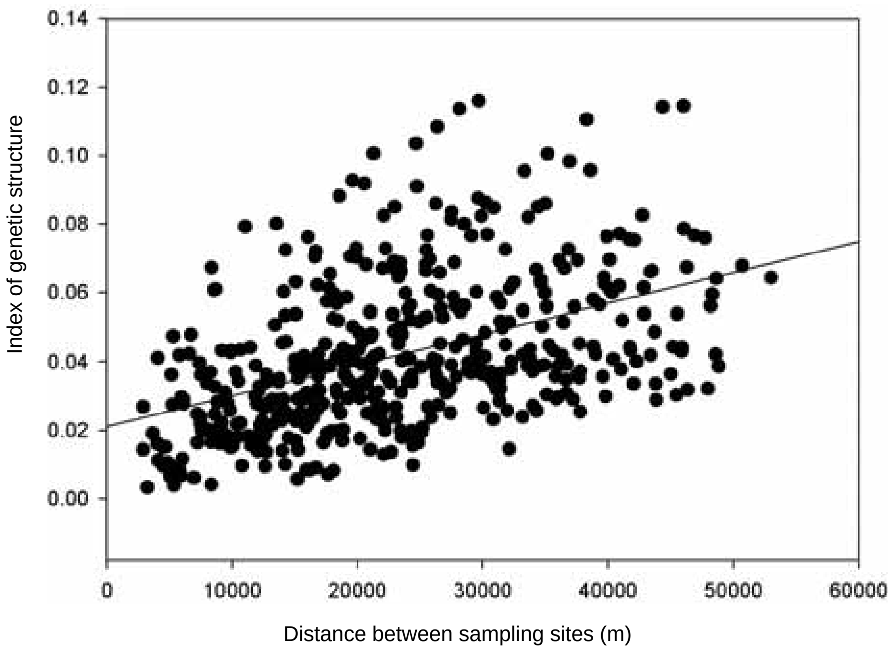

Fig.2. Graphical representation of the relationship of distance between populations and genetic structure in possums from the Hawke's Bay area. The graph shows clearly that genetic structure increases with distance between populations.

Genetic correlation among all individuals (r) declined rapidly to c. 25 km, but significant spatial structuring was still detected at between 42 and 48 km. This implies that possum dispersal typically occurs up to 20+ km in this area and up to or beyond 42 km. These distances are towards the upper limit of those estimated from radio-tracking studies.

The team also found an unambiguous effect of major rivers on the movement of male and female possums, with populations separated by rivers having significantly lower levels of interaction than that observed among populations on the same side of a river. They attributed that to the barrier to dispersal posed by significant rivers and potentially to increased dispersal along rivers promoted by riparian vegetation. Road bridges and possibly other structures that cross rivers appear to provide important links for possums across rivers that would otherwise present a significant barrier.

Surprisingly, since radio-tracking studies show males disperse much more often than females and their previous South Island study found a strong sex difference, the team found only small differences in genetic structuring between males and females in Hawke's Bay. Given that sex bias in dispersal is well documented in possums, the most likely explanation for the different finding is that the distribution of major rivers across the study area acts to reduce male-mediated dispersal, resulting in approximately equivalent dispersal characteristics between the two sexes.

This study provides a robust baseline for future genetic appraisal of the effectiveness of buffer zones implemented to contain possum movement out from infected areas. To improve Tb management, the study suggests (i) buffer zone effectiveness could be improved significantly by the inclusion of substantial rivers within them; (ii) the development of barriers at points of potential crossings of rivers within buffer zones should be considered as part of the strategy for successful buffer zone implementation; and (iii) genetic surveys following the sampling strategy developed here should be incorporated into the planning for future buffer zone implementation. Such genetic surveys should be tightly integrated with GIS mapping to maximise the information derived to assist in the identification of key habitat and topographical features to be incorporated into buffer design.

This work was done under contract to the Animal Health Board.

References

Cowan P.; Clout M. 2000. *In:* Montague T.L. *ed.* The brushtail possum: biology, impact and management of an introduced marsupial. Lincoln, Manaaki Whenua Press. Pp. 24–34.

Cowan P.; Sarre S.D.; Chapman J. 2002. Landcare Research Contract Report LC0102/086. 27 p.

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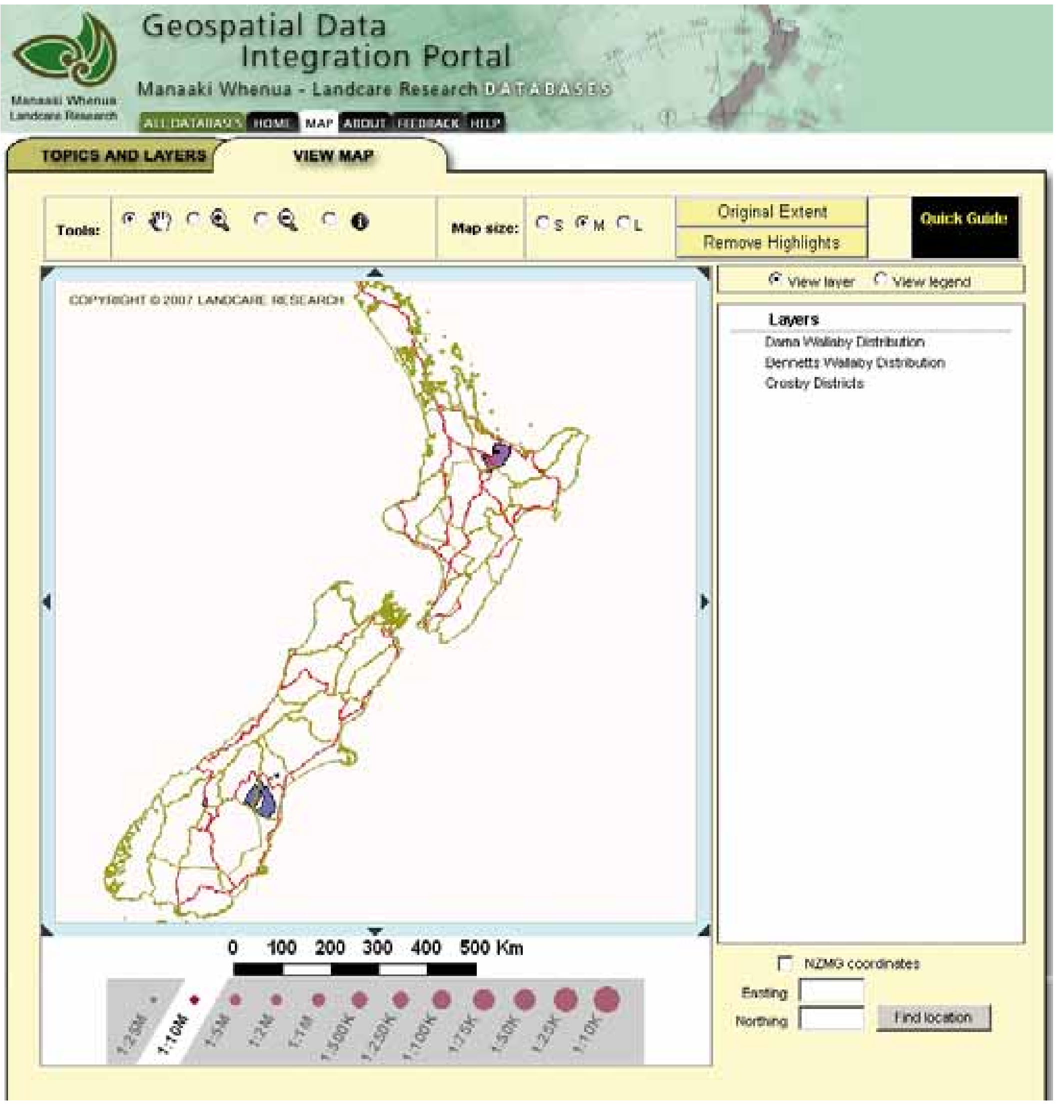
Web-based Tools for Managing Wild Animals

Whether managing wildlife, people, or processes, managers need relevant information. The better informed they are, the better the decisions they are likely to make. A team led by Bruce Warburton has developed a range of web-accessible databases to assist pest managers and end-users find information on wild animal distribution, wild animal survey reports, and how best to control brushtail possums. All three systems are hosted on the Landcare Research website *(www.landcareresearch.co.nz)* and are accessible free of charge.

Wild Animal Distribution
(http://animaldistribution.landcareresearch.co.nz/)
The distribution of many of New Zealand's introduced wild animals is changing. Population ranges are expanding both naturally and through illegal liberations in new areas. The Wild Animal Distribution database provides up-to-date maps of species' distributions, with the capability to update them whenever new information is submitted. Maps of the current national distribution of 7 species of deer, 5 species of wallaby, and thar, chamois, goats and pigs have been developed as an interactive package that allows public access and enquiry. In addition, a feedback module allows users to submit new information on recent sightings of animals outside their known range (or of their local eradication) that can subsequently be screened for validity, and, if accepted, used to further update the distribution maps.

Wild Animal Survey Reports
(http://animalreports.landcareresearch.co.nz/)
Many unpublished reports exist of wild animal surveys undertaken by research teams and animal managers in the Department of Conservation, by Landcare Research for various clients, or by earlier agencies such as the New Zealand Forest Service, New Zealand Wildlife Service, and DSIR. A new database lists all relevant reports. Searches of the database can be made on the title, author(s), DOC conservancy, date, method of survey, or animal species. The database provides a link to the title page and a summary or abstract of the survey results, so the user can assess the relevance of the report before requesting a copy from Landcare Research's library.

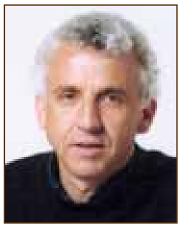


Dama and Bennetts wallaby distribution map from the website

Best methods to control possums
(http://posssumdss.landcareresearch.co.nz)
A decision support system (DSS) has been developed to assist possum managers and contractors in planning control operations. The system has three components. The first includes two checklists covering all of the possible biological and technical constraints and the rationale behind them, including operational, behavioural, legal, and public issues that planners and operators are likely to encounter and need to consider when planning possum control operations. The second component is an expert system that provides recommendations for preferred control options based on a set of queries submitted to the system. The third component comprises an encyclopedia of information sheets hyperlinked through key words for easy movement between related subjects, and covering all relevant aspects of possum control.

The DSS provides recommended actions plus explanations of how these recommendations were derived. This gives users a better understanding of the system, engendering greater trust in it (in contrast to 'black-box' web-based systems that exclude any understanding of the 'system'). The system also enables users to provide constructive feedback. This feature turns the DSS into a collaborative platform, i.e. users not only gain knowledge by querying the system, but also contribute information for others by reflecting on the recommendations, the rules used to support them, and by providing feedback. This should lead to a process of continuous improvement amongst possum control managers.
As users become more familiar and comfortable with using web-based databases, their knowledge and decision-making power will improve.

The Department of Conservation funded the development of the two databases through TFBIS (Terrestrial and Freshwater Biodiversity Information System). The DSS of best methods for improving possum control was developed under contract to the Animal Health Board.



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1080 Information that Māori Can Access Easily

'The forests go silent after aerial 1080 operations' has been a common catch-phrase of those opposed to aerial sowing of 1080 baits for possum control. This concern has been heard again recently, during the Environmental Risk Management Authority (ERMA) reassessment of 1080 under the Hazardous Substances and New Organisms Act (1996). According to James Ataria (Landcare Research) and Shaun Ogilvie (Lincoln University), Māori often repeat this phrase at hui whenever 1080 is discussed. Important issues relating to this concern are the apparent lack of access to the considerable scientific literature published on 1080, the highly technical nature of many of the articles (a barrier to lay-people), and the perception amongst some Māori communities that scientific information published by agencies that use 1080 is often skewed to support the user's point of view – therefore it cannot be trusted.

Aware of these concerns, James and Shaun worked with James Waiwai (Lake Waikaremoana Hapū Restoration Trust) and Jim Doherty (Tūhoe Tuawhenua Trust) to develop a means of allowing Māori communities easy access to reliable information on 1080.

The group came up with the idea of a visual web-based database that would provide a graphical representation of the fate of 1080 in forests. This approach won approval from many Māori land managers who readily associated with the whole environment approach. To achieve it, the team built their database around a foodweb (Fig.) – an ecological concept describing feeding interactions between different groups of organisms in the environment. Clicking on a species takes the user to a page that contains a summary of the impacts of 1080 on that species and its foods, and a level of risk to poisoning from 1080 as assigned by the research team. Each summary also lists relevant references for more information.

By clicking on any of the references, the user is linked to a bibliography where the details of papers are listed. In many instances, a full copy of the referenced paper can also be accessed. At any stage of the search, the user can move to the next level, move back to the previous level, or return to the foodweb page.

The database is underpinned by information from more than 100 scientific articles. However, as it was created in response to concern over non-target deaths, only scientific information on native species in indigenous forest ecosystems is included. Future development of the database is likely to include all other information relevant to 1080 use in pest control.

This database can be accessed free of charge on the Lincoln University website *(http://www2.lincoln.ac.nz/1080/1_Header file.pps* – please note there is a space between the words 'Header' and 'file').

This work was done under contract to the Animal Health Board. They are considering updating the information as new verified data become available.

Other reading

Innes, J.; Barker G. 1999. *New Zealand Journal of Ecology. 23 (2)*: 111–127.

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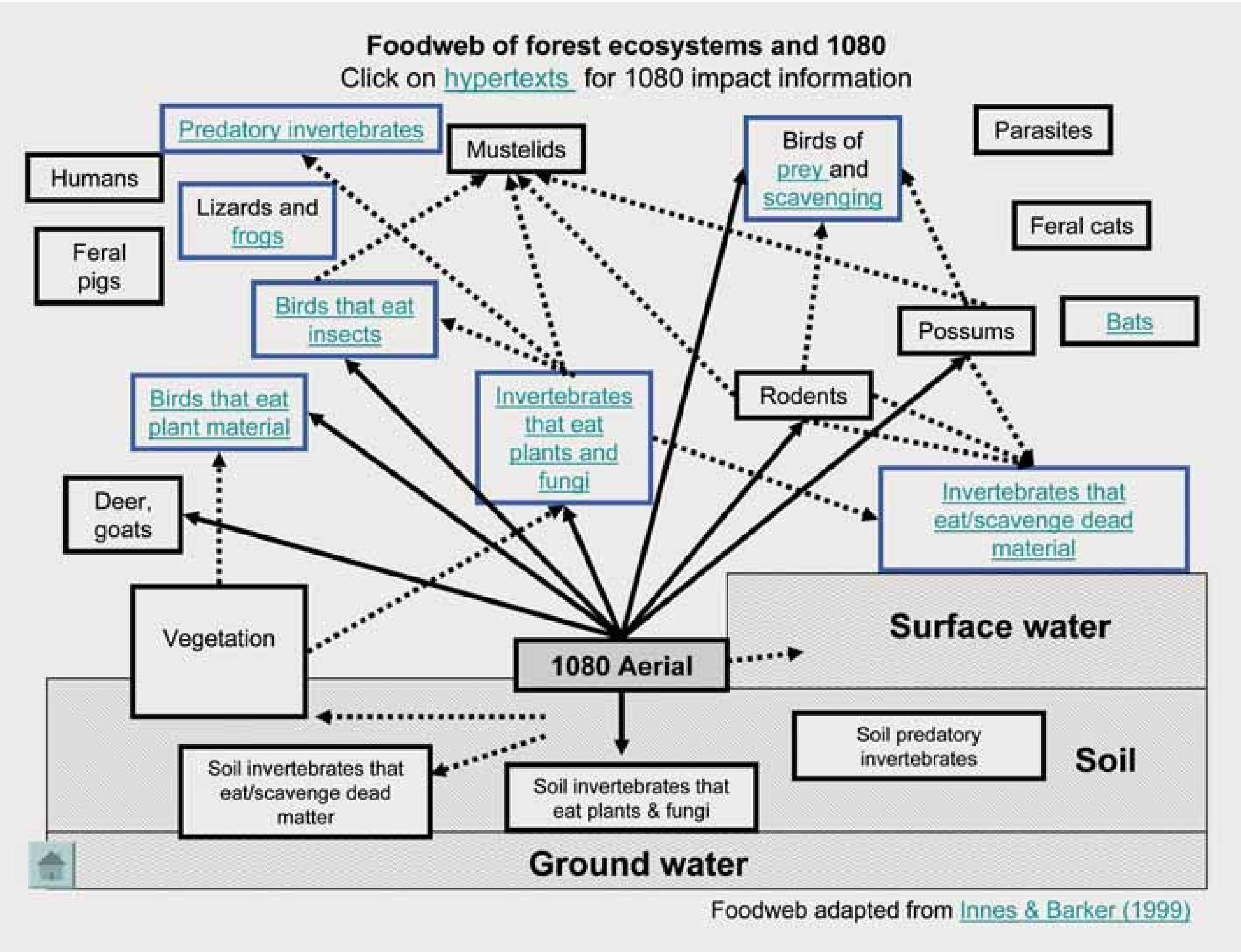

Fig. Graphic presentation of the website, based on a foodweb. Information is accessed by clicking on hyperlinks within the foodweb.

House Mice Avoid 1080

Tricking rats and mice into accepting toxic food is a common tactic used by pest managers seeking to reduce or eradicate pest rodent populations. However, this is not as easy as it sounds. Although a wide range of food items are palatable to rodents, they have highly discriminatory senses (such as smell and taste) and adaptive behavioural responses (such as neophobia and learned aversions) that help them select palatable and nutritious food, while rejecting palatable but harmful food such as a bait containing poison.

Field baiting operations for rodents in New Zealand are generally aimed at the ship rat. In some cases, these operations also control house mice effectively, although the reasons for this success is not well understood. Bait formulations and application methods that specifically target mouse populations in New Zealand have received little attention. Penny Fisher and colleagues recently conducted a trial with captive wild-caught mice, investigating how some basic characteristics of commercial bait types used for rats and possums affected acceptability to mice. The following factors were considered:

- poison-type: 1080 (0.15%) or brodifacoum (0.002%)
- type of bait: 'Wanganui No.7' or 'RS5'
- presence/absence of green dye
- presence/absence of 0.3% cinnamon lure
- bait size: 10–12-mm diameter (2 g) or 20-mm diameter (12 g).

Testing all combinations of these variables required 32 different bait types, which were supplied by Animal Control Products, Wanganui. Once the 96 wild-caught mice had acclimatised to individual laboratory cages, they were presented with a paired choice of 30 g of test bait and 30 g of non-toxic feed pellets daily (i.e. their normal diet while in captivity) for 10 days. Bait consumption was measured daily and fresh test bait and feed pellets offered. Any weight changes of the food due to moisture were corrected for, and any mortality of mice and time to death were recorded.

Toxin type was the only factor that significantly influenced bait acceptance (Fig.); mice clearly avoided eating bait that contained1080 and on average each mouse ate only 0.52 ± 0.04 g of baits with 1080 over the 10 days. All brodifacoum baits were eaten, with an average consumption of 13.2 ± 0.5 g over the 10 days. Overall, there was 100% mortality in mice offered brodifacoum baits but only 8% mortality in those offered 1080 baits. Oral toxicity (LD_{50}) estimates for brodifacoum in mice range from 0.4 to 0.52 mg/kg and are similar to those for rat (*Rattus)* species. Mice in this trial ate up to 20 times more brodifacoum bait than was required for a lethal dose (i.e. 0.43–0.65 g). Despite the high efficacy of the brodifacoum baits, this 'over-eating' behaviour reinforces concerns over the field use of this bait because of the increased secondary poisoning risks to non-target species that may eat poisoned mice. Other bait characteristics such as bait formulation, dye, cinnamon lure, or size did not significantly affect bait acceptance.

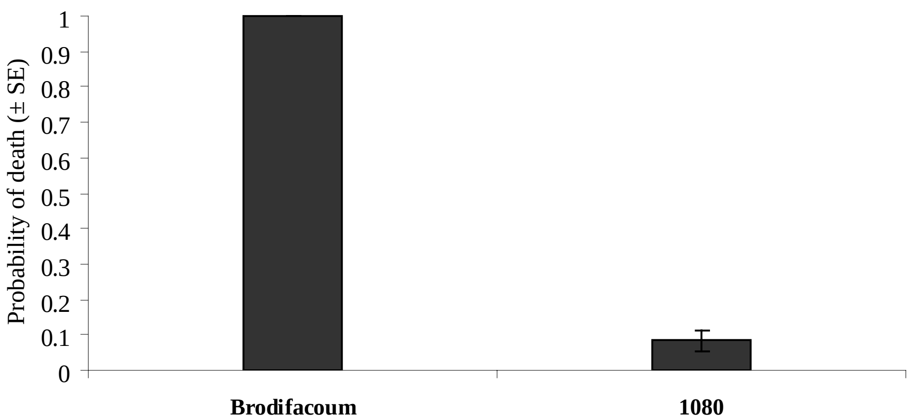

Fig. Probability of death (mean ± SE) in mice, within 21 days, following two-choice test treatments with non-toxic food and baits containing either brodifacoum or 1080.

The avoidance of 0.15% 1080 baits by mice has major implications for mouse control. In the light of these results, it is not surprising that standard 1080 baiting operations for possums and rats on the New Zealand mainland have variable success at controlling mice.

Penny and her team are now investigating whether there is a threshold concentration at which mice can detect 1080 and, if so, how mice are detecting it, e.g. by smell or taste. Preliminary results suggest that mice can detect 1080 at concentrations much lower than 0.15% in bait. Establishing the detection threshold will help determine whether it is feasible to develop and apply a 1080 baiting strategy for mouse control or whether ways can be found to disguise the presence of 1080 in baits and thus increase their efficacy.

This work was funded by the Department of Conservation.

Other reading

Fisher P. 2005. *DOC Science Internal Series 198*: 1–18.

O'Connor C.; Booth L. 2001. *Science for Conservation 184*: 1–11.

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The Science and Socio-Politics of Using 1080 to Control Native Pest Species in Tasmania

In Tasmania, three native species – brushtail possum, Bennett's wallaby (also present in South Canterbury) and Tasmanian pademelon (rufous wallaby) – damage agriculture and forestry through their browsing. Many of their populations have apparently benefited from agricultural and forestry activities, which have created a mosaic of land-use types and consequently increased forest perimeters abutting grasslands, agricultural crops, or forestry coupes.

Since 1952, 1080 has been the only toxin used in Tasmania to mitigate the impacts of possums, wallabies and pademelons, but its use has been increasingly opposed by animal welfare and conservation groups. In December 2005, the use of 1080 was stopped in public forests. Although this ban does not affect private land, the Commonwealth government recently decided to invest $4 million in research, field testing, and a demonstration programme to provide alternative options for private landholders to manage these pests.

In 2006, Bruce Warburton and colleagues were contracted to review past and current research on alternatives to 1080 baiting, and advise on new research directions and alternative approaches to managing browse-damage. Key stakeholders including farmers, forest managers, pest controllers, animal welfare groups, conservation groups, Government land management agencies, and research organisations were invited to share perspectives in a workshop, then subsequently interviewed separately. Gaps in current research and management were identified and ranked taking into account economic feasibility, environmental sustainability, and social acceptability. The findings were presented at a stakeholder workshop, and feedback from this was included in the final report.

Guy Robertson

Grazing damage by wallabies on pasture alongside protected farmland.


Andrew Walsh

Browsing by wallabies on a regenerating forest species.

The report (Coleman *et al*. 2006) covered a wide range of technical solutions, including chemical and acoustic repellents, physical barriers (fences and tree guards), fertility control, alternative toxins, trapping, shooting, commercial harvesting, and preventative farming and forestry practices. Many of these solutions had been considered in previous reports (including some by Landcare Research dating back to 1987) but never adopted, which reflects the difficulty of finding effective, low-cost, publicly acceptable alternatives to 1080.

The latest report also highlighted a range of strategic issues relating to the management of browse-damage. In particular, it emphasised the need to document the amount of damage caused by possums, wallabies and pademelons to the farming and forestry sectors in Tasmania, and to determine damage-based targets for pest control at local (farm) scales. The reviewers believe that land managers (and society as a whole) need to reach a consensus on what the desirable population densities are for these native species, and what levels of damage are acceptable. Being clear about control objectives should make it easier to set benchmarks for determining the ultimate success of pest control programmes.

Most control techniques, or combinations of techniques, need to be adapted to local conditions, a process best achieved by 'adaptive experimental management' with collaboration between land managers and scientists.

Monitoring and evaluation are integral to pest control programmes. How else can the cost of control be justified and the fulfilling of ethical responsibilities for wildlife management be demonstrated? The review therefore recommended improved protocols for monitoring animal numbers and damage, and better use of existing data to track changes in wallaby and pademelon numbers at local and regional scales.

Perhaps most importantly, Bruce and his colleagues separated the issues requiring biological research from those that are the responsibility of politicians and society. Biologists could develop new solutions using non-specific lethal techniques (e.g. replacing 1080 by an alternative non-specific toxin), species-specific lethal techniques (e.g. live capture and euthanasia) or non-lethal techniques (repellents, barriers or fertility control). However, which of these should be used and what line of research should be followed is a socio-political decision.

In February 2007, the Commonwealth and Tasmanian governments announced funding for 12 research and demonstration activities in a two year programme. For 9 projects, the emphasis is on research that is likely to generate quick, short-term technical solutions. One project will deal with the factors affecting a landowner's decision to use 1080, and another one will consider pest management at a regional scale. Only one project, monitoring the impacts of pests on pasture, partly addresses the strategic issues highlighted by the reviewers. Future research to find long-term solutions will require a "systems" approach (i.e. combining ecological, social and economic factors), which has been strongly advocated by many wildlife management scientists in recent decades.

This work was funded by the Department of Primary Industries and Water, Tasmania.

Other reading

Coleman, J.D.; Pech, R.P.; Warburton, B.; Forsyth, D.M. 2006. Landcare Research Contract Report: LC0506/144, 93 p.

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Small Mammal Outbreaks in Serengeti National Park, Tanzania

In May 2006, Wendy Ruscoe and Andrea Byrom visited Tanzania to participate in the Serengeti Biodiversity Program. This programme is jointly run by Simon Mduma (Tanzanian Wildlife Research Institute) and Tony Sinclair (University of British Columbia). Both Wendy and Andrea have worked with Tony for a number of years on a range of projects in New Zealand and Canada.

The Serengeti Biodiversity Program has been running at a variety of sites in Serengeti National Park (SNP) for more than 40 years. It focuses specifically on understanding (1) the factors that affect all species in the Serengeti ecosystem, and (2) how the protected area affects human populations surrounding the park.

An important issue that was recognised only recently is that rodents, particularly the multimammate rat (*Mastomys*), go through periodic fluctuations in numbers within SNP every 4–5 years. In contrast, this species remains at moderate to high numbers in the villages outside the park. These rodents are known to transmit diseases to humans. Understanding the dynamics of the rodent populations inside and outside the park will help to predict potential outbreaks and transmission of disease. In short, research on rodents within SNP could help people living nearby.

Serengeti researchers had already been monitoring rodent populations for 6 years. However, they were keen to have some outside expertise to ensure that their trapping techniques were correct, and that their 'catch' during the 'low periods' really was 'zero catch' and not a result of incorrect techniques. Wendy and Andrea were able to give the local researchers and field staff useful pointers on several field techniques, including (1) labelling individual animals correctly and matching this with the written data; (2) preparing samples for genetic identification; (3) field identifying rodent genera (including unusual genera such as the spiny mouse); (4) measuring and handling rodents in the field; and (5) collecting voucher specimens.

A spiny mouse, Acomys*, captured near rock outcrops on the Serengeti Plains.*

A second, ongoing need of the Serengeti Biodiversity Program is analysing the rodent capture data to determine which factors (such as weather or food supply) trigger changes in rodent numbers. Since their visit, Wendy and Andrea have been analysing the Serengeti rodent data, the results of which will be published in a chapter in the next Serengeti book, SERENGETI IV: Biodiversity. This chapter will address four interlinked pieces of research:

Do small mammal communities of Serengeti undergo regular population increases and declines? Research in Tanzanian agricultural areas has shown that small mammal species go through sudden population increases related to rainfall. These population increases affect both crops and people. The data from SNP, using indicators such as the black-shouldered kite (a specialist predator of small mammals), indicate that such outbreaks may be more regular than anyone has anticipated. Current knowledge of rodents around the world suggests that regular outbreaks (cycles) occur only in northern temperate regions of Eurasia and North America. The data from SNP may be the first evidence of regular cycles in a tropical region.

What causes temporal changes in the Serengeti small mammal community? Data from the agricultural areas suggest that small mammal population outbreaks are driven by increases in food availability, which is affected by rainfall. Wendy and Andrea should be able to show whether the observed population dynamics within SNP are also driven by rainfall, or whether other factors such as predation drive the dynamics of these small mammal populations.

How do the observed changes in small mammal communities relate to other components of the ecosystem? Small mammals often provide valuable food for birds of prey and small carnivores. If this is so in SNP, then fluctuations in small mammal populations may lead to delayed fluctuations in predators, perhaps with important consequences for other prey species. By quantifying the dynamics of small mammals, Wendy and Andrea will be able to predict the impact on other components of the ecosystem, e.g. invertebrates, amphibians and reptiles.

How do the dynamics of small mammals in Serengeti affect small carnivore populations and disease (rabies and distemper) transmission to humans? Small carnivores are implicated in the transfer of rabies and distemper to humans and to their domestic animals, and vice-versa. If increases in small mammal populations drive increases in carnivore populations, then there is an increased risk of transmission of rabies and distemper both directly (from the rodents themselves) and indirectly (from wild carnivores to domestic dogs) to humans. If small mammal outbreaks can be predicted in advance, then such diseases may be managed more efficiently when the risk to humans is greatest.

Once the Serengeti rodent data have been analysed, a follow-up article in Kararehe Kino will let you know what the researchers have found.

Some of this work was funded by the Foundation for Research, Science and Technology.

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Sirtrack* GPS Collars for Small Mammals

For many years Sirtrack GPS (Global Positioning System) collars have been used around the globe for monitoring wildlife ranging in size from lynx and wild dogs through to feral pigs, camels and elephants. However, one challenge has been to minaturise these units for use on smaller mammals. Sirtrack has now succeeded in this, and believe their GPS collars are the first in the world to be used on feral cats and possums.

The latest GPS collar that Sirtrack currently makes weighs just 105 grams. It has been specially designed for possums and also includes a VHF transmitter. The transmitter has a life of about 12 months (under ideal conditions), but the GPS unit has a more variable life depending upon the 'sample' interval. For example, if positional data are recorded at one hour intervals, the GPS lasts roughly 55 days. But this is very hard to predict as the time taken by the unit to obtain a positional fix varies considerably with the 'view' of the sky above it: with an unobstructed view, a fix is normally obtained in under 15 seconds; but under dense, wet vegetation, it may take several minutes.

To save power and prolong the life of the GPS unit, the on-board software is programmed to abort any attempt to obtain a fix if it cannot be obtained in 3 minutes.

To further extend the life of the GPS, a duty cycle can be added to the microcontroller to turn the GPS on and off at programmed intervals. Attempting to get repeated positional fixes of a possum during the day when it is asleep in a den would be a waste of power. In this, and in like situations, the duty cycle can be programmed to take fixes from an

Sirtrack GPS collars for a cat (left) and possum (right).

hour after dusk through to an hour before dawn. The above example of a duty cycle would roughly double the life of the GPS.

Feedback from clients indicates these collars produce high-quality, fine-scale animal tracking data that surpass any animal tracking data obtained using earlier-model radio collars. Consequently, there is considerable demand for these collars from researchers.

For further details, please contact *sirtrack@sirtrack.com*

* Sirtrack is a subsidiary of Landcare Research, and is based at Havelock North.

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Some Recent Vertebrate-Pest-Related Publications

Duckworth, J. A.; Cui, X.; Molinia, F. C.; Cowan, P. E.; Walcher, P.; Lubitz, W. 2005: Fertility control vaccines for the management of brushtail possums in New Zealand. *Tissue Antigens 66:* P. 163.

Efford, M. G.; Warburton, B.; Coleman, M. C.; Barker, R. J. 2005: A field test of two methods for density estimation. *Wildlife Society Bulletin 33:* 731–738.

Forsyth, D.M.; Barker, R.J.; Morriss, G.; Scroggie, M.P. 2007: Modeling the relationship between fecal pellet indices and deer density. *Journal of Wildlife Management 71:* 964–970.

Hutton, I.; Parkes, J.P.; Sinclair, A.R.E. 2007: Reassembling island ecosystems: the case of Lord Howe Island. *Animal Conservation 10:* 22–29.

Jones, C.; Toft, R. 2006: Impacts of mice and hedgehogs on native forest invertebrates. *DOC Research and Development Series 245*. Wellington, Department of Conservation. 32 p.

Morgan, D.R. 2006: Field efficacy of cholecalciferol gel baits for possum (*Trichosurus vulpecula*) control. *New Zealand Journal of Zoology 33:* 221–228.

Morgan, D.R.; Nugent, G.; Warburton, B. 2006: Benefits and feasibility of local elimination of possum populations. *Wildlife Research 33:* 605–614

Parkes, J. P.; Robley, A.; Forsyth, D. M.; Choquenot, D. 2006: Adaptive management experiments in vertebrate pest control in New Zealand and Australia. *Wildlife Society Bulletin 34:* 229-236.

Ramsey, D.S.L.; Coleman, J.D.; Coleman, M.C.; Horton, P. 2006: The effect of fertility control on the transmission of bovine tuberculosis in wild brushtail possums. *New Zealand Veterinary Journal 54:* 218–223.

Ryan, T. J.; Livingstone, P. G.; Ramsey, D. S. L.; de Lisle, G. W.; Nugent, G.; Collins, D. M.; Buddle, B. M. 2006: Advances in understanding disease epidemiology and implications for control and eradication of tuberculosis in livestock: the experience from New Zealand. *Veterinary Microbiology 112:* 211-219.

Tompkins, D.M.; Ramsey, D. 2007: Optimising bait-station delivery of fertility control agents to brushtail possum populations. *Wildlife Research 34(1):* 67–76.

Wilkinson, R.; Fitzgerald, G. 2006: Public attitudes toward possum fertility control and genetic engineering in New Zealand. *Landcare Research Science Series 29*. Lincoln, Manaaki Whenua Press. 50 p.

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Cartoon: Susan Marks

Thanks to: Judy Grindell

Layout: Cissy Pan

Published by: Manaaki Whenua
Landcare Research
PO Box 40
Lincoln 7640, New Zealand
ph +64 3 321 9999
fax +64 3 321 9998

PAPER STOCK
9 Lives Satin 150gsm
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