FOREST RESEARCH INSTITUTE

THE IMPACT OF AERIAL 1080 POISONING ON SHIP-RAT POPULATIONS AT MAPARA AND KAHAROA

INVESTIGATION NO : P579
KEY OUTPUT NO: 5.23

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CONTENTS

EXECUTIVE SUMMARY (FINAL):

KEY OUTPUT: 5.23
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INVESTIGATION TITLE:	The impact of aerial 1080 poisoning on ship-rat populations at Mapara and Kaharoa.
STUDY VENUE:	Central North Island
INVESTIGATION LEADER:	J. Innes
INVESTIGATION STATUS:	Completed
CLIENT:	DOC, Science and Research Division

INVESTIGATION OVERVIEW:

The impact of aerial 1080 poisoning on populations of ship rats at Mapara and Kaharoa was assessed by Northern Wildlands section, Forest Research Institute, Rotorua, between August 1990 and May 1991. The objective of poisoning was to kill possums and rats to improve North Island kokako food supply and to protect nesting kokako from predation. The project was funded by the Department of Conservation.

OBJECTIVES:

- To determine the impact of aerial 1080 poisoning, as routinely carried out against possums, on ship-rat populations at Mapara and Kaharoa.
- To assess the rate of population recovery after poisoning.

METHODS:

- Percent kill was assessed by measuring tracking rates and trapping success in poison and non-poison blocks both before and after poisoning at Mapara and Kaharoa.
- Both poisoned populations were monitored until their tracking rates no longer differed significantly from those of populations in non-poison blocks.

RESULTS:

- Poisoning reduced rat populations at both locations by nearly 100%.
- At Mapara, the average tracking index 4.5 months after poisoning was still only 11% of the pre-poison average. At Kaharoa it was 8% after 3.5 months.
- Populations then increased markedly, so that after 6.5 months indices in poison blocks were no longer significantly different from those in non-poison blocks, in both study areas.

CONCLUSIONS:

- Aerial 1080 poisoning with cereal baits in September-October kills nearly all ship rats present. Population recovery is very slow for 3-4 months, but rapid thereafter.
- Aerial 1080 poisoning is a useful tool for reducing rat abundance for the duration of one bird-breeding season only.
- Aerial 1080 poisoning is satisfactory for continued use in kokako research-by-management programmes, since it kills most ship rats but poses only a small risk to kokako.

2. INTRODUCTION

The Northern Wildlands section, Forest Research Institute, Rotorua, monitored the impact of aerial 1080 (sodium monofluoroacetate) poisoning on populations of ship rats (*Rattus rattus*) between August 1990 and May 1991 at Mapara, King Country, and advised on monitoring methods for the same objective at Kaharoa, north of Rotorua (Fig. 1). The aim of the poisoning was to provide protection against predation for nesting North Island kokako (*Callaeas cinerea wilsoni*).

The monitoring was funded by the Department of Conservation at Mapara and by Tasman Forestry Ltd at Kaharoa. Department of Conservation staff undertook the aerial 1080 poisoning operations in both areas.

3. BACKGROUND

The kokako is declining in numbers and distribution on the North Island mainland. Research to assist kokako recovery is focusing on the probable importance of introduced mammalian browsers and predators as causes of the decline. The predation of kokako eggs, chicks, and adults by introduced small mammals stops many nesting attempts (Hay 1981; J. Innes, unpubl. data), and evidence suggests that the ship rat (*Rattus rattus*) is the most important predator. One way to investigate whether predation limits kokako populations has been to experimentally reduce populations of mammalian predators, and to monitor whether kokako breeding success improves (Rasch, in press).

Aerial poisoning is a new strategy for the large-scale control of ship rats. In the 1989-90 kokako breeding season, anticoagulant poison was placed on the ground throughout known kokako pairs' territories at Mapara to kill ship rats (J. Innes & D. Williams 1990a, unpublished FRI contract report). This method kept rat numbers low for the duration of the breeding season, but reinvasion by rats from the unpoisoned surrounding forest was rapid and continual. The ongoing labour required to maintain the presence of baits made the operation costly.

A routine aerial 1080 operation which targeted possums (*Trichosurus vulpecula*) in north Taranaki in 1989 killed more than 90% of ship rats (B. Warburton 1989, unpublished FRI contract report). This result suggested that the method was worth further investigation as a tool for kokako predator control. Possible advantages of this large-scale poisoning strategy are:

- Rat numbers are reduced throughout the whole forest, so that there is not a problem of rats reinvading the protected forest from unpoisoned areas.
- The operation is undertaken once only, so there is no need for repeat visits to replace poison.
- Both possums and ship rats are controlled with the same operation.
- There is no need to know in detail the likely nesting sites of all kokako pairs, as there was with ground poisoning.

The method has potential application wherever large-scale control of ship rats is needed.

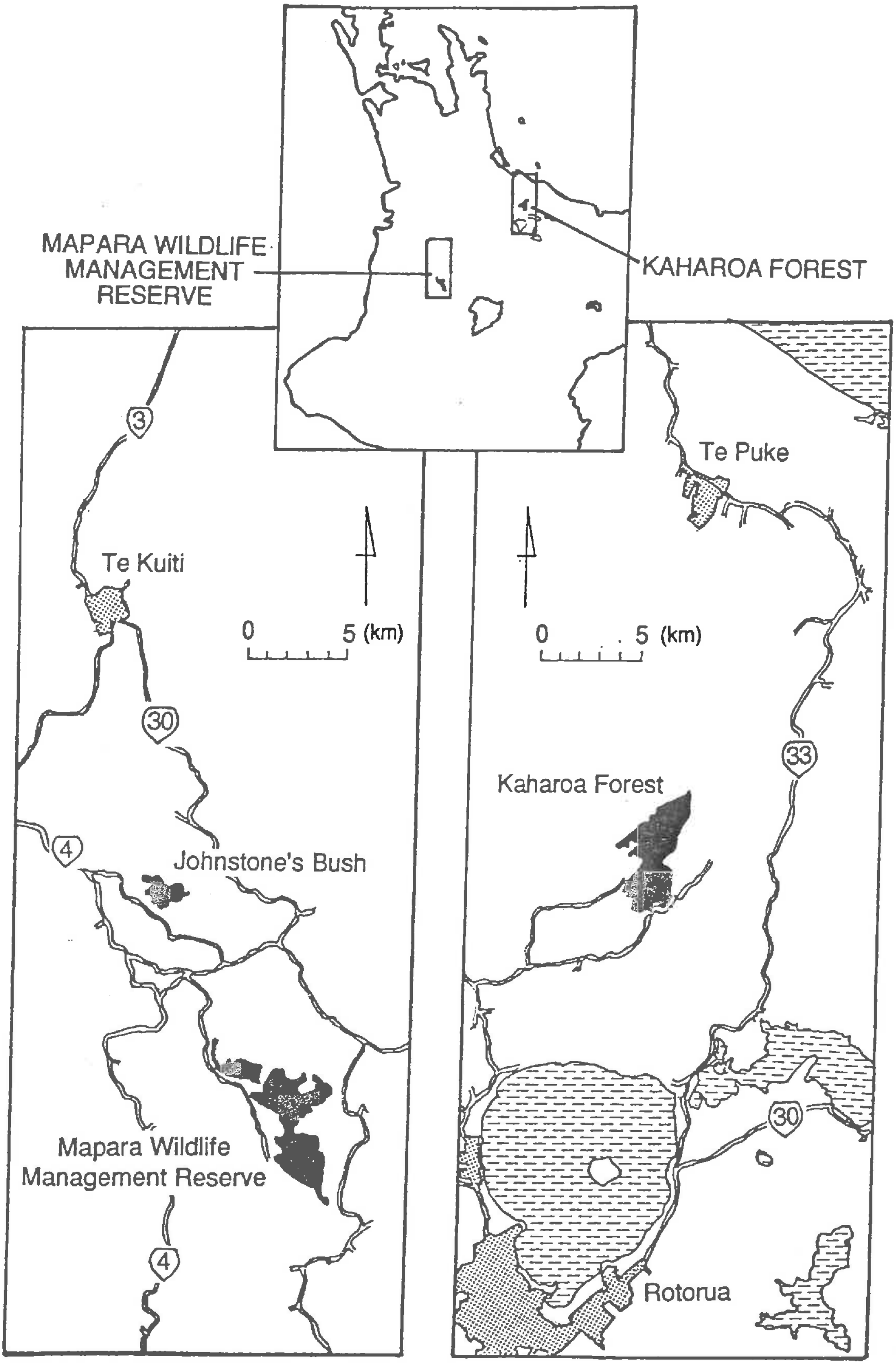


FIG. 1: Location maps of the study areas used to monitor rat populations after aerial 1080 poisoning.

Previous research by the Northern Wildlands section of the Forest Research Institute established that there is little risk to kokako themselves from aerial 1080 operations (J. Innes & D. Williams 1990b, unpublished FRI contract report).

4. OBJECTIVES

- To determine the impact of aerial 1080 poisoning, as routinely carried out against possums, on ship rat populations at Mapara and Kaharoa.
- To assess the rate of population recovery after poisoning.

5. METHODS

5.1 Poisoning

At Mapara, Wanganui No.7 pollard baits nominally containing 0.08% 1080 were aerially broadcast at 8 kg/ha over the entire Mapara Wildlife Management Area (1432 ha) on 10 September 1990. There was no pre-feed.

At Kaharoa, a non-toxic pre-feed bait was aerially distributed at 2 kg per ha on 9 October 1990. Wanganui No.7 toxic baits nominally containing 0.15% 1080 were distributed from a helicopter on 30 October 1990, at 10 kg/ha over 630 ha of forest.

5.2 Monitoring of the rat population

5.2.1 Footprint tracking

Populations were monitored with the footprint-tracking method of King & Edgar (1977).

Footprint tracking (a measure of rat activity) is the most appropriate index of rat abundance for the Mapara and Kaharoa studies, since it does not kill any rats, and has in the past given coherent indices of abundance after rat poisoning operations (Hickson, Moller & Garrick 1986; J. Innes & D. Williams 1990a, unpublished FRI contract report; J. Innes, unpubl. data).

At Mapara, tracking tunnels were placed in three rectangular grids in the poisoned block, each containing 56 tunnels spaced 50 m apart. A non-poison block was chosen at Johnstone's Bush, 8 km from Mapara, after checks that its forest composition and rat abundance before poisoning were very similar to those at Mapara. The 56 tunnels at Johnstone's Bush were set at 50-m intervals in a large circle, rather than in a grid. All tunnels were baited with peanut butter and "set" for 1 night each 6 weeks from August 1990 to May 1991.

At Kaharoa, 72 tracking tunnels were placed 50-m apart in a line in the poisoned block, and 36 tunnels at the same spacing were put in a non-poison block in very similar forest in the adjacent Onaia Ecological Area. As at Mapara, these were baited with peanut butter and set each 5-6 weeks, but for 2 consecutive nights rather than 1, since initial trials showed a lower tracking rate at Kaharoa than at Mapara. Indices were taken from October 1990 to May 1991 (H. Speed, pers. comm.).

In both study areas, the tunnels in the poison and non-poison blocks were set on the same nights, so that the indices from the two blocks within each study area were directly comparable.

The actual measure used to assess poisoning impact was the percentage of tunnels that showed rat tracks.

5.2.2 Fenn trapping

Fenn traps set in tunnels to kill mustelids at both Mapara and Kaharoa had an incidental by-catch of ship rats, and so provided a second rat abundance index independent of the tracking index. Traps were set for most of the period spanned by tracking, and results are expressed as rats captured per week of trapping effort. Trapping itself would have had only a minor impact on rat populations.

About 140 traps were set at Mapara, mostly unbaited, at ca. 200-m intervals along tracks and ridges throughout the entire study area. Trapping was still being undertaken in late May 1991 (P. Bradfield, pers. comm.). At Kaharoa, 72 traps were set at 150-m intervals, baited with "beef and gravy" catfood. Traps were set until late March 1991 on roads and tracks throughout the study area (H. Speed, pers. comm.).

6. RESULTS

6.1 Tracking indices

No rats visited tracking tunnels at either Mapara or Kaharoa when the first index was taken 1 month after 1080 poisoning, indicating 100% reduction in the rat population (Figs 2a,b). A few rats did survive the operations, however, or reinvaded from elsewhere, since there was then a slow but steady increase in the subsequent indices in both areas.

At Mapara, the average index on January 23 1991 (4.5 months after poisoning) was 11% of the pre-poison average, and at Kaharoa on 15 February (3.5 months after poisoning) it was 8% of the pre-poison figure. Indices increased rapidly after these dates (Figs 2a,b).

Indices were significantly lower in the poison blocks than in the non-poison blocks immediately after poisoning, but were not significantly different ($p>0.05$) after 6.5 months, in both localities.

6.2 Fenn-trapping indices

The trends of Fenn-trapping indices in both study areas were similar to those revealed by tracking, despite the large differences between the trapping and tracking methodologies (Figs 3a, b).

Very few rats were trapped in the first 3 months after 1080 poisoning in either study area, despite considerable effort. Only one (0.015 rats per 100 trap-nights) was trapped at Kaharoa, and four (0.022 rats per 100 trap-nights) at Mapara.

FIG. 2a

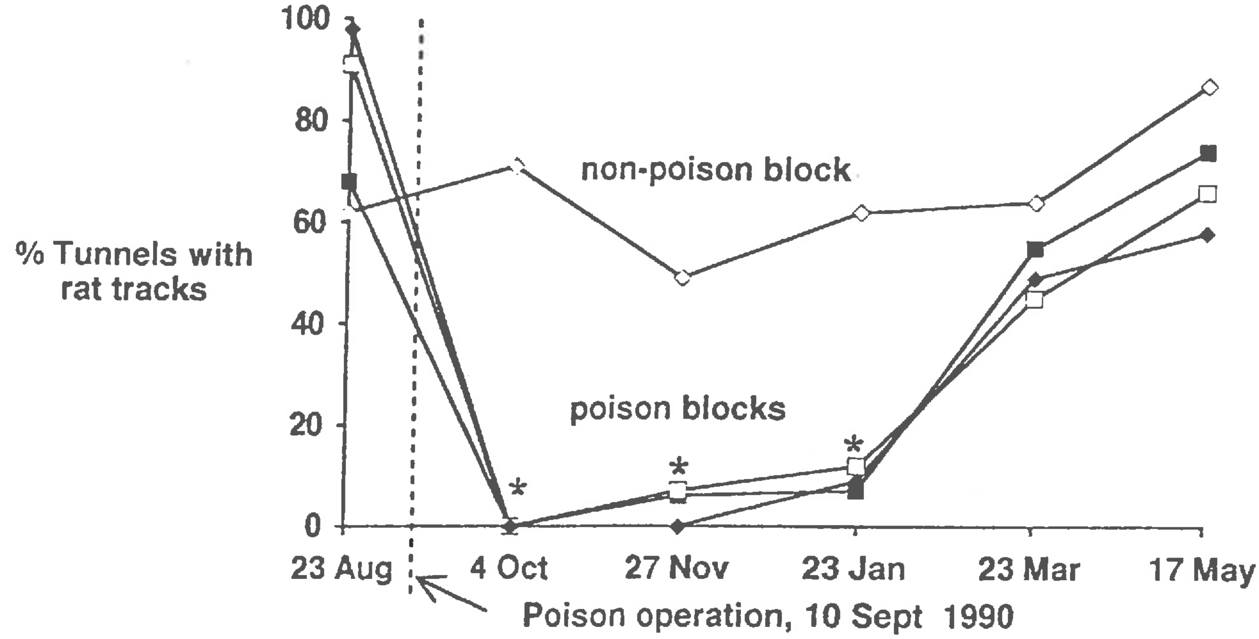
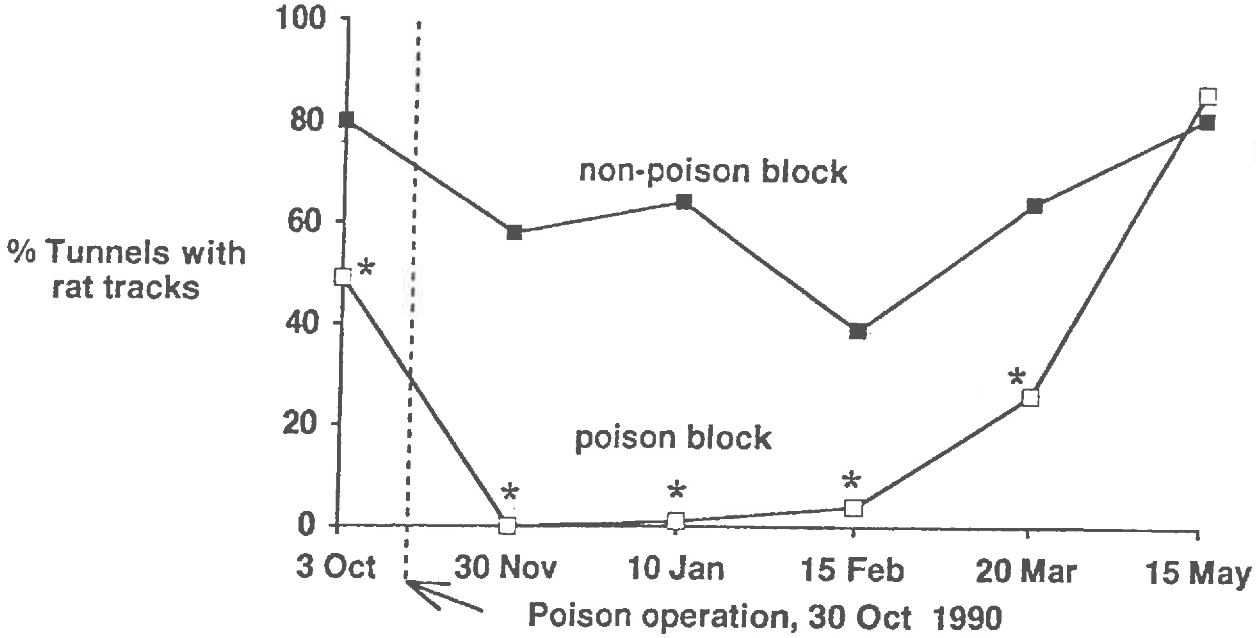


FIG. 2b



FIGS. 2a and 2b: Ship-rat footprint tracking indices before and after aerial 1080 poisoning at Mapara (2a) and Kaharoa (2b). An asterisk * indicates a significant ($p < 0.05$) difference between indices of the poison and non-poison blocks.

FIG. 3a

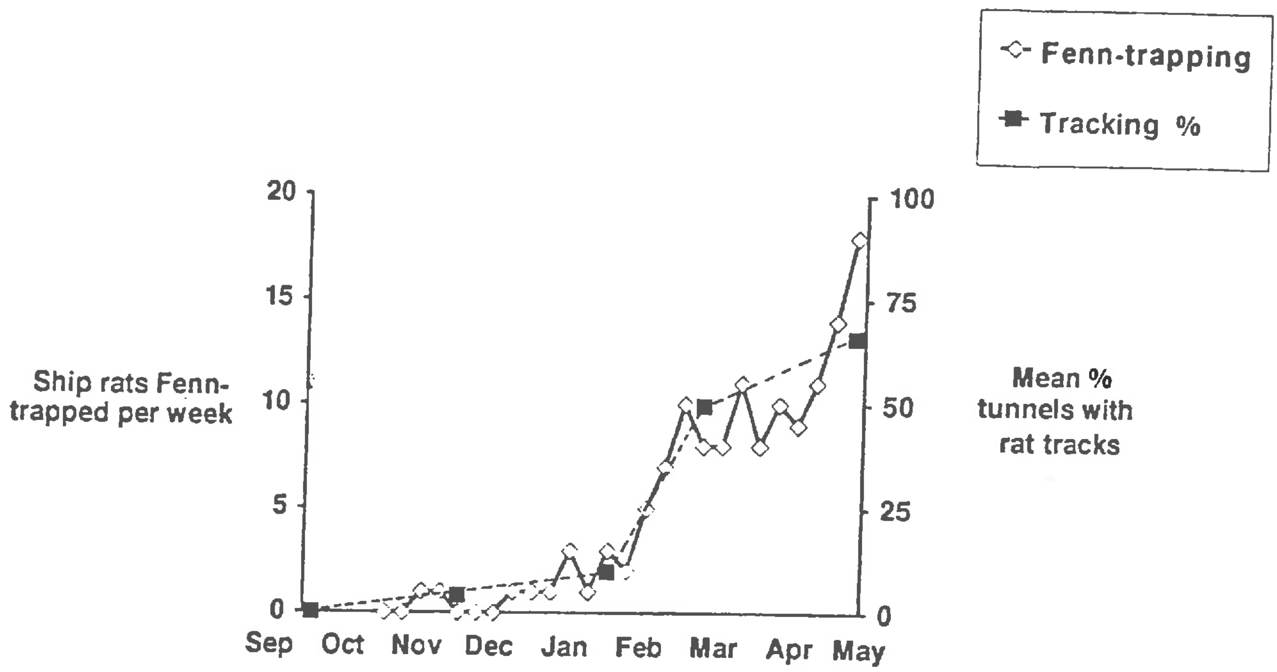
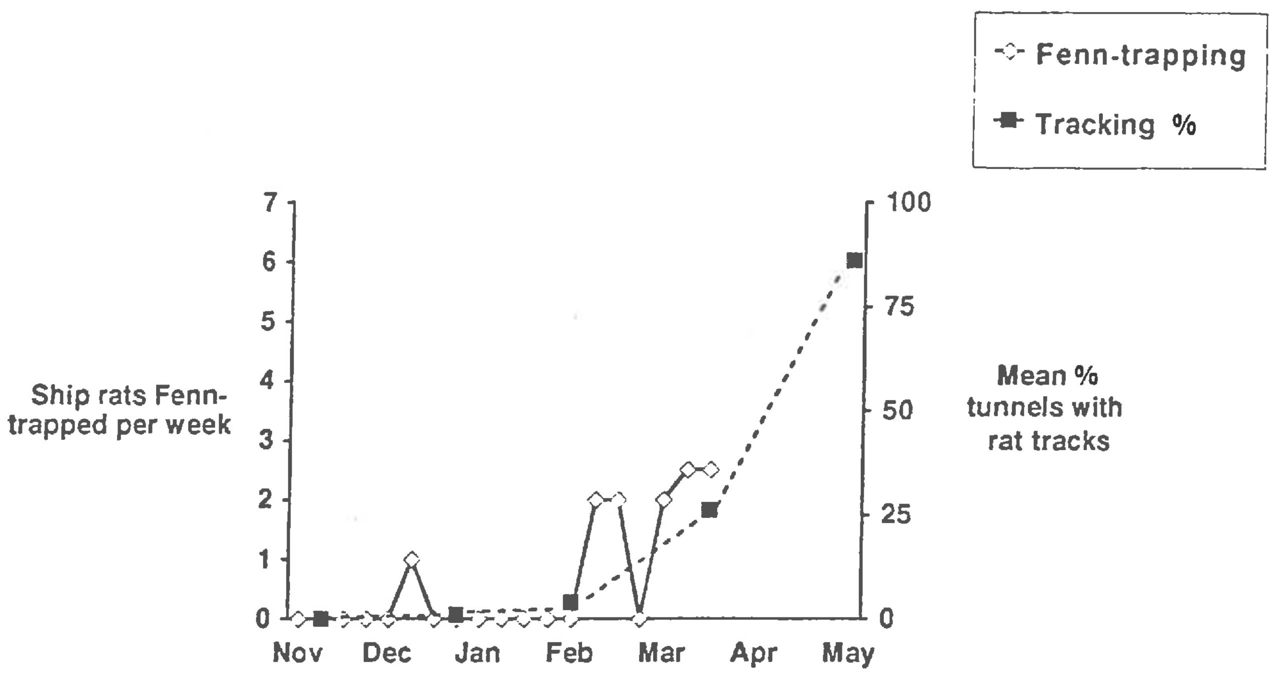


FIG. 3b



FIGS. 3a and 3b: Tracking rate and trapping success as indices of ship-rat abundance in poison blocks at Mapara (3a) and Kaharoa (3b). Poisoning was on 10 September 1990 at Mapara and 30 October 1990 at Kaharoa.

7. DISCUSSION

7.1 The effectiveness of 1080 operations against ship rats

The LD_{50} (the amount of poison per bodyweight of animal required to kill 50% of a population) of the ship rat is 0.76 mg/kg (McIlroy 1982). The amount of 1080 in an average 6-g pollard bait is 4.8 mg if 0.08% 1080 is used and 9 mg if 0.15% 1080 is used. A larger-than-average (150 g) ship rat therefore has to consume only 1/42 of a 0.08% bait or 1/79 of a 0.15% bait to receive an LD_{50} dose of 1080, and smaller rats need consume even less. The average time until death is 12 h (McIlroy 1986).

A sowing rate of 8 kg of baits per hectare, as used at Mapara, would result in an average bait density of 1 bait per 7.5 m^2. Home-range areas of ship rats in New Zealand forests are little known, and will vary with rat density. However, the figures of Daniel (1972) of 0.17 ha and 0.08 ha for male and female home range areas respectively, can be used to estimate the number of baits (sown at 8 kg per hectare) a rat might encounter inside its range area. The numbers are 227 baits for males and 107 for females, if the rats traverse over all their range. This is the equivalent of between 4500 and 18000 LD_{50} doses of 1080 poison per home range, depending on which strength of 1080 bait is used.

The very large kills of ship rats shown in this study and that of B. Warburton (1989, unpublished FRI contract report) indicate that rat acceptance of the pollard baits normally used in possum control operations is high. However, a few rats either do not consume baits or immigrate from outside the poison area after baits are detoxified by rainfall. The amount of bait used in a standard possum operation would give a substantial overkill if the target is ship rats, and considerable savings may be possible by reducing both the toxicity and density of baits.

7.2 Recovery of ship-rat populations after poisoning

Rat-abundance indices ceased to be significantly lower in the poison block than in the non-poison block after, at most, 5.5 months at Mapara and 6.5 months at Kaharoa. This result confirms the prediction of B. Warburton (1989, unpublished FRI contract report) that any direct benefit from the reduction in rat numbers is confined to one bird-breeding season.

Ship-rat breeding is strongly seasonal. Pregnant or lactating females have been trapped mainly between mid-September and mid-April in mainland podocarp-broadleaved forests, occasionally to mid-winter after a heavy seedfall (Daniel 1972; Best 1973; Innes 1979). The operations at Mapara and Kaharoa were timed to reduce the rat populations at the very start of the breeding season.

New Zealand ship rats average 4.9-6.1 young per litter (Daniel 1972; Best 1973; Innes 1979); for laboratory animals, the interval between litters averages 32 days, and the pups are weaned at 21-28 days (Cowan 1981). They may reach sexual maturity at 3-4 months (Watts & Aslin 1981). Most of the rats trapped between late February and April at Mapara were small and probably young (P. Bradfield, DOC, pers. comm.). These were probably the first litters of rats that had survived the poison operation, which suggests that it took 2-3 months for rats to find mates after the poisoning. Rats trapped in Fenn traps in the 1991/92 season should be collected, aged, and their reproductive status noted to examine this hypothesis. This would confirm that repopulation of the forest was by reproduction rather than immigration.

Ship-rat populations are very resilient to control efforts. Small areas cleared of rats are swiftly recolonised (Innes & Skipworth 1983; Hickson *et al.* 1986; J. Innes & D. Williams 1990a, unpublished FRI contract report). Now, this study has shown that in large areas where nearly all rats present are killed, the fast reproductive rate of the remnant population means that recovery is within months, not years.

However, 1080 poisoning is a useful experimental tool for the kokako research-by-management programme, which requires low rat numbers only for the few months of the kokako breeding season, especially from November to January when most breeding attempts are made (J. Innes, unpubl. data). The success of rat control must ultimately be measured in terms of the gain in breeding success of kokako, rather than by the change in the rat population itself.

8. CONCLUSIONS AND RECOMMENDATIONS

- Aerial 1080 poisoning with pollard baits kills nearly all ship rats present. Population recovery is very slow for 3-4 months after operations in September/October, but rapid thereafter.
- Aerial 1080 poisoning is a useful tool for reducing rat abundance for the duration of 1 bird-breeding season only, and is satisfactory for continued use in kokako research-by-management programmes.
- For future operations targeted only at ship rats, considerable savings may be possible by reducing both the toxicity and density of baits.

9. ACKNOWLEDGEMENTS

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