He Kōrero Paihama
Possum Research News

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Manaaki Whenua
Landcare Research
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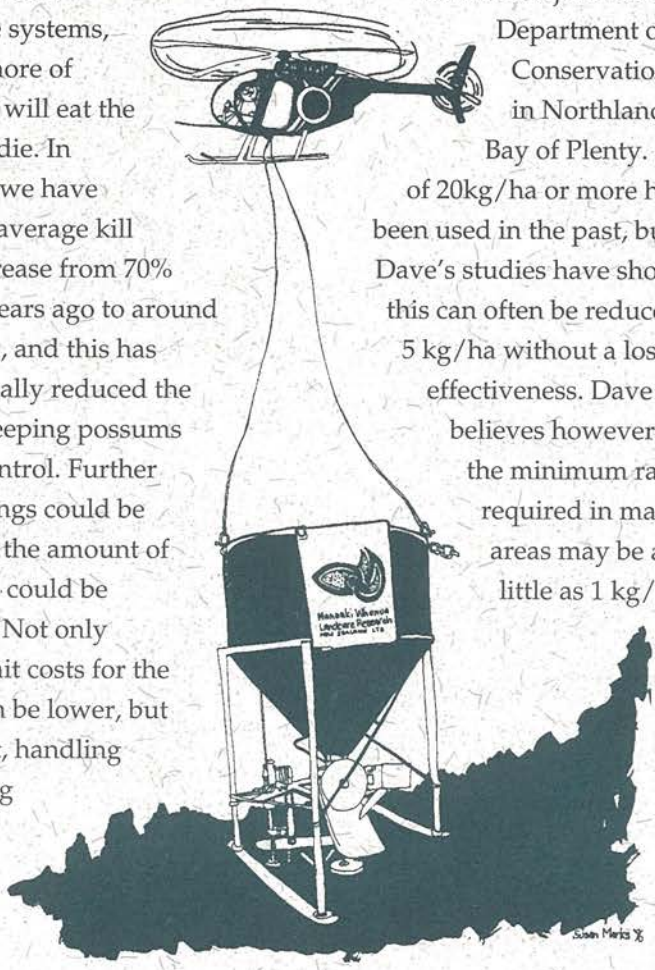
Aerial Sowing and Buckets - a New Tool for the Job

Why do some possums survive aerial control operations? This has been the underlying question behind much of Dave Morgan's research over many years and has led to a gradual improvement in the standard of aerial baiting. Dave's trials predict that if correctly prepared baits are used at the right time and distributed uniformly with the aid of GPS - guidance systems, 95% or more of possums will eat the bait and die. In practice, we have seen the average kill rates increase from 70% twenty years ago to around 85% now, and this has substantially reduced the cost of keeping possums under control. Further cost-savings could be gained if the amount of bait used could be reduced. Not only would bait costs for the operation be lower, but transport, handling and flying costs would also be reduced. Control budgets could be stretched to control possums over a greater area. Public demand (in New Zealand and overseas) for reductions in the amount of pesticide being introduced into the environment would also be met.

In trying to compare the effectiveness of different bait sowing rates, Dave established trials in conjunction with Department of Conservation staff in Northland and Bay of Plenty. Rates of 20kg/ha or more have been used in the past, but Dave's studies have shown this can often be reduced to 5 kg/ha without a loss in effectiveness. Dave believes however, that the minimum rate required in many areas may be as little as 1 kg/ha or

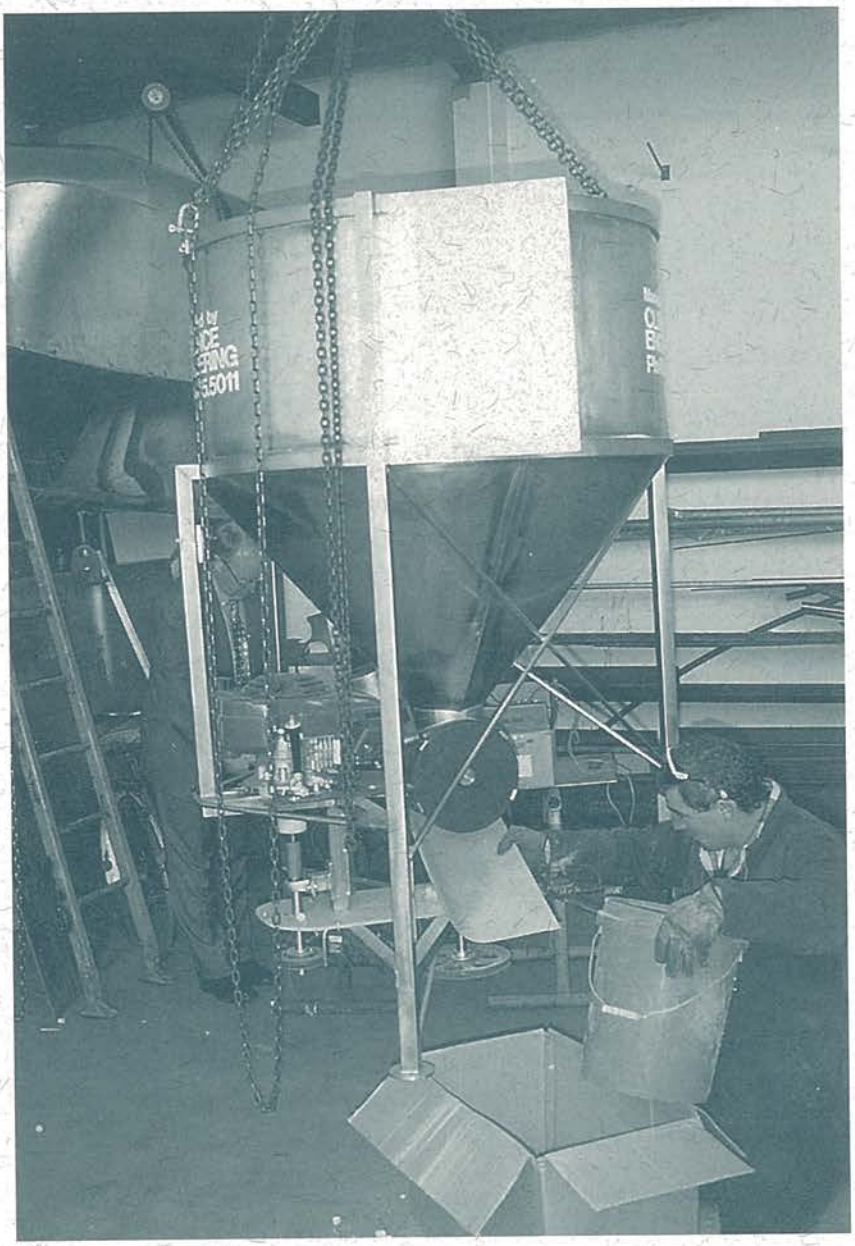


even less, particularly where there are few deer or rats also eating baits. Unfortunately, most bait sowing machinery in current use is mechanically unable to sow baits at such low rates. Because of this difficulty Dave and colleague Malcom Thomas, built a purpose-designed bucket.

The researchers worked in partnership with two engineering companies (John Brooks Ltd and Clemence Engineering Ltd) and an aerial operator (Amuri Helicopters Ltd) to develop and test a new sowing bucket. The prototype bucket built is capable of sowing 6-g cereal pellets uniformly at rates from 10 kg/ha down to as little as 0.5 kg/ha. At this lower rate, around 80 baits are still sown over each hectare where possums generally number less than 10/ha. The partners are now field testing the bucket to find out if it can withstand the hardships of prolonged use.

The new improved bucket has been given the name 'SowLow' and will assist the researchers with ongoing work to reduce sowing rates. Eventually the new design may be adopted by many aerial operators seeking lower application rates of baits.

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



Calibrating the newly designed aerial bait-sowing bucket 'SowLow' in the engineering workshop

***Dave Morgan** and **Malcolm Thomas** are both currently working on improving possum control techniques and are in Landcare Research's Pest Control Technology Team based at Lincoln.*

Guest Editorial

New Zealand - the image is clean and green. That's how we project our environment and our produce; it's an image that is becoming the key to our success as a trading nation and tourism destination. This is the land of the kiwi, the silver fern and perhaps the best butter in the world.

But the hard fact is that if we are to preserve that image, we need to manage a wildly perturbed ecology. The biota of these islands has been massively disrupted by the recent invasion of humans, and the exotic plants and animals they brought with them, whether by accident or design. In just a thousand years New Zealand's ecology has been changed beyond recognition, and that process of change continues.

Most of these changes are now irreversible, and some of our exotic introductions present problems we cannot ignore. We know that if we are to retain good examples of our remnant native biota, we have to protect them from possums. And possums appear to be at the centre of a complex bovine tuberculosis epidemic, involving a variety of introduced wild mammals, interacting in a dynamic fashion which we are struggling to understand.

In the meantime, we are doing our best to protect native ecosystems and control Tb, by supporting increasing efforts in possum control. Because our native flora and fauna, and billions of dollars in beef, dairy and venison exports are at risk, doing nothing is not an option.

We urgently need more refined ways of controlling vertebrate pests. This means we need research on two fronts: short term to refine current use of the few toxins and technologies available to us; and long term, to develop new approaches to our pest problems.

As part of its mission to eradicate bovine Tb, the Animal Health Board is a major funder of short-term possum control research aimed at getting better production on the farm. Much of that work has been carried out for us in recent years by Landcare Research.

At present our most effective possum control tool is aerial baiting with 1080 poison. It is not surprising that such an apparently drastic pest control measure has attracted public concern and controversy. Fortunately, Landcare Research's high quality environmental toxicology work has allowed us to justify 1080 poisoning as an environmentally acceptable strategy, the benefits of which outweigh the minimal, and now largely quantified, risks.

Landcare Research is also helping us develop new poisons, and improve the performance and safety of old ones. Ecological studies are improving our understanding of the behaviour and interactions of possums and other Tb vectors, leading to better targeted control programmes.

But in the end, maintaining tools such as 1080 is only a stop gap measure, and the science involved is hardly breaking new ground. The real scientific and intellectual challenges lie ahead: to develop completely new control technologies, and to apply them in integrated pest management programmes based on a thorough knowledge of vertebrate ecology and Tb epidemiology. We have to get much smarter about what we're doing especially if we are going to maintain our success as a trading nation into the future.

Will the brave new world of bio-technology provide us with precision tools for the management of unwanted mammals in New Zealand? Do we have the skills and resources for such blue-sky science (remembering we have a unique ecological problem which nobody else is going to solve for us)? And if we can do the science, will the results be acceptable to the public?

We need outstanding science, and public confidence in that science, to achieve a new paradigm for vertebrate pest management in New Zealand.

Robert Isbister
General Manager
Animal Health Board

Aerial 1080 Poisoning for Possums With and Without Pre-Feeding

Before aerial poisoning possums with 1080 carrot baits, pest managers usually pre-feed the area to "introduce" possums to the bait. This almost doubles the cost of the operation but it has been assumed that the extra cost is justified by better kills. However, a closely monitored possum control operation in the Hauhungaroa Range in 1994 indicated that this is not always true. This operation killed 96% of possums in an area that was not pre-fed, with only 78-92% of possums killed in three nearby areas where pre-feeding occurred.

As a result of the Hauhungaroa control operation, Landcare Research was commissioned by the Animal Health Board to test the effectiveness of aerial control using 1080 carrots with and without pre-feeding. Wayne Fraser and Phil Knightbridge used an operation planned for winter 1995 in Tasman Forestry's radiata pine-dominated Tahorakuri Forest (north-east of Taupo) for the study. With assistance from Environment Waikato's field staff, Wayne and Phil monitored possum kills in two 4000-ha blocks, one of which was pre-fed with non-toxic carrot about 3 weeks before the whole area was poisoned with carrot baits loaded with 0.08% 1080.

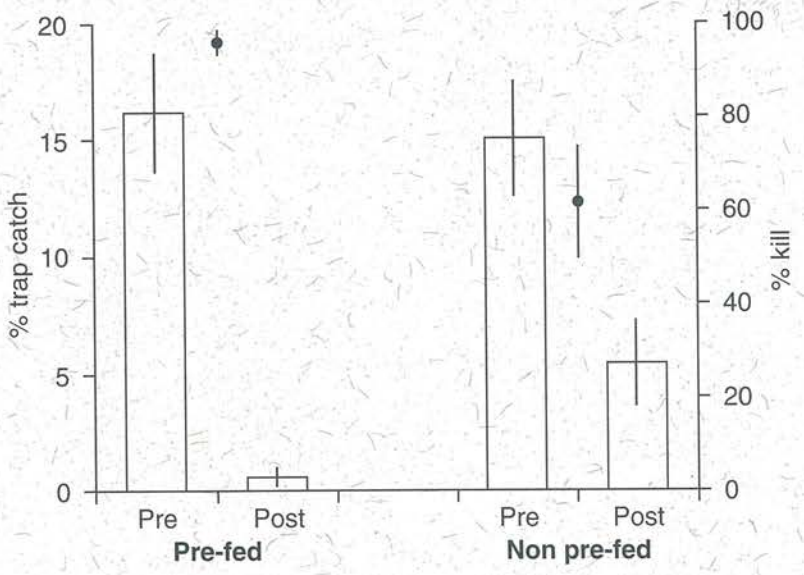
MONITORING THE POSSUM KILL

Possum densities in both blocks were assessed before and after the control operation using leg-hold traps set on randomly located trap lines. The percentage of possums killed during the poison operation was calculated from the pre- and post-control trap-catch.

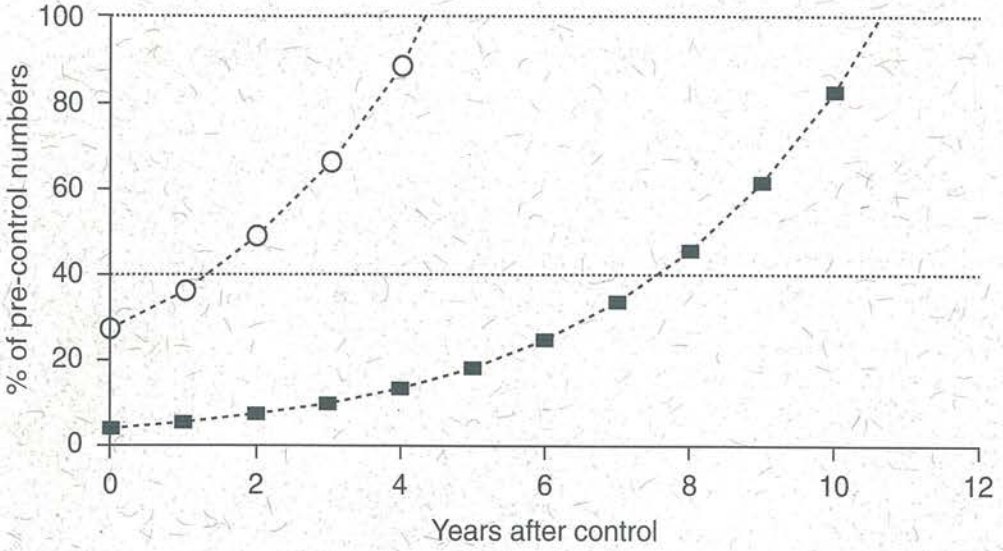
Possum densities before poisoning were similar in the two blocks. Catch rate in the pre-fed block declined from 15.9% before control to 0.6% after control, giving an estimated possum kill of 96%. Catch rate in the block which was not pre-fed declined from 14.9% before control to 5.4% after control, giving an estimated possum kill of 61%.

Despite similar pre-control population densities in the two blocks, a significantly greater proportion of the population was killed in the pre-fed block.

Clearly, pre-feeding significantly enhanced the effectiveness of the aerial 1080 control operation in Tahorakuri Forest. This is in contrast to the 1994 trial in which possum kills were similar with and without pre-feeding. The high extra cost incurred by pre-feeding and the conflicting result from the 1994 trial means at least two further trials are needed to determine whether the benefits attained in this trial can be achieved consistently.



Pre- and post-control trap-catch rates (bars) and the percentage reductions in possum numbers (•) in the pre-fed and non pre-fed blocks (± 95% confidence levels)



Estimated recovery of possum populations after control in the pre-fed (■) and non pre-fed (○) blocks in Tahorakuri Forest.

RATES OF POPULATION RECOVERY

As another way of assessing the relative merits of control with and without pre-feeding, Wayne and Phil also compared the likely rates of recovery for possums in Tahorakuri Forest with those in two blocks of indigenous forest in the nearby Hauhungaroa Range. The percentage of immature female possums in the population was much lower (7.6%) in the exotic forest. This is likely to be a reflection of the fact that female possums mature earlier in exotic forests. Furthermore, the proportion of mature female possums with pouch young (96%) was relatively high indicating that environmental conditions within the pine forest were favourable for possums - the population was reproducing at close to its potential maximum.

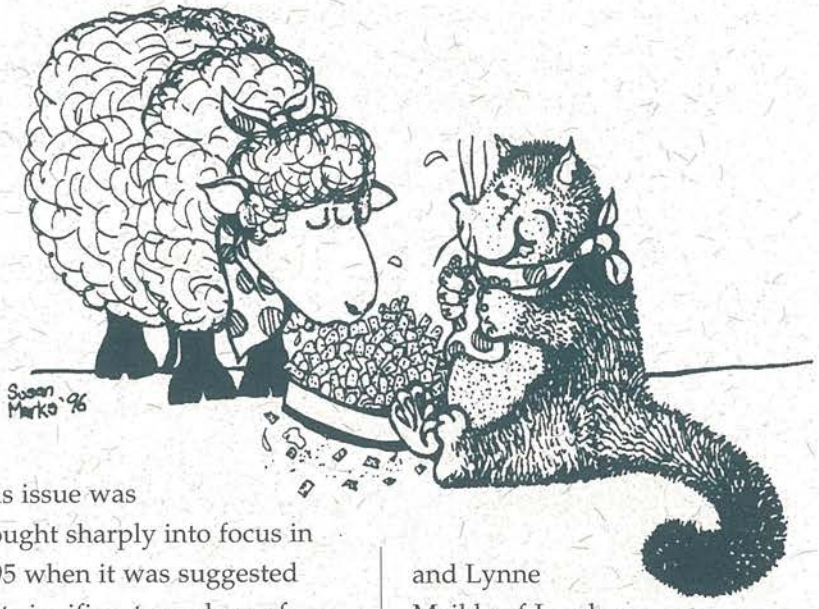
Assuming that natural mortality is about 10% and that residual (post-control) populations continue to breed at a similar rate (i.e., about 90% of females producing one young each year), possums in the pre-fed block should return to pre-control levels in about 11 years (if no maintenance control is carried out). Because of the lower kill in the non pre-fed block, recovery would be quicker (about 4-5 years). As the Animal Health Board bases its Tb eradication strategy on a disease control model that requires possum populations to be reduced to <25% of carrying capacity and then maintained at 40% of pre-control levels, these population recovery estimates suggest that maintenance control could be delayed for up to 7 years in the pre-fed block but would be necessary after only 1 year in the non pre-fed block.

This research was funded by the Animal Health Board and carried out with logistical assistance from Environment Waikato.

Wayne Fraser *and* ***Phil Knightbridge*** *are in Landcare Research's Ecological Impacts Team and work on the impacts, management, and control of possums and deer. Wayne is an animal ecologist based at Lincoln and Phil is a botanist based at Palmerston North.*

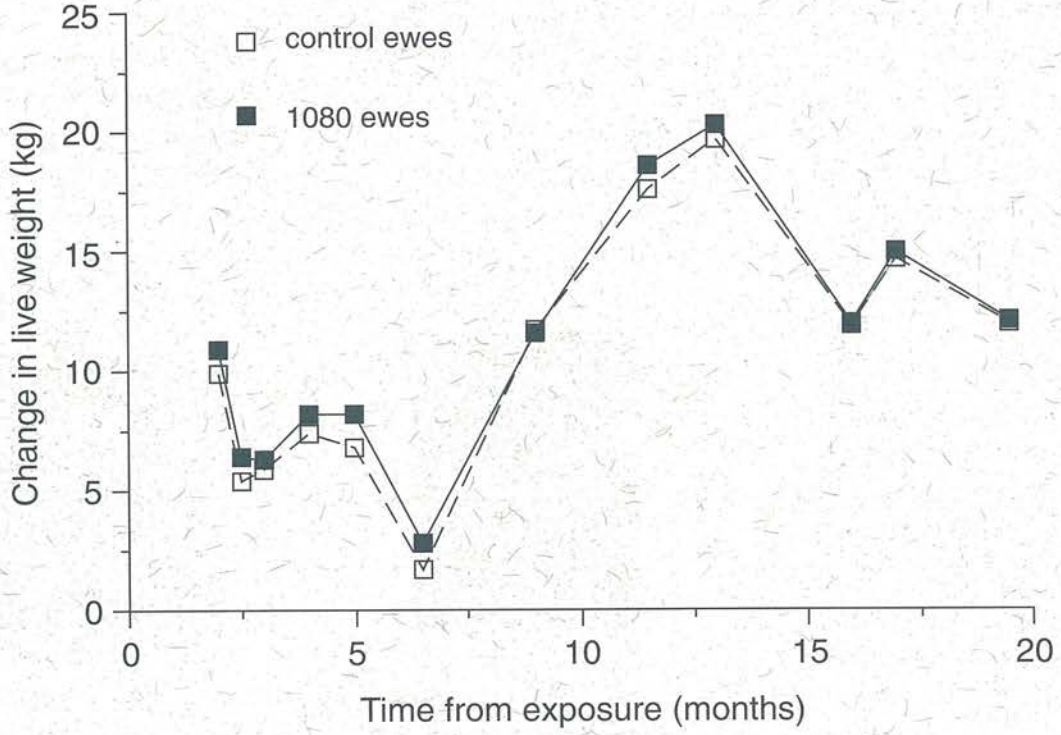
The Acute and Long-Term Effects of Exposure to Sodium Monofluroacetate (1080) in Sheep

Sodium monofluoroacetate (1080) is an effective, though often unpopular, tool for possum control. It breaks down readily and is unlikely to accumulate in the food chain. Even with the advent of new toxins and biocontrol techniques, it is likely that 1080 will continue to play an integral part in possum management for the forseeable future.



Although stringent operational procedures for the use of 1080 have been established to protect non-target species, accidental poisoning of livestock with 1080 baits has highlighted the need for a better understanding of the long-term effects of near-lethal exposures.

This issue was brought sharply into focus in 1995 when it was suggested that significant numbers of sheep had died approximately 6 months after exposure to 1080 following baiting for possum control. The Animal Health Board funded Charlie Eason and Lynne Meikle of Landcare Research, in conjunction with Ravi Gooneratne of Lincoln University and Don Arthur of the Ministry of Agriculture and Fisheries, to determine whether



Fluctuations in live weight of 21 ewes surviving after receiving a single dose of 0.25-0.30 mg of 1080/kg compared with 24 control ewes. There were no significant differences between the two groups. Standard errors ranged from 0.3 to 1.4 kg.

there are any long-term effects of poisoning in sheep surviving a near-lethal dose of 1080.

In their research, 52 sheep received a single dose of 0.25–0.30 mg of 1080/kg, equivalent to approximately 2 - 3 toxic possum baits, and 21 died within 4 days of dosing. It was found that the animals that died usually had fluid on the lungs and damage to their heart muscle.

A full battery of blood chemistry tests were conducted on all survivors, and 10 further sheep were humanely killed after 2 weeks and autopsied. No 1080 residues, and no blood, biochemical, or cellular toxic-related abnormalities could be detected in these animals. The twenty-one surviving sheep have been maintained under normal farming practices for nearly 2 years, and their body weights and lambing rates have not differed from a matched group of control sheep. Since no deaths occurred more than 4 days after receiving the 1080 and the survivors all appeared normal, long-term adverse effects in sheep receiving a single high dose of 1080 appear to be unlikely.

This research was funded by the Animal Health Board and approved by Landcare Research's Animal Ethics Committee.

This work was carried out by ***Charles Eason****, Team Leader, and* ***Lynne Meikle****, Animal Research Facility Manager, of Landcare Research's Pest Control Technology team based at Lincoln.*

Don Arthur *of Animal Health Laboratories, Ministry of Agriculture and Fisheries, Lincoln and* ***Ravi Gooneratne*** *of the Animal and Veterinary Sciences Group, Lincoln University collaborated.*

Research Notes

FIRST *IN-VITRO* (IVF) FERTILIZATION OF POSSUMS

A better understanding of possum fertilization is essential for developing biocontrol methods so Andy Glazier of Landcare Research is excited to report the first ever brushtail possum embryo to be produced by *in-vitro* or "test-tube" fertilisation. By using standard IVF procedures developed for humans he was able to produce one possum embryo from 20 possum eggs. The 20 eggs were placed in a 1 ml petri dish and 150 thousand possum sperm were added. After 20 hours an embryo was found to have reached the 4-cell division stage. This is much faster than the 48 hr it takes human embryos to reach the same stage. Andy is keen to repeat the experiment to find out how reliable the method will be.

SUCCESSFUL ARTIFICIAL INSEMINATION (AI) OF POSSUMS

Another first was achieved in artificial insemination of possums by Frank Molinia and Melissa Nickel from the University of Newcastle, Australia, when they visited Landcare Research at Lincoln recently. It was the first vaginal artificial insemination of possums ever and the technique proved to be about 30% successful. Last year, Frank's team was the first to produce a successful artificial insemination of possums by injecting sperm directly into the uterus.

The latest process involved taking sperm from the epididymis (where sperm matures) of male possums and with the aid of a laparoscope injecting them into the front of the vagina of female possums. The female possums were put on fertility hormones to produce multiple numbers of eggs. When the female possums were examined after the procedure, several fertilized eggs were found.

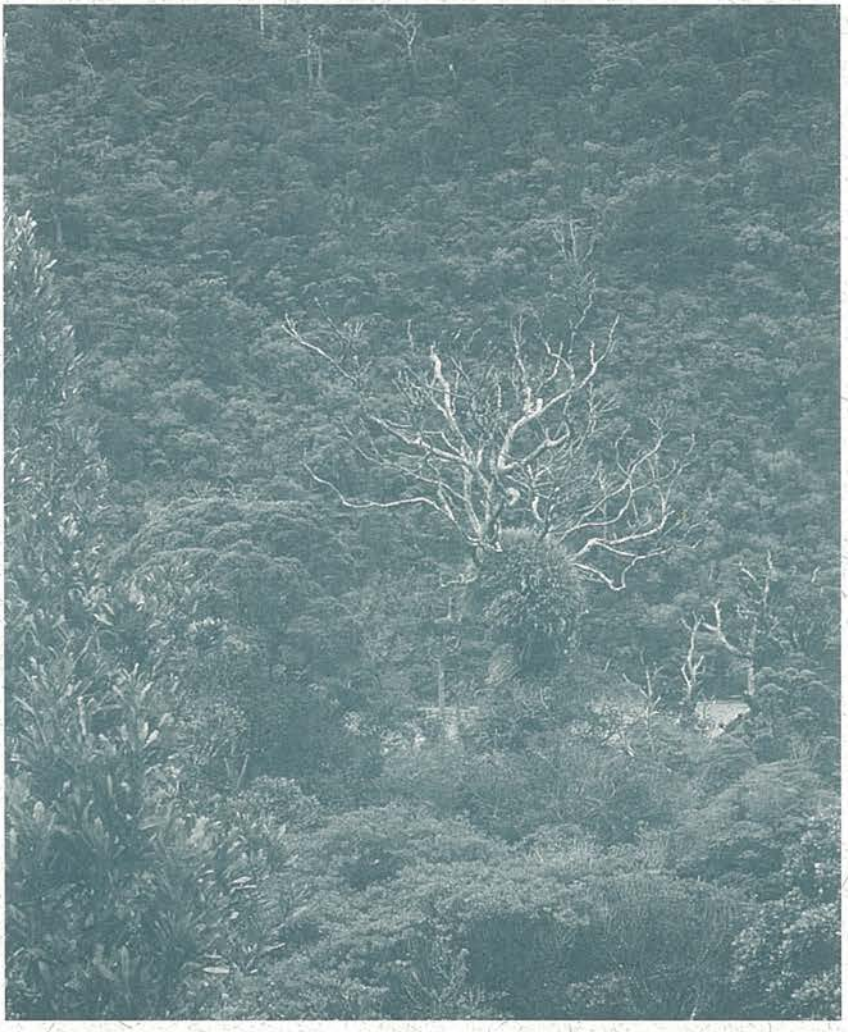
Possum Impacts on Northern Rata - Episodic Events?

Northern rata (*Metrosideros robusta*) has been in decline throughout its range since the turn of the century. The decline has been blamed mostly on defoliation by possums. In the Orongorongo Valley, near Wellington where possums have been present for about 100 years, rata foliage is a highly preferred possum food making up about 30% of their diet. The impact of possums on 24 rata trees in the valley was studied by Mike Meads of the DSIR between 1970 and 1974. Possum browsing apparently resulted in the death of three of the trees. It was predicted that, at that level of browsing, the ongoing damage and progressive deaths of trees would leave fewer trees available for possums, concentrate the possums on the remaining trees and result in an escalating rate of rata mortality.

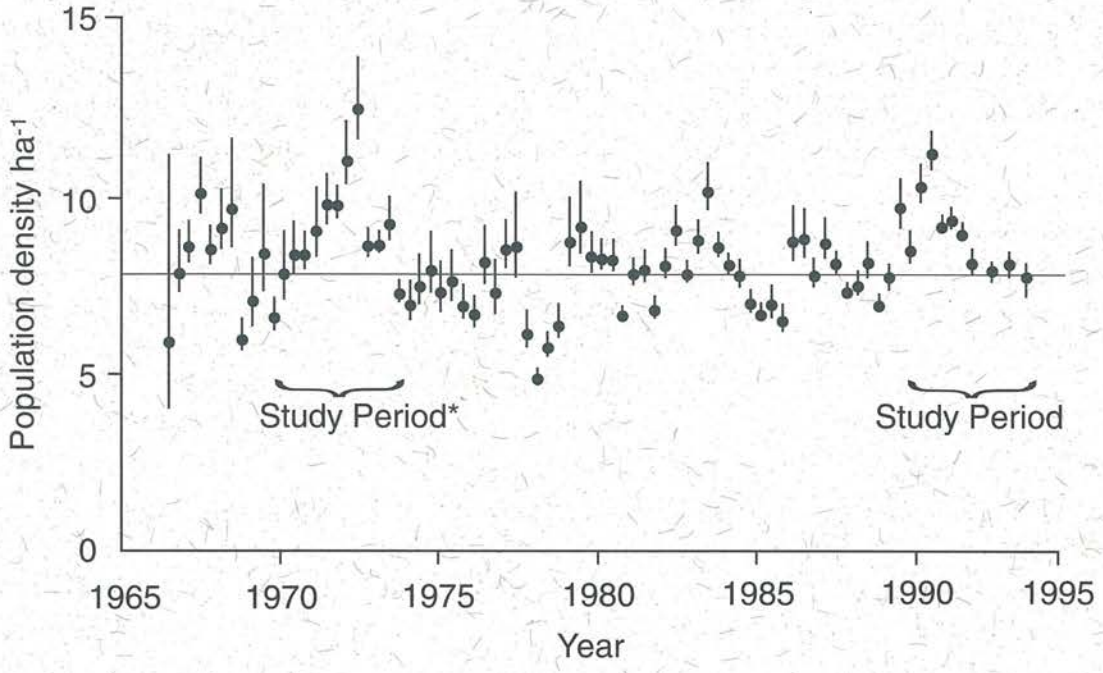
Surprisingly, when Louise Chilvers of Landcare Research returned to the area in 1990, 16 years later, all 21 trees surviving in 1974 were still alive although four other nearby rata trees had died. She also found that levels of possum browse in 1990 were lower than in 1974. Louise resurveyed the trees again in 1994 and found that browsing damage had increased significantly from the 1990 level, although no rata trees had died. So why did some rata survive and why were the rata in better condition at the beginning of 1990 than in 1974? And why did trees die during 1970-74 and not 1990-94?

Some of the answers lie in the possum density data collected by Louise and previous workers at the study site. During the period 1966 to 1994 possum density fluctuated from 6 to 12/ha, and averaged 8.2/ha. The only periods during this time where possum numbers remained above average for three consecutive years were 1970 - 72 and 1990 - 92 and both these periods also showed the highest browse levels. It appears that heavy browsing and death of rata may be episodic, occurring mainly during periods of high possum numbers. Periods of lower possum densities, such as between 1974 and 1990, appear to allow rata to recover from periods of heavy browsing. This hypothesis supports the findings from the 1970 study where possums were excluded from severely browsed trees, with the result that trees recovered within 2 to 3 years.

The mortality of rata in 1970-74 appears to have resulted from



A dead northern rata tree amongst healthy rata, Orongorongo Valley, Wellington



Population density of possums in the study area, Orongorongo Valley, Wellington, 1965-1994 (± Standard error)
** 3 northern rata trees died*

the combined effects of heavy browsing by possums and a 1-in-50 year regional drought. The combination of these impacts appeared to increase the trees' susceptibility to damage, and ultimately their death, whereas in 1990-94 heavy browsing alone did not cause any trees to die.

Although Louise's study suggests that natural fluctuations in possum density may allow rata trees to recover from heavy possum browsing, northern rata will continue to decline if possum numbers are not controlled in native forest as possums also reduce regeneration of rata. Dead adult rata are replaced by species unpalatable to possums rather than by other rata, altering the ecological balance of the forest.

Only a permanent reduction in possum numbers will allow northern rata and other palatable native trees to recover and flourish.

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

***Louise Chilvers** currently works on possum parasite surveys and possum/forest impacts and is a researcher in the Bovine Tb Team of Landcare Research based at Palmerston North.*

Conference

The 9th conference of the Australasian Wildlife Management Society (AWMS) will be held at the University of Canberra on December 3, 4, 5, 1996.

Symposia:

- Universities, education & wildlife management
- Wildlife in the high country
- AWMS & wildlife management

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The World's Largest Possum?

As part of a study in the Copland Valley, Westland in 1978, Wayne Fraser of Landcare Research discovered what could be the world's largest brushtail possum - a whopping 6.4 kg male. To date, there have been no possums studied which break this record.

Possum populations in New Zealand have been studied intensively for decades with many studies involving autopsies in which a range of standard information is recorded. A measurement common to almost all studies is total body weight.

Colonising populations of many animal species tend to have highest body size (or weight), reproductive rates and best condition, particularly where there is little competition for food. The Copland Valley population studied in 1978 by Wayne Fraser was a colonising population. While possums had been present in the lower part of the valley for 15-20 years, they were still increasing in numbers in the mid-valley area and only beginning to colonise the upper parts of the valley. Wayne's study showed that the mean body weights for adult possums rose with increasing distance up the valley, as the following table shows. Although only a few possums were sampled from the upper Copland Valley, the sample contained the biggest possums ever recorded in New Zealand (and possibly anywhere), with the record a 6.4 kg 5-year old male. The second largest male was a 9-year old weighing in at 5.8 kg. The heaviest female was a 3-year old, at only 4.5 kg.

The main vegetation cover in the Copland Valley is rata-kamahi forest, a favoured habitat-type for possums in New Zealand. In 1978, much of the food resources in the lower and mid areas of the valley had been depleted by the moderate to high density possum populations present. However in the upper Copland Valley, highly palatable plant species were abundant. Possums there were markedly larger than those found in most other studies in New Zealand, where average adult body weight ranges from about 2.0 - 3.5 kg. Also, the general condition and reproductive performance of the upper Copland

Location	Population status	No. of possums sampled	Mean adult body weight (kg)	Range (kg)
Lower Copland	post-peak	68	3.27	1.58 - 4.52
Mid Copland	pre-peak	54	3.58	2.31 - 5.20
Upper Copland	colonising	12	4.11	2.47 - 6.40

Body weights of possums caught during 1978 in the Copland Valley, Westland

animals was considerably higher than found in other studies. Since most available habitat in New Zealand has now been colonised (the only possum-free areas remaining are parts of Fiordland and some offshore islands), it is unlikely that we will ever see body weights such as these again.

This work was part of a wider study funded by Science and Research, Department of Conservation.

Wayne Fraser *works on the impacts, management and control of possums and deer as part of Landcare Research's Ecological Impacts Team based at Lincoln.*

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A Selection of Recent Possum-Related Publications

Cooke, M.M.; Jackson, R.; Coleman, J.D.; Alley, M.R. 1995: Naturally occurring tuberculosis caused by *Mycobacterium bovis* in brushtail possums (*Trichosurus vulpecula*): II. Pathology. *New Zealand veterinary journal 43:* 315-321.

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