He Kōrero Paihama
Possum Research News

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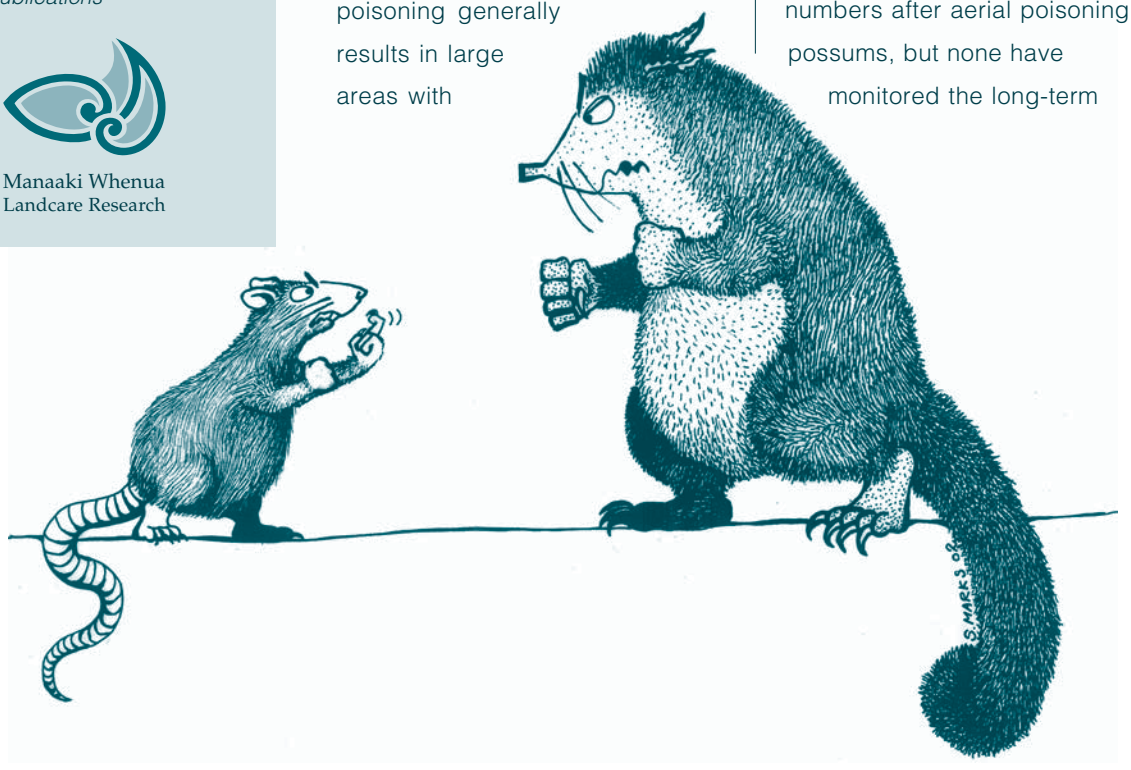
Contents

Manaaki Whenua
Landcare Research

Long-term Changes in Rat Abundance following Possum Control

The effect of sustained possum control on other pests is something we know little about. Aerial sowing of poison baits at intervals of 5–7 years is commonly used to control possums in large areas of remote native forest. Such operations typically kill more than 80% of possums and 80% of rats. Possum populations recover slowly, typically taking at least 5 years to reach pre-control levels. However, rats reproduce more rapidly, populations often reaching pre-control levels within 12 months. Hence, aerial poisoning generally results in large areas with controlled possum populations but uncontrolled rat populations.

Forest fruits and seeds (when they are available) are major components in the diet of both possums and rats. Possum browsing has been shown to suppress fruit production. It is therefore easy to see that, following possum control, rat populations could increase to higher numbers than before because there is less competition for favoured foods. Many studies have monitored the decline and short-term recovery of rat numbers after aerial poisoning for possums, but none have monitored the long-term



responses of rat populations to reduced possum numbers.

Peter Sweetapple, Graham Nugent and Wayne Fraser have spent over 10 years studying possum diet at Waihaha (Pureora Forest Park). This has given them some insights into possum/rat population dynamics. In order to obtain possum stomach samples for diet analyses, cyanide baits were laid for possums. The number of baits disturbed by animals other than possums was recorded intermittently throughout the study (1990–2002). During this period, the possum population was initially at moderately high levels, with a residual trap catch (RTC) index of 24% in 1994. Possums were then reduced to low levels in an aerial 1080 poisoning operation. This was repeated in 2000. Prior to the 1994 control operation, the disturbance rates to cyanide baits averaged 13%. Between 1998 and 2000 (Fig.), when RTC indices of possum numbers were less than 8%, bait disturbance was four times higher.

Peter also monitored rat abundance since 1998 using snap-back traps. He found rat abundance (Fig.) was directly correlated with disturbance to possum baits. These results suggest that a huge sustained increase in rat abundance following initial possum control in 1994 was reversed by further possum control in 2000. Since then, rat populations have again increased rapidly. This increase may have serious consequences, not only for native species preyed on by rats, but also for native species threatened by stoats or cats as both these predators may increase when rats (a major element in their diet) are very abundant.

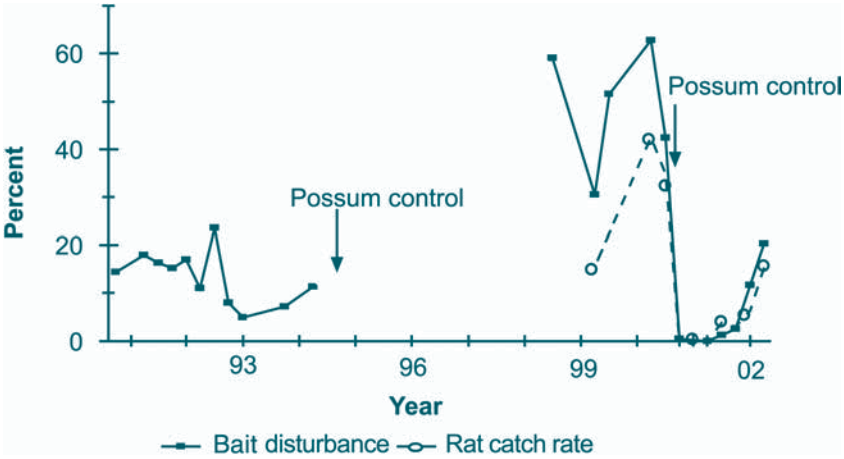


Fig. *Cyanide bait disturbance and ship rat catch-rates during the study. No indexing of rat abundance was undertaken between 1995 and 1997.*

Because there could easily be other explanantions for these results Peter and Graham are undertaking further research at Waihaha, using a purpose-designed study rather than 'incidental' findings. This research will quantify the magnitude of the changes in rat and stoat abundance following possum control.

This work was jointly funded by the Foundation for Science, Research and Technology and the Department of Conservation.



Peter Sweetapple, ***Graham Nugent*** *and* ***Wayne Fraser*** *work on the ecology and control of vertebrate pests.*

Guest Editorial

What Does DOC Need from Possum Research?

The Department of Conservation needs developments that make conventional control methods cheaper, and we need new tools that are possum-specific in their action. This would help us allay the fears that people are expressing about the safety of 1080. Experience is teaching us that well-conducted risk assessments based on robust data do not influence some concerned citizens – they want to see new approaches.

The catch-22 is that new tools might attract as much criticism as current ones. There will be very close scrutiny as the time for field trials of new products comes round. This means everybody, including DOC, needs ongoing measurement of public opinion. People's appreciation of biotechnology can be expected to change with time, so reality checks at frequent intervals along the R&D pathway seem sensible.

It's unlikely that we'll see very rapid progress on new methods to control possum populations. In the meantime, refinements that further reduce mortality of native wildlife during poison operations will be welcomed. The health and safety of people using pesticides and the humaneness of present control methods continue to warrant study. Maybe it's boring to plug for conventional work on conventional methods, but our commitment to quality conservation management means that improvements from research will be adopted.

Supposing nothing promising emerges, and support for possum control in remote places using 1080 collapses? Clearly, researchers will be asked for ways to target trapping or bait stations so that enormous tracts of difficult country can be economically treated. Are possums really distributed in a uniform way across such landscapes? Or are they clustered in habitat patches that can be identified by remote sensing and then visited by ground teams with helicopter support?

Some sort of durable and very attractive material would be helpful for situations where possums are now at low densities. As pest densities decline in a patch, we face a problem that looks more like biosecurity surveillance. That is, we need 'remote' ways to detect increases in possum density in time to apply remedial action. On islands we deploy poison baits to simultaneously detect and kill invading rodents, and to do something similar for possums in cleared patches on the mainland we'll need a long-life bait. Perhaps improved thermal imaging cameras will come onto the market that can be used to sample patches of forest at occasional intervals?

Interactions between natural disturbance patterns and prevailing possum densities seem under-researched. Switching on possum control at some places may make very little difference compared to other damaging influences, and research to help us identify those places or times is needed.

Possums are not the only mammals that alter the natural character of our forests and grasslands. As the Department adopts more integrated pest control at sites, we'll need decision support tools for optimising control regimes. We have anecdotal evidence that control of one pest population can benefit other pests, and have initiated a small study to model these effects. The interactions between possums and other pest populations, like pigs and rats, also need study.

At a strategic level, we also need information to feed into other Government programmes. For example, what is the net effect of possum control on carbon fixation rates in our forests? Should the Animal Health Board eventually withdraw from possum control, which parts of the agricultural landscape will become source populations for forest sinks?

The Department hopes that, as a user of the knowledge and products developed by research organisations, this article gives researchers an overview of its needs. DOC always welcomes contact with researchers, especially at technology transfer seminars, and looks forward to hearing how fresh ideas develop.

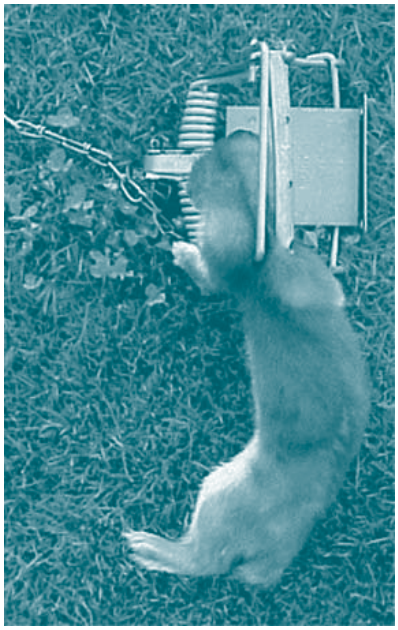
Peter Lawless *is the Regional General Manager (Northern) for the Department of Conservation and Chair of National Possum Control Agencies (Unincorporated).*

Traps - Raising the Standard

Society increasingly demands that we consider animal welfare issues when deciding on methods for pest control, so trap performance is therefore increasingly coming under scrutiny. Traps are used extensively in New Zealand for controlling possums, stoats, ferrets, feral cats, and rodents. They enable pest-control personnel to mix non-toxic and toxic control methods (to, for example, overcome or avoid aversions that may develop from extended use of poisons) and provide an alternative control option for use where poisons are unacceptable. For the control of mustelids and feral cats, traps currently provide the only effective control method.

From the early 1920s (when traps were first used in New Zealand for trapping rabbits and possums) up until 1999, there were no restrictions on what traps could be used for any vertebrate pest species. Additionally, there were no requirements for trap importers and distributors to ensure that their leg-hold traps captured animals with minimal injury, or that their kill traps killed target animals quickly. However, from 1960, the Animal Protection Act required that all traps be checked within 24 hours of setting.

In 1999, animal welfare legislation in New Zealand was reformed via the Animal Welfare Act. Although this Act provides exemptions for most activities carried out for pest control, it does allow for the prohibition of traps that cause animals unreasonable pain or distress. Thus, the National Animal Welfare Advisory Committee (NAWAC) makes recommendations to the Minister of Agriculture and Forestry on which traps should be prohibited. Such recommendations are based on an international draft trap standard for assessing the welfare performance of traps, and include criteria for both restraining traps (i.e., cage, box, and leg-hold traps), and kill traps. Restraining traps, especially leg-hold traps, have the potential to cause limb injuries, and the performance criteria to assess them is based on the frequency and degree of any injuries. For kill traps, the performance criteria are based on the time taken for captured animals to be rendered irreversibly unconscious, and is currently set at 3 minutes.



Stoat caught across the chest in a Fenn Mark VI trap.

Bruce Warburton and Nick Poutu have been pen-testing a range of

Table 1. *Test results of two kill traps when used against three stoats each. Both these traps failed the test criteria.*

Animal	Strike location(s)	Loss of blinking reflex
	Trap 1	
Stoat 1	Chest & hips	> 5 min
Stoat 2	Head & chest	52 s
Stoat 3	Shoulders	> 5 min
	Trap 2	
Stoat 4	Chest	> 5 min
Stoat 5	Chest	> 5 min
Stoat 6	Chest & shoulder	> 5 min

Table 2. *Test results for a snap-back rat trap when used for trapping Norway rats. This trap passed the test criteria (data from all animals tested presented).*

Animal	Strike location	Loss of blinking reflex(seconds)
Rat 1	Neck	< 30
Rat 2	Head	< 30
Rat 3	Neck	< 25
Rat 4	Head	< 25
Rat 5	Head	< 30
Rat 6	Head	< 20
Rat 7	Head	< 25
Rat 8	Head	< 30
Rat 9	Neck	< 30
Rat 10	Neck	33

new kill traps for possums, stoats, ferrets, feral cats, and rats. During nightly vigils, Nick watches selected target animals enter and spring traps, and then assesses when the trapped animal loses consciousness (by touching the edge of the eye or blowing on the cornea to elicit a blinking response seen only in conscious animals). Where a trap performs successfully, further animals are tested until either 10 out of 10 or 13 out of 15 animals are rendered unconscious within 3 minutes. Conversely, if a sample of 10 animals is selected for the test and one trapping fails (even the first one), or 3 animals in a 15-animal test fails, then the trap has failed and no further testing is undertaken (Tables 1 and 2).

NAWAC has now made their first recommendations for prohibiting some traps, including glue-boards (cardboard smeared with sticky glue to entrap rodents), Lanes-Ace ('gin') and similar traps, and Victor No.1½ and larger unpadded double-coil spring traps. The commonly used Victor No.1 trap and its 'look-a-likes' will not be prohibited. This is, however, only the start of the prohibition process. Before the Minister (currently the Hon. Jim Sutton) recommends an Order in Council to prohibit any trap, he must have regard to a number of issues identified by the Animal Welfare Act. These include, in part, the nature and purpose of the trap, whether the pain or distress caused is unreasonable, whether it conforms to relevant New Zealand standards, and whether it can be modified to meet the welfare concerns.

These issues are currently being evaluated for the three trap models listed above, with the outcome of the evaluation still unknown.

Trap testing carried out by Landcare Research staff is not about eliminating trapping from New Zealand, but rather about ensuring that traps used for controlling pests are both effective and humane, and continue to be available. This work has been approved by Landcare Research's Animal Ethics Committee.

This work was funded by the Foundation for Research, Science and Technology, the Department of Conservation, and the Ministry of Agriculture and Forestry.

Bruce Warburton *and* ***Nick Poutu*** *work on the control and monitoring technology of small mammal pests.*

The ART of Possum Biocontrol

No, this isn't about a new feature exhibition at Te Papa! Research on Assisted Reproductive Technology (ART) in the possum began almost 7 years ago, as an initiative by the Marsupial Cooperative Research Centre (CRC) to help breed endangered marsupials in Australia. The possum, New Zealand's number one vertebrate pest, clearly needs no assistance here, but Landcare Research and Marsupial CRC scientists are now cleverly using ARTs to assist with development of possum biocontrol.

Key strategies for achieving possum biocontrol include the disruption of important reproductive processes like egg and sperm maturation, fertilisation and embryo development. Using ART, the scientists are developing experimental ways (models) of manipulating these key reproductive events both inside (*in vivo*) and outside (*in vitro*) the possum (Table). These systems are now being used as 'tools' for rapidly identifying and testing suitable ways of interfering with reproduction.

The team uses 'test-tube' models of egg and sperm maturation to confirm where potential contraceptive antigens are located and how they may be used to block fertilisation. Testing the fertility of possums immunised against these antigens, is now routinely done using hormone treatment to induce egg production (superovulation) and artificial insemination (AI). This screening of *in vivo* fertility of immunised possums is necessary before we can progress to costly natural breeding trials. Testing in the laboratory also minimises the need to use live animals in research. Thus *in vitro* fertilisation (IVF) technology (testing 'in a Petri dish') promises to be the most efficient and cost-effective way of testing vaccines that disrupt fertilisation. Culture systems for embryo development are currently being developed and the team will use them to rapidly test prospective vaccines designed to interfere with the embryo and its interaction with the reproductive tract.

In developing these systems the team have vastly increased their knowledge of possum reproduction. This has provided them with opportunities to identify unique biocontrol targets. For example, sperm acquire the ability to fertilise an egg during their passage in the female reproductive tract – a process known as capacitation. Recently the scientists confirmed that secretions from the possum's oviduct are critical to this process. They have identified a glycoprotein in these secretions similar to one that plays an important role in fertilisation in other mammals and are currently investigating this as a promising oviduct target. Also they have discovered that calcium plays a

Microscopic assessment of possum sperm motility prior to use for artificial insemination.

critical role in sperm capacitation. This and the mechanisms of sperm–egg fusion are also being investigated, since these processes are different to those found in non-marsupial mammals and thus represent emerging new target areas for possum biocontrol.

Finding ways to improve possum reproduction may at first seem an odd way to find methods to control them, but ART research is making a substantial contribution to progress in the development of possum biocontrol.

This research was supported by the Foundation for Research, Science and Technology, MAF Policy, and the Cooperative Research Centre for Conservation and Management of Marsupials.

Frank Molinia *is a senior member of Landcare Research's team working on possum biocontrol.*

Table: *Models of key reproductive events for the possum*

Key event	***In vitro* model**	***Status***	***In vivo* model**	***Status***	***Application***
Egg maturation	Egg culture	Established	Superovulation Breeding season Seasonal anoestrus	 Established In progress	Screen vaccines that interfere with the development of matured eggs
Sperm maturation (capacitation)	Sperm + oviduct extracts culture	Established	Sperm recovered from oviducts after superovulation/AI	Established	Screen vaccines that interfere with the ability of sperm to fertilise eggs Identify key reproductive tract targets
Fertilisation	IVF	Sperm–egg binding, penetration and fusion	Superovulation/AI	Established	Screen vaccines that interfere with fertilisation Identify key sperm–egg interaction sites as targets
Embryo development	Embryo culture	In progress	Up to blastocyst stage Cleavage to birth stages	Established In progress	Screen vaccines that interfere with the developing embryo and its interaction with the female reproductive tract

Understanding Information in Pest Management

Increased interest in protecting biodiversity on private land, challenges to the use of 1080, and the Animal Health Board's aim to eradicate Tb from livestock, exemplify recent changes that affect vertebrate pest management in New Zealand. Communities and landowners are becoming more involved in pest management. As a result, agencies managing pests increasingly have to develop partnerships to ensure that control work is carried out. All players in such partnerships need information to ensure the success of their work. Hence, an important part of the partnership approach to pest control is managing information within a complex network of individuals, groups, contractors, management agencies, policy makers and researchers. So how can we, as part of this network, begin to improve information management for pest research?

Many of our current ways of communicating with each other are based on the idea that experts (such as scientists) need to transfer information outwards in a linear fashion. However, some researchers and practitioners are finding it useful to think of information as an integral part of a network of people and organisations who are focusing on a common problem. This implies that information management is a social process rather than just a technical one. We also need to understand how people in the network interact with each other and with the information-transfer media that we use, and how they react to changes that occur outside the network. Legislation, policy, economics and social change all impact on an information system.

Fig. *Kolb's learning cycle*

It is useful to think about how the different players (social scientists included) in pest management can contribute towards achieving better pest management outcomes. An important feature of complex network systems is that all individuals within the network affect the network as a whole. In some ways this is reassuring, because it means that to change the information network, it is possible to begin the process by working to change ourselves and our interactions with others in the network. In general, it is not feasible to think about changing the behaviour of others without also being prepared to change ourselves.

Part of this process, then, means understanding the barriers that we all strike when we deal with new information. We may not understand another person's information, may not have time to work with the information, or may not realise how another's information might help us. There are also times when information does not seem entirely relevant *now,* but we find ourselves later trying to remember where we read or heard something. These are all things that we can learn about by reflecting on our own experiences. Everyone in the network is likely to have similar problems at being heard, or in being aware of different kinds of useful information. This suggests that it will probably be easier to work together to think about how to lessen those barriers.

In any complex network system, sometimes it is not obvious what changes will result in better outcomes, so monitoring the outcomes of our changes over time

is important. Of course, hand in hand with monitoring any system is the need to research that system, to understand the different processes operating within it, and to find ways to think about how to change what we do to improve the situation. This is a key focus of the collaborative learning group at Landcare Research. The process of monitoring what we do, and evaluating the outcomes, is something that we can all do, and is the basis of the Kolb learning cycle illustrated in the accompanying figure.

If we know that we need to improve the function of the system, then trying to do more of the same thing is unlikely to bring about improvements. We know, for example, that it is a waste of resources to focus on killing more and more possums without thinking about longer-term goals, and without monitoring what we do. To be increasingly effective, we need to work out what we want from pest management, try some different strategies, observe what happens, and think about how we could change what we are doing to improve our outcomes. The same applies to an information system. We need to work to understand the system, try some strategies, and evaluate their effect on the system. We need to think beyond simply putting our information out more loudly or more frequently.

For more information see our website: http://www.LandcareResearch.co.nz/research/social

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

Chrys Horn *and* ***Will Allen*** *are social researchers investigating collaborative learning for environmental management.*

Handling Tb-infected Wildlife in the Field

Bovine tuberculosis (Tb) is still a serious health risk to humans in New Zealand. It can be transmitted to them via cattle and deer products or through contact with wild animals. Amongst wild animals, Tb is most widespread in possum populations, and infected populations occur over about one-quarter of New Zealand. In these areas, Tb can also occur in other wild animal species, most commonly deer, ferrets, and pigs, and all may be highly infectious. In addition, 11 other species of common introduced wild animals are occasionally infected. All of these animals may excrete *Mycobacterium bovis,* the bacillus that causes the disease, and all pose a direct threat to humans who handle them.

Possum with a large Tb lesion in a lymph node in its axilla.

Humans can become infected in several ways. *Mycobacterium bovis* can enter the body via the mouth (typically either from food or cigarettes contaminated by unwashed hands), via inhaling airborne bacilli exhaled by infected animals, via cuts and grazes in the

Inspecting the submaxillary lymph nodes of a pig for Tb.

skin, or via the membranes of the eye. Anyone working with infected wildlife is at risk of becoming infected, and while the infection is usually treatable, it can be a serious life-threatening affliction and may remain dormant only to reactivate (recur) in middle to old age when immune responses naturally wane.

People and agencies involved in working with wildlife populations likely to be infected with Tb should therefore understand and manage the risks of human infection. Acceptable safety procedures should be developed and followed whenever 'suspect' wild animals are approached or handled, and human health monitoring procedures should be established.

Landcare Research has developed mandatory procedures for all field staff working with infected wildlife populations. These procedures are based on providing the best protection possible within the limitations to human activity imposed by the field situations in which most work is undertaken. Jim Coleman, in discussion with medical and veterinary staff, has identified procedures for handling potentially infected wild animals, which must be followed by all of the Institute's staff. These include:

- wearing surgical masks when approaching live animals, particularly those likely to provide explosive aerosols (infected exhalations such as coughing and sneezing)
- using surgical gloves when handling suspect animals
- keeping any normally exposed broken skin covered with waterproof dressings
- immediately disinfecting with alcohol-based antibacterial cleansers any wounds inflicted by possums
- thoroughly washing hands with antibacterial cleansers before eating or smoking, and when finishing work for the day
- removing all potentially contaminated clothing and footwear, before entering any accommodation
- disinfecting all field clothing and equipment with antibacterial cleansers and/or sunlight at the end of each field trip, and
- incinerating or burying carcasses and disposable equipment.

Staff from Landcare Research required to work with wildlife likely to be infected with Tb initially undergo thorough checks of their relevant past medical history, including possible contact with infectious animals, personal or family history of Tb, the dates of any Mantoux skin test (to establish their current Tb and baseline sensitivity to the bacillus), the date of any BCG vaccination, and relevant X-ray results. They are then required to undergo annual or two-yearly follow-up Mantoux tests.

We believe these safety procedures and health checks are the minimum required to protect field staff placed at risk through approaching or handling wildlife that could be infected with Tb. Landcare Research is continuing to work with experienced epidemiologists to refine and reaffirm our commitment to best possible field practices.

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

Jim Coleman *works on the epidemiology of Tb in wild animals.*

Editorial Note:

Possum Research News Changes to Animal Pest Research News

In December 1994, Landcare Research published Issue No 1 of He Kôrero Paihama – Possum Research News, and forwarded it to some 800 recipients. Seventeen issues containing about 100 articles and 8 years later, we have decided to expand our Newsletter both in size and in content, to include articles on all mammal pests investigated by Landcare Research staff. We currently intend to call our new Newsletter He Kôrero Kararehe Kino – Animal Pest Research News. Issue 17 of He Kôrero Paihama – Possum Research News is thus the last issue in this series. The first issue of our new expanded newsletter will come out in late 2002, and will be forwarded to all 1100 individuals on our current address listing.

Jim Coleman
Caroline Thomson

Contacts and Addresses

Researchers whose articles appear in this issue of *He Kôrero Paihama - Possum Research News* can be contacted at the following addresses:

Will Allen
Jim Coleman
Wayne Fraser
Chrys Horn
Frank Molinia
Graham Nugent
Nick Poutu
Peter Sweetapple
Bruce Warburton

Landcare Research
PO Box 69
Lincoln
ph: +64 3 325 6700
fax: +64 3 325 2418

Peter Lawless
Regional General Manager (Northern)
Department of Conservation
PO Box 112
Hamilton
ph: +64 7 858 0000
fax: +64 7 858 0001

For more information on research in Landcare Research see our website: http://www.LandcareResearch.co.nz

A Selection of Recent Possum-related Publications

Bolton-Grob, R.M.; Ahokas, J.T.; Eason, C.T. 2001: Marsupialia and Monotremata. *In*: Shore, R.F.; Rattner, B.A. *eds*. Ecotoxicology of wild mammals. Chichester, John Wiley. Pp. 85-122.

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Editors:	Jim Coleman Caroline Thomson	Published by:	Manaaki Whenua Landcare Research PO Box 69 Lincoln, New Zealand ph +64 3 325 6700 fax +64 3 325 2418
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Cartoons:	Susan Marks		
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