Feasibility of using wax-blocks to measure rodent and possum abundance and changes in population size

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ABSTRACT

Rats and possums are major pest species in New Zealand native forests because they cause reductions, and in some cases extinction, of native bird species by predating eggs and chicks. Consequently large amounts of money are spent on possum and rat control. Forest managers need to know when to undertake these control operations and they base these decisions on estimates of possum and rat abundance. Also forest managers need to reliably measure possum and rat kills so that control technologies can be improved. Existing census methods used are tracking tunnels, which contain ink-pads that record animal foot prints, and traps that record animal captures or kills. These techniques are time-consuming, thus limiting the numbers of permanent tunnels and portable traps that can be located in the field. As a result sample sizes are small, which reduces the precision of the estimates obtained. This study investigated the feasibility of an alternative monitoring technique, i.e. the frequency of rat and possum bite-marks on lured wax-blocks. Results showed that both rat and possum bite-marks can be separately identified on wax-blocks. In addition to indicating the presence of these species, the method may also be suitable for measuring their abundance as well as reductions after poisoning operations. Wax-blocks were also found to be more user-friendly because they were not heavy to carry. This allowed large numbers to be located in the field so the precision of kill estimates could be increased. The residual (post-poison) index of possum abundance using wax-blocks was also similar to the index obtained using leg-hold traps. Thus the method may be suitable as an alternative to the more time-consuming trap-catch method for measuring residual possum populations. Issues that remain unresolved are: (1) do any of the methods give accurate estimates of rat and possum abundance over a range of densities? (2) do any of the methods produce reliable estimates of rat and possum kills? and (3) what is the best sampling protocol when using the methods?

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1. Introduction

The ship rat, *Rattus rattus,* has been shown to contribute directly to the demise of the North Island kokako, *Callaeas cinerea* (J.R. Hay 1981 unpubl. report), and perhaps other declining native bird species, by predating eggs and chicks (Moors 1983). In addition, as rats feed predominantly on invertebrates, fruits, and seeds (Best 1969), they compete with a wide range of bird species for these foods. The mouse (*Mus musculus*) is also likely to compete with some bird species for food resources. Consequently rodent control, predominantly by poisoning, is frequently undertaken in forest where birds are endangered. Timing of these control operations depends to some extent on the population density at the time. Kill rates need to be measured so control technologies can be improved. This requires the use of reliable and cost-effective census techniques.

At present snap-back trapping and footprint tracking (Moors 1978, Innes et al. 1995) are used and Brown et al. (1996) showed that these methods appear to give accurate estimates. Both methods have two key disadvantages. Firstly, portable traps and permanent tracking tunnels are heavy and bulky: the methods are labour intensive and sample sizes are restricted by the amount of equipment that can be positioned. Secondly, rats are removed by snap-back trapping. This means trap-lines must be sited at different locations for pre- and post-poison estimates to ensure that the kill estimates reflect only the kill due to poisoning. Both factors lead to increased sampling costs and reduced precision.

A possible alternative to these methods is the bait interference method (Bamford 1970) where the frequencies of non-toxic flour baits eaten are recorded. Initially the method was developed to monitor possum (*Trichosurus vulpecula*) populations but was found to have two major limitations. Firstly the flour paste baits used were very palatable so possums actively searched for them which caused over-estimates of possum abundance (Spurr 1994). Secondly, the baits were eaten by other species, such as rats and ground-birds, and these could not be differentiated from the baits eaten by possums.

A promising improvement is the use of non-toxic wax-blocks. Wax-blocks have a low palatability, so rats and possums are less likely to actively search for them, and they have the potential to identify individual species because of differences in bite-mark impressions. Wax-blocks have been used to estimate possum kill achieved by a control operation on farmland and a similar kill estimate was recorded from that gained from trap-catch (Thomas and Meenken 1995). Trials used to measure possum kills in native forest using wax-blocks (Thomas et al.1997) indicated the possibility of identifying rat bite-marks in addition to those made by possums. This led to this investigation which aimed to determine the feasibility of using wax-blocks to estimate rodent and possum abundance in native forest.

The specific objectives were to:

- Determine whether bite-marks in wax-blocks can be used to identify the presence of different pest species.
- Compare rat bite-mark frequencies with snap-back trap and footprint-tracking frequencies to decide whether wax-blocks are a feasible option for measuring rat abundance.

- Compare frequencies of possum bite-marks in wax-blocks (used for rat monitoring) with frequencies of possum captures in leg-hold traps to decide whether wax-blocks are a feasible option to measure possum abundance.
- Identify problems that field staff encounter when using wax-blocks and compare user-friendliness with trapping and footprint tracking.

2. Methods

2.1 THE WAX-BLOCKS

Wax-blocks approximately 25 mm × 15 mm × 5 mm were moulded in plastic ice cube trays using microcrystalline wax containing 5% orange oil as an attractant. An ice block stick was inserted into each block so they could be anchored to the ground. Once the wax had hardened, the blocks were removed from the trays and dipped in red-coloured wax to improve visibility in the field.

2.2 IDENTIFICATION OF BITE-MARKS

Skulls collected from possums, rats, mice, hedgehogs and rabbits were used to make simulated bite-marks. In addition, captive possums, rats, and mice were given wax-blocks. The bite marks on these test blocks were used to identify bite-marks that were collected in the field.

2.3 COMPARISON OF RAT BITE-MARK AND SNAP-BACK TRAP CAPTURE FREQUENCIES

Two study sites in Northland (Trounson Kauri Reserve and Katui Reserve) were used to compare bite-mark frequencies in wax-blocks with capture frequencies from snap-back traps. At Trounson, rats and possums were poisoned regularly during the period the traps and wax-blocks were used. The poisoning was conducted using baits containing 0.002% brodifacoum (Talon®) in bait stations spaced at 100-m intervals. At Katui no poisoning was undertaken.

At both study sites 100 'Victor Esy set' snap-back traps set for 3 nights were located at 20-m intervals on five lines in October 1996, January 1997 and April 1997. Traps were checked daily and those that were sprung or caught rats were reset. For the first 2 nights of trapping 200 wax-blocks were located at 10-m intervals on five separate lines, i.e. 40 blocks per line. The blocks were checked daily and any bite-marks identified and recorded. Blocks bitten on the first night were replaced or marked to prevent double recording.

2.4 COMPARISON OF RAT BITE-MARK AND FOOTPRINT TRACKING FREQUENCIES

Waipapa (Northern Hunters Access) and Waimanoa Forests in the Central North Island were selected as study sites to compare footprint marks in tracking tunnels with frequencies of bite-marks in wax-blocks. Tracking tunnels were located on a grid spaced at approximately 200 m × 50 m and were baited during each tracking period with peanut butter. A total of 200 wax-blocks were located at 10-m intervals on 5 individual lines, i.e. 40 blocks per line, along the tracking tunnel lines and were checked for 2 nights.

At Waipapa Forest possums and rats were poisoned using bait stations spaced on a 150-m grid (Thomas 1994). The poisoning was initially conducted in December 1995 using baits containing 0.15% 1080 followed with Talon® baits in February 1996 (Henderson et al. 1997). The Talon® poisoning was repeated thereafter at approximately 6-weekly intervals. A total of fourteen population estimates were made between December 1995 and November 1997 using footprint tracking tunnels and five estimates made between December 1995 and June 1997 using bite-marks in wax-blocks. No poisoning was undertaken at Waimanoa Forest where only two population estimates were made in January and May 1997.

2.5 POSSUM BITE-MARKS IN THE WAX-BLOCKS

At all study sites the wax-blocks that were bitten by possums were recorded as were those with rat bite-marks. The frequencies of possum bite-marks at the poisoned sites (Trounson and Waipapa) were compared with the frequencies at the unpoisoned sites (Katui and Waimanoa) to determine whether the method is capable of differentiating between high and low possum densities. The possum bite-mark trend at Waipapa was compared with the possum capture trend using 100 'Victor' leg-hold traps set for 3 nights using the standard trap-catch protocol (Warburton 1996). Capture frequencies were recorded seven times from October 1995 to October 1997 and bite-mark frequencies were recorded five times from October 1995 to June 1997.

3. Results

3.1 IDENTIFICATION OF BITE-MARKS

The captive animal trials demonstrated that it was possible to differentiate between rat and possum bite-marks. However mice left very small and shallow marks and it was considered that these would not be able to be identified with any reliability in the field. Bite-marks collected in the field were identified as being made by rats, possums, hedgehogs, and rabbits but none were identified as being made by mice. Hedgehog and rabbit bite-marks were able to be identified from the simulated bite marks. The hedgehog marks were identifiable from a gap between the upper incisors and rabbit marks from serrations on the incisors.

Initially, observers in Northland had difficulties differentiating scuff marks, made during transportation of the wax-blocks from marks made by animals. This caused a large number of 'unknowns' to be recorded. However, in subsequent trials operators gained sufficient confidence to differentiate between scuff marks and animal bite-marks.

3.2 COMPARISON OF RAT BITE-MARKS AND SNAP-BACK TRAP CAPTURE FREQUENCIES

At Trounson, snap-back capture rates were almost nil suggesting a virtual absence of rats but rat bite-marks suggested that rats were more abundant (Fig. 1). It is possible that this was due to individual rats biting more than one block. The high sprung-trap frequency of 1–8% suggested rats were more abundant (Fig. 1) but mice, reportedly more abundant at the time (pers. comm. C. Gillies, DOC), may have contributed to this. The bite-mark trends indicated that rat numbers were increasing which appears unusual because of the regular Talon® poisoning that was undertaken during the study (Fig. 1). This may suggests either poor indication of population change, or that the poison efficiency was declining.

At Katui, where no poisoning was undertaken, catch and sprung-trap rates were higher than those recorded at Trounson, as expected (Fig. 2). However, unlike the Trounson results, the wax-block bite-mark trend did not follow the trends from trap-catch and sprung-traps. This was due to the unusually low bite-mark frequency recorded in the January sample (Fig. 2).

FIGURE 1
PROPORTION OF RAT BITE-MARKS, CAPTURES AND SPRUNG TRAPS AT TROUNSON KAURI RESERVE. ERROR BARS ARE ± 1 SE.

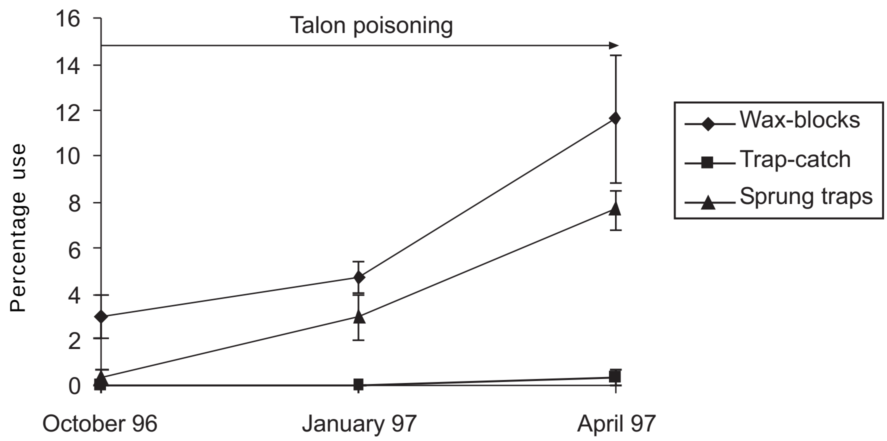


FIGURE 2
PROPORTION OF RAT BITE-MARKS,CAPTURES AND SPRUNG TRAPS AT KATUI RESERVE. NO POISONING WAS UNDERTAKEN. ERROR BARS ARE ± 1 SE.

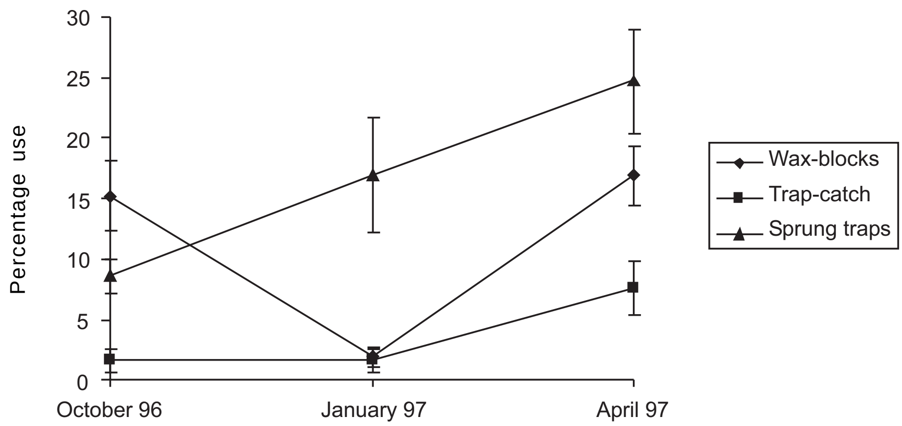
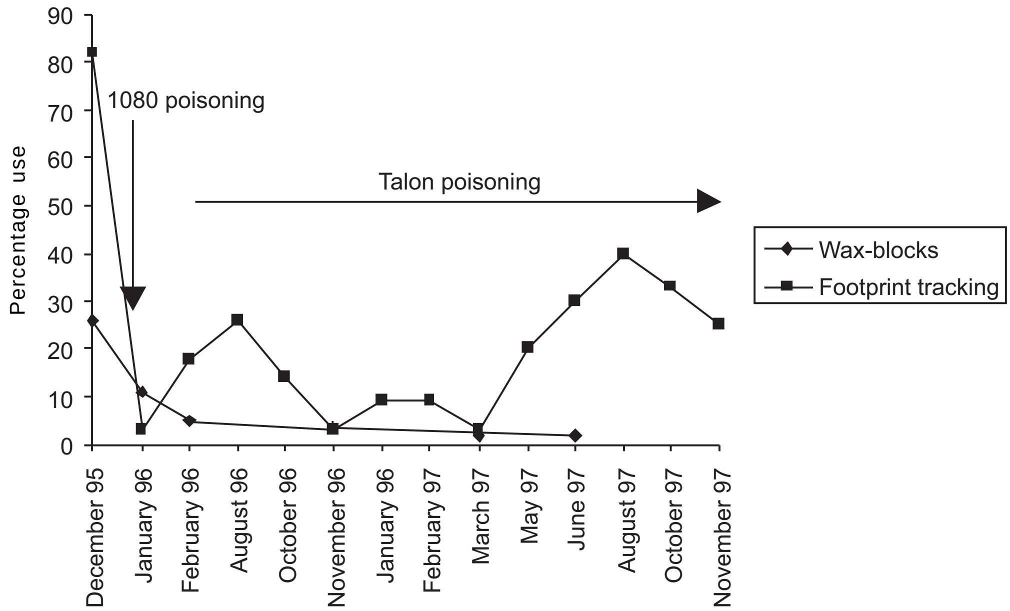


FIGURE 3
PROPORTION OF RAT FOOTPRINT MARKS AND RAT BITE-MARKS AT WAIPAPA FOREST.

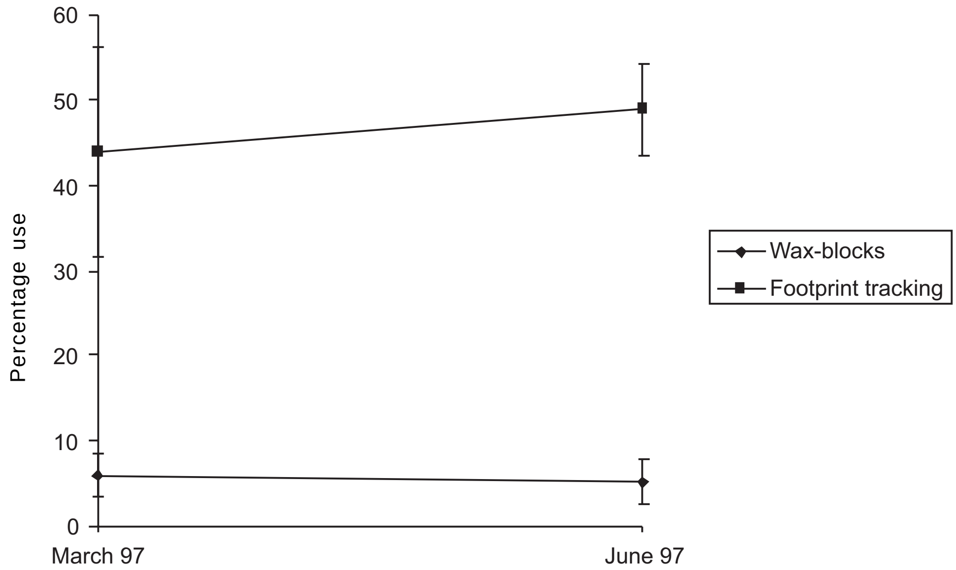


3.3 COMPARISON OF BITE-MARKS AND FOOTPRINT TRACKING FREQUENCIES

At Waipapa, bite-mark frequencies declined following 1080 poisoning and remained low throughout the Talon® poisoning stabilizing at about a 4% frequency. The rat footprint tracking frequencies also declined after 1080 poisoning but then fluctuated between 2 and 40% during Talon® poisoning (Fig. 3).

At Waimanoa, the unpoisoned site, the wax-blocks showed a lower frequency of use than the footprint tracking tunnels (Fig. 4). This may indicate that the tracking-tunnels are a more sensitive measure of rat abundance.

FIGURE 4
PROPORTION OF RAT FOOTPRINT MARKS AND RAT BITE-MARKS AT WAIMANOA FOREST. NO POISONING WAS UNDERTAKEN. ERROR BARS ARE ± 1 SE.



3.4 POSSUM BITE-MARKS IN THE WAX-BLOCKS

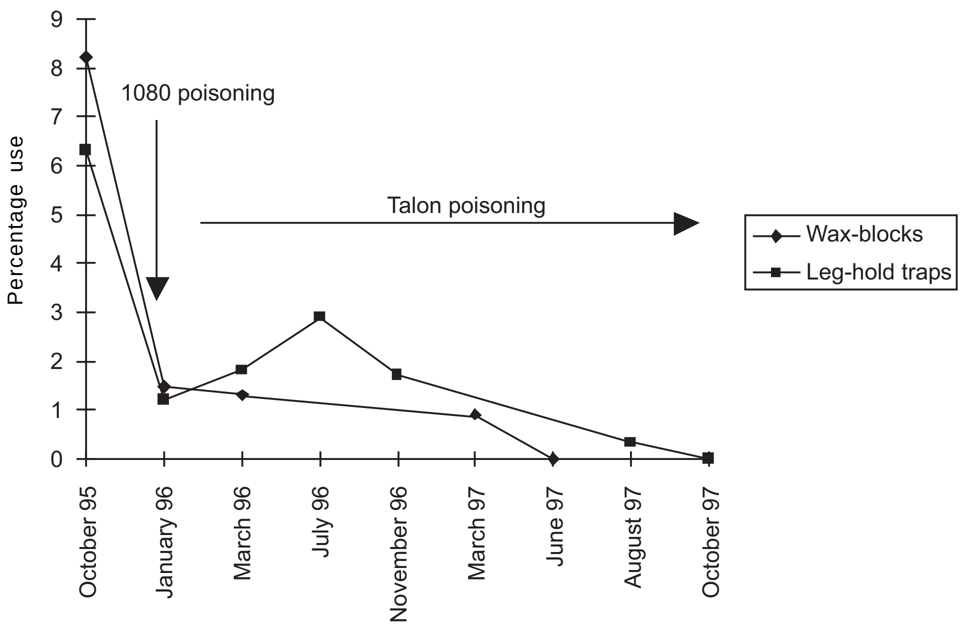
In both the Northland and Central North Island sites, the frequency of possum bite-marks in wax-blocks was higher at the non-poisoned sites than at the poisoned sites (Table 1). This suggests that wax-blocks are capable of differentiating between high and low possum densities.

TABLE 1 PERCENTAGE OF WAX-BLOCKS WITH POSSUM BITE MARKS ± 1 SE AT POISONED AND UNPOISONED SITES.

	NORTHLAND	CENTRAL NORTH ISLAND
Poisoned	6 ± 1	1 ± 1
Unpoisoned	26 ± 3	14 ± 2

Possum leg-hold trap capture and bite-mark frequencies at Waipapa forest showed similar declines following 1080 poisoning and both methods indicated a low possum abundance during the Talon® poisoning period. The leg-hold trap frequencies tended to be slightly more variable than the wax-block bite-mark frequencies (Fig. 5).

FIGURE 5 PROPORTION OF POSSUM CAPTURES IN LEG-HOLD TRAPS AND POSSUM BITE-MARKS AT WAIPAPA FOREST.



4. Conclusions

4.1 FEASIBILITY OF USING WAX-BLOCKS TO MONITOR RAT AND POSSUM ABUNDANCE

These pilot trial results show that wax-blocks can indicate the presence of rats and possums in native forest. They also show that wax-blocks may be suitable for measuring rat and possum abundance. Both rat and possum bite-marks could be identified and what appeared to be realistic reductions in bite-mark frequencies occurred for both species after 1080 poisoning. At Trounson the rat bite-mark trends tended to follow sprung-trap trends which may be indicative of changes in rat abundance. However the low bite-mark frequency recorded at Katui in January 1997 may indicate that the method can give inconsistent results.

The lower possum bite-mark frequencies in the poisoned areas also suggests the method is capable of differentiating between high and low possum population abundance. Therefore it may be feasible to use the method as an alternative to trap-catch for measuring the abundance of post-poisoned 'residual' possum populations. If true this would provide a cheaper alternative to the more labour intensive trap-catch method.

The results also indicate that wax-blocks may be suitable for monitoring both rat and possum abundance simultaneously. If feasible monitoring costs would be reduced substantially in areas where both species are monitored.

4.2 USER-FRIENDLINESS OF WAX-BLOCKS

The wax-block method proved to be more user friendly than both the kill / leg-hold trapping and footprint tracking. The wax-blocks were easy to locate in the field because they were light and compact which enabled hundreds to be carried at one time. In contrast, kill and leg-hold trapping was more labour intensive. Wax-blocks were also easier to use than tracking tunnels and did not require the use of ink chemicals or food colouring which are unpleasant or awkward to handle.

4.3 SNAP-BACK CAPTURES

The high incidence of rat escapes from the 'Victor Esy set' snap-back traps, or the traps being sprung by mice, suggests that the traps are unsuitable for use as a monitoring and rat control tool. There is evidence that other commercially available traps are more capture efficient (B. Warburton pers. comm.).

4.4 UNRESOLVED ISSUES

Three issues remain unresolved:

1. Do the methods give accurate estimates of rat and possum abundance over a range of densities?
2. Do the methods produce reliable estimates of rat and possum kills?
3. What are the best sampling protocols to follow when using these methods?

For possums, the second question is being addressed by further Landcare Research.

5. Recommendations

Wax-blocks can be used as an additional technique to determine the presence of rats and possums in native forest, although they appear to be less sensitive than tracking tunnels. Further research is recommended, to:

- Assess the accuracy of abundance measurements by comparing the frequency of bite-marks, trap captures and tracking rates with the number of rats and possums present. This could be determined using extinction trapping (see Brown et al. 1996).
- Determine the ability of wax-blocks, kill-traps and tracking tunnels to measure rat kills. Trials should be conducted in a variety of habitat types and could be undertaken in conjunction with future or existing rat control operations. Estimates of true kill could be gained by using mortality-sensing radio-transmitters as used in the current FRST programme for possums.
- Determine the optimum sampling protocol using these methods. This needs to be designed to give greatest statistical power so that the likelihood of reaching the correct conclusion about rat or possum abundance is maximised. This would require studies to determine the optimal number of lines, the number of traps, tunnels or blocks per line and their spacing along the lines. There is some evidence that groups of tracking tunnels may provide more precise estimates of abundance than individual tunnels on lines (see Brown and Millar 1998).
- Use wax-blocks in addition to leg-hold trapping in selected DOC post-poison possum monitoring operations. This would provide additional comparative data for Landcare Research to determine the feasibility of using wax-blocks to measure post-poison ('residual') possum population abundance.
- Measure the relative capture efficiency of the common commercial available rat traps.

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