Project No: R- 80621

Possum Monitoring in the Presence of Ground Birds

(Objective 1) Calibrating *TSI* with *RTCI*

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Pest Control Research Contract Report: 2004/6

PREPARED FOR:
Animal Health Board
PO Box 3412, Wellington

DATE: June 2004

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Summary

Project and Client
Research to provide a method for monitoring possums that is safe for ground birds was undertaken by Pest Control Research Ltd, for the Animal Health Board (AHB). The work presented in this report was carried out between July 2003 and June 2004 under Objective 1 of Project No. R-80621**.**

Objective
- To provide an accurate and precise method for possum monitoring that does not harm ground birds by calibrating the Tag Station Index (*TSI*) with the Residual Trap Catch Index (*RTCI*).

Methods
- 20 lines of three Waxtag stations measured over 10 nights spaced at 100 m were compared with 20 lines of 10 leg-hold traps measured over 3 nights for measuring possum presence.
- This work was replicated at four sites predicted to cover a range of *RTCI* values.

Results
- The range of *RTCI* values covered by the four study sites was 1 to 8.3%.
- At the 8.3% *RTCI* site, all of the Waxtag station lines and nearly all of the leg-hold trap lines detected possums.
- At low *RTCI*'s of 1 to 2.2%, between 38 and 50% of trap lines did not capture possums when Waxtag lines at the same locations indicated that possums were present.
- There was a good correlation between the *TSI* and the *RTCI* estimates ($R^2 = 0.97$).

Conclusions
- Waxtag stations can provide a safer alternative to leg-hold traps for monitoring low-density possum populations at sites where ground birds such as kiwi or weka are present.
- Lines of Waxtag stations over 7 and 10 nights were more effective at indicating the presence of possums (i.e. better sensitivity) than leg-hold trap lines set for 3 nights. This supports previous research findings.
- Up to 50% of leg-hold trap lines can fail to detect the presence of possums when *RTCI* levels are low.
- Waxtag stations are not suitable for monitoring possum populations with high possum densities because of problems of device saturation.
- Monitoring possums with Waxtag stations will improve the precision of possum population estimates because larger sample sizes can be achieved when using the same labour input as used with the trap-catch method.
- The *TSI* and *PAI* estimates appear to be closely related to *RTCI* estimates although the small sample size of 4 does not provide certainty.

Recommendations

- Waxtag stations should be considered as an alternative to lines of leg-hold traps for monitoring low-density possum populations especially where ground birds are present.
- Waxtag stations should be used for possum monitoring where the AHB requires a accurate estimate of possum presence following control operations. The method would be suited to "input" based control operations conducted in areas where *RTCI* indicate low possum densities but Tb levels still persist.
- Waxtag stations should be used where high levels of precision are required because large sample sizes can be obtained without increase in monitoring costs.
- *TSI* and *PAI* disease reduction targets should be defined separately from *RTCI* targets but the relationship between the two estimates defined in this study can be used as a guide.
- Further trials comparing *TSI* and *PAI* estimates with *RTCI* estimates should be undertaken especially at the 1 to 5% *RTCI* levels to further strengthen the findings from this study. This could be undertaken in collaboration with possum monitoring contractors and DOC staff to save costs.
- Trials should be undertaken to evaluate the reliability of Waxtag stations to monitor contractor performance compared to the current *RTCI* method.
- The relationship between *TSI* and *PAI* estimates and absolute possum densities should be determined as proposed for objective 2 of this study.
- Consideration should be given to supporting the production of a standard protocol for the use of Waxtag stations for possum monitoring so that use of the method will be consistent throughout New Zealand.

1. Introduction

Research to provide a method for monitoring possums that is safe for ground birds was undertaken by Pest Control Research Ltd, for the Animal Health Board (AHB). The work presented in this report was carried out between July 2003 and June 2004 under Objective 1 of Project No. R-80621.

2. Background

Reducing possum numbers and maintaining them at low levels is an essential component of the AHB's goal to eradicate bovine tuberculosis (Tb). To do this effectively vector managers need to have methods that provide accurate and precise estimates of possum population densities i.e. possum monitoring. Appropriate monitoring methods are vital for successful management (Thompson et al. 1998). Currently there is one method that has been adopted nationwide for monitoring possum populations. This is based on the percentage of possums captured in leg-hold traps (Batcheler et al. 1967). In 1996 the technique was standardised with a protocol (NPCA 2002) allowing density estimates to be comparable throughout New Zealand. Density estimates using this method have been called the residual trap catch index or *RTCI*.

Unfortunately the method causes risk to flightless birds such as weka (*Gallirallus australis*) and kiwi (*Apteryx sp*) which can be captured in the leg-hold traps. (Reid 1983). An attempt has been made to overcome this problem by raising traps above ground but this is labour intensive and increases the risk of capturing birds such as kereru (*Hemiphaga novaeseelandiae*) and kaka (*Nestor meridionalis*) as occurred on Kapiti Island (Sherley 1992). Also raising traps reduces the ability of the method to detect possums (Thomas & Brown 2001). Therefore there is a need for a possum monitoring method that does not place ground birds at risk, and provides an index of possum density as well as, or better than, the current method. Bait interference methods show promise as a potential alternative.

Bait interference uses the frequency of non-toxic baits eaten (or interfered with) by possums to provide density estimates (Bamford 1970). It was first developed in the 1970s using a flour-paste placed on bottle tops located on wires. However, it was soon found that possum interference could not be differentiated from other animals such as rats (Jane 1979). In the 1990's a new bait interference method, using wax blocks, was developed to overcome this problem (Thomas et al. 1999). There was also a need for a device that was light-weight and did not need to be checked daily so that sample sizes could be increased and precision improved (Brown and Thomas 2000). Also in a recent review on possum monitoring it was recommended that alternative monitoring methods should be designed for monitoring low-density possum populations (Fraser et al. 2002). Wax blocks were able to detect individual species that can be identified by species specific bite-marks. The method was further refined by improving the ability of the wax block to detect possums by making the wax blocks more visible, as recommended by McGlinchy & Warburton (1999). This was achieved by attaching the wax block to a white plastic tag and using it with a flour and orange oil lure. This device has been called the Waxtag (Fig.1).

The Waxtag method has potential as a suitable possum monitoring method particularly where ground birds are present because it poses no risk to these species. This has been endorsed by end users of Waxtag technology. In a recently-published article, pest operators from the Northland Regional Council have been able to monitor the success of their possum control work using Waxtags, and chose this method of monitoring primarily because the tags are less labour intensive, but also, and perhaps more importantly, because they removed all risk to kiwi, (NRC 2004). However for the Waxtag methodology to be accepted by the industry as a viable possum monitoring method further research is required to provide evidence that the method can identify the presence of possums as effectively as leg-hold traps and that there is a relationship between numbers of possums and density estimates derived when using Waxtags.

This report details research aimed at comparing the ability of the WaxTag stations and leg-hold traps to identify the presence of possums and to determining the relationship between Waxtag population indices and the *RTCI*. This research is Objective 1 of Project No. R-80621

3. Objective

To provide an accurate and precise method for possum monitoring that does not harm ground birds by calibrating the Tag Station Index (*TSI*) with the *RTCI*.

4. Methods

4.1 The Waxtag

The Waxtag has been developed specifically for estimating possum abundance. Each Waxtag consists of a 40 cm^2 piece of approximately triangular-shaped injection moulded plastic, with a 12 cc block of wax moulded to the sharpest point of the triangle (Fig. 1). Possums are attracted to the tag and their presence is recorded by bite marks on the wax.

Figure 1 *Waxtag (with coin shown for scale)*

4.2 Sampling Methodology

Waxtags were located in the field in a design based on the sampling methodology described by Linhart and Knowlton (1975) who developed a standardised method to monitor predators in the USA. They required a method that would enable comparisons of different population levels of coyotes in the western states. The method used lines of scent stations to attract the predators and used animal tracks to detect visitations. They used the proportion of stations showing visitations as an index of population abundance and called it the scent station index or *SSI*. Since then the *SSI* method has been used extensively in the USA to estimate the relative abundance of bobcats (Johnson & Pelton 1981, Diefenbach et al 1994), cottontail rabbits (Drew et al. 1988), raccoons and opossums (Conner et al 1983) and black bears (Lindzey & Thompson 1977).

An index based on the *SSI* methodology was used in the present study to provide an index of possum density, and used the presence of bite marks on Waxtags as an indicator of possum presence. Tag stations consisting of 5 Waxtags spaced at 10 m intervals were located in a cruciform shape (Fig. 2). A 'blaze' consisting of approximately 4 g of 1:5 mix of icing sugar and flour was spread onto the tree above each tag (NPCA 2002), and a mix of 1 part "Jaffa Orange" flavour (International Flavours, Auckland) in 9 parts canola oil was sprayed onto the wax part of the tags using a small hand operated spray gun.

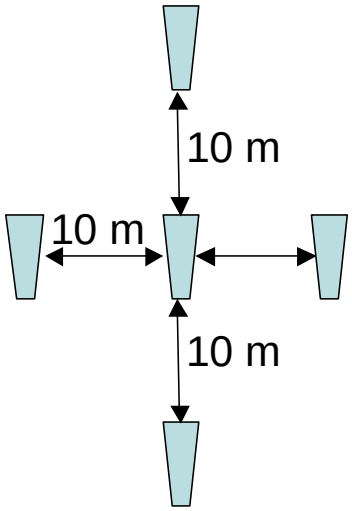

Figure 2 *A station consisting of 5 Waxtags spaced at 10 m intervals and arranged in a cruciform pattern.*

Tag stations were located on lines with three per line, spaced at 100 m intervals (measured from the central WaxTag to the next central WaxTag, Fig. 3). The 100-m spacing was chosen to minimise the possibility of individual possums moving along lines and biting more than one tag station (i.e. contagion). With 100-m spacing individual stations were considered to be the sample unit and no model adjustment for spatial correlation was used. A total of twenty systematically-located (but no nearer than 200 m from neighbouring lines) monitoring lines were established in each study site, giving a sample size of 60 stations for each site. Stations were checked for the presence of bite marks after 1, 2, 4, 7, and 10 nights.

A Tag Station Index (*TSI*) and Residual Trap Catch Index (*RTCI*) were calculated for each of the habitat types and used to calibrate *TSI* with *RTCI*. The *TSI* was calculated as:

TSI = The number of stations with tags bitten/total number of stations x 100

About 2 to 4 weeks after the 10-night period of Waxtag monitoring, 10 leg-hold traps were located along the lines at 20 m intervals using the standard trap catch protocol (NPCA 2002). Traps were located at the start of the lines and finished at 200 m distance (Fig. 3), and overlapped the sites where the Waxtag stations were previously located (Fig. 3). This layout allowed direct comparison of:

1. The ability of both device types to indicate the presence of possums.
2. The population density estimates derived using both devices.

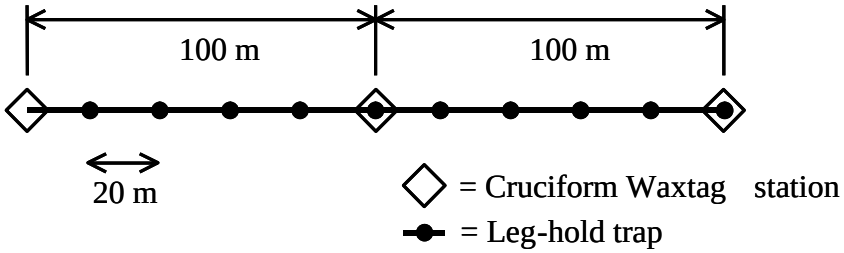

Figure 3 *Field arrangement used for each monitoring line, with three cruciform Waxtag stations spaced at 100 m intervals, and 10 leg-hold traps spaced 20 m apart. Neighbouring monitoring lines were at least 200 m away.*

4.3 Study sites

This work was replicated in habitats representative of where possum monitoring is commonly undertaken, and in a range of possum densities, to allow the two monitoring techniques to be compared. The chosen study sites were:

- South Island podocarp forest (Hohonu Forest, Westland)
- North Island podocarp forest (Whirinaki Scenic Reserve, Central North Island)
- Farm scrub habitat (Opepe Reserve, Taupo East, Central North Island)
- Forest pasture margin (Aickens/Inchbonnie, Westland)

4.4 Measuring sensitivity

Sensitivity of the Waxtags was determined by comparing numbers of lines of Waxtag stations that indicated possums were present with the numbers of lines of leg-hold traps that captured possums.

4.5 Calibrating the *TSI* with *RTCI*

TSI and *PAI* were calibrated with the *RTCI* using regression analysis. A logarithmic regression (Microsoft EXCEL) was fitted to the four study site estimates of *TSI*, *PAI* and *RTCI*. Reliability of the trendline was evaluated using the R-squared value. The *TSI* and *PAI* estimates were calculated from the data collected over the 7 night sampling period.

4.6 Calculating a Possum Activity Index (*PAI*)

In addition to calculating the *TSI* a possum activity index (*PAI*) was calculated for the four study sites for each nightly sampling period. The *PAI* was calculated as the mean number of tags bitten per cruciform station. These data were graphed for each study site and related to the *RTCI* for that site.

5. Results and Discussion

5.1 The *RTCI* estimates

RTCI estimates at the four study sites ranged from 1 to 8.3% (Table 1). The Westland site that had the highest *RTCI* of 8.3% was the first site measured. Following completion of this site we endeavoured to ensure the other sites were representative of successful knock-down operations where targets of 2% *RTCI* or less are specified.

Table 1 *The residual trap catch indices (RTCI) at each of the four study sites.*

Study site type	Residual Trap Catch Index (*RTCI*)
South Island podocarp forest (Hohonu Forest, Westland, South Island)	8.3%
Farm scrub habitat (Opepe Reserve, Taupo East, Central North Island)	2.2%
Forest pasture margin (Aickens/Inchbonnie, Westland, South Island)	2.0%
North Island podocarp forest (Whirinaki Scenic Reserve, Central North Island)	1.0%

5.2 The *TSI* estimates

The *TSI* estimates varied according to the estimated *RTCI* estimates at all study sites. In the Westland podocarp site at Hohonu (8.3% *RTCI*), the proportion of stations that indicated possum presence showed a sharp increase over the first four nights, and then reached an asymptote at the 7 and 10 night sampling periods where all lines indicated possums were present (Fig. 4). The shape of the *TSI* curve for this 8.3% *RTCI* site and the fact that nearly all the stations detected possum presence, suggests that the Waxtag stations were near saturation at this possum density. These results suggest that the method is unlikely to accurately detect differences in possum densities when populations are above approximately 10% *RTCI*.

Conversely, at the two sites with *RTCI*s of 2% (Opepe Reserve and Aickens/Inchbonnie), it is unlikely that the monitoring devices became saturated. At these sites the *TSI* steadily increased over the 10 night sampling period, with about 15% of Waxtag stations showing possum presence after 1 night, increasing to about 50% of stations by night 10 (Fig. 4). At the North Island Podocarp site which had the lowest *RTCI* of 1%, the *TSI* estimates slowly increased to about 30% of Waxtag stations bitten after 10 nights (Fig. 4).

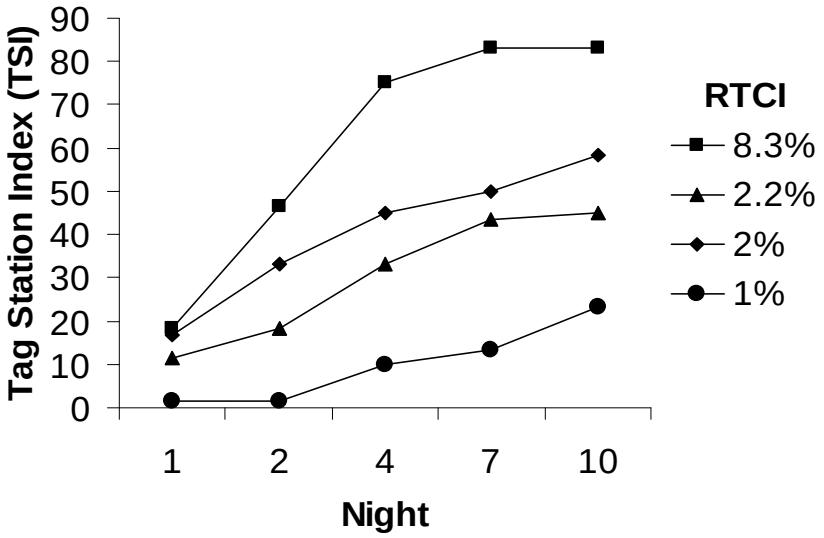

Figure 4 *Tag Station Index (TSI) data at each of the residual trap catch index (RTCI) levels at the four study sites. Waxtag stations were checked at 1, 2, 4, 7 and 10 night intervals. Each site had 60 Waxtag stations located on 20 lines.*

5.3 Sensitivity of the Waxtag stations

More lines of Waxtag stations detected the presence of possums than lines of leg-hold traps Waxtags when deployed for 4, 7 and 10 nights with the exception of the North Island podocarp forest site which recorded equal numbers of Waxtag and trap lines detecting possums on night 4 (Table 2). At the low density sites 17 to 50% of the trap-lines failed to detect the presence of possums when they were detected on the same Waxtag lines. At the higher 8.2% *RTCI* density level at Hohonu, only 1 trap line (5%) failed to detect possums that were detected by the Waxtag lines on nights 4, 7 and 10. Less Waxtag lines (no more than 1) failed to detect possums compared to trap lines for the 4, 7 and 10 night sampling periods (Table 2).

These results are supported by similar findings from earlier studies. A bait interference method was trailed in Northland in 2002 by comparing the percentage of possum bite marks recorded using lines of Waxtags with records of *RTCI*. Results showed that Waxtags were more sensitive than traps for detecting possums (Thomas et al. 2003). Similar results were recorded in a study funded by the Department of Conservation (DOC) where Waxtag stations recorded a *TSI* of 12% and an *RTCI* of 0% (Bearman 2002). Also at Balmoral Forest possums were detected using Waxtags after intensive leg-hold trapping was undertaken designed to remove all possums (Fraser et al. 2003).

Table 2 *Total number of Waxtag lines (after 4, 7 and 10 nights) and trap lines (after 3 nights) that detected possums at the four study sites. Each site had 20 lines of each type of detection device. Figures in parenthesis are the proportion of the lines where possums were present that the leg-hold trap lines or Waxtag lines failed to detect.*

Site	**Waxtag lines detecting possums (out of 20)**			**Trap lines detecting possums (out of 20)**	**Trap lines failing to detect possums when Waxtags indicated possum presence**			**Waxtag lines failing to detect possums when traps indicated possum presence**		
Waxtag nights	**4**	**7**	**10**		**4**	**7**	**10**	**4**	**7**	**10**
South Island Podocarp forest 8.3% *RTCI*	20	20	20	19	1 (5%)	1 (5%)	1 (5%)	0	0	0
Farm/scrub 2.2% *RTCI*	14	15	16	10	4 (29%)	6 (40%)	6 (47%)	1 (10%)	1 (10%)	0
Bush pasture margin 2% *RTCI*	16	17	17	9	8 (50%)	8 (47%)	8 (47%)	1 (11%)	0	0
North Island Podocarp forest 1% *RTCI*	6	8	12	6	1 (17%)	3 (37%)	6 (50%)	1 (17%)	1 (17%)	0

5.4 Calibration of the *TSI* with *RTCI*

TSI and *PAI* estimates were closely correlated with the *RTCI* estimates $R^2 = 0.92$ and 0.98 for *TSI* and *PAI* respectively (Fig. 5). However this relationship is based on only 4 samples and is therefore weak. Further sample points in the low-density range (*RTCI* estimates of around 1 to 5%) would further define the relationship for low-density populations. Also caution needs to be exercised when calibrating one index against another because of the intrinsic error around the estimates (see Thomas and Brown 2001). Ideally separate *TSI* and *PAI* targets would need to be defined by possum control agencies to achieve specific disease outcomes. Using figure 5 a *TSI* target of < 50% or a *PAI* target of < 1would appear to achieve a similar result as a < 2% *RTCI* target.

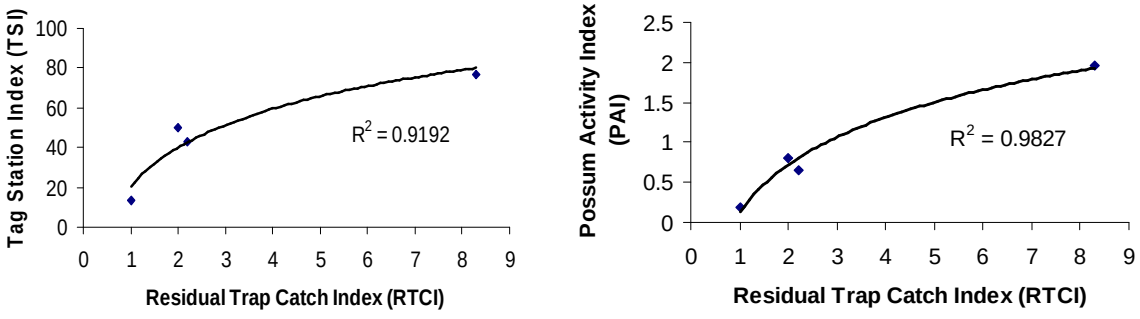

Figure 5. *Calibration of TSI and PAI estimates with RTCI estimates calculated by fitting a logarithmic regression to the data using Microsoft EXCEL. The TSI and PAI estimates were calculated after a sampling period of 7 nights.*

Without reading too much into a graph with only 4 data points it appears that saturation of the tag stations at the higher density site (Hohonu 8.2% *RTCI*) is pulling the upper tail of the line down and creating some of the non-linearity.

5.5 Comparisons of the *PAI and RTCI*

Results indicated that there was a relationship between the *PAI* and the *RTCI* at the four study sites (Fig. 6). At the North Island podocarp forest site (*RTCI* = 1%) the *PAI* was low for all sampling periods (0.02, 0.02, 0.08, 0.18, and 0.33 for the 1 – 10 night sampling periods respectively). The bush pasture margin site (*RTCI* = 2%) and the farm/scrub site (*RTCI* = 2.2%) gave similar *PAI* estimates (0.25, 0.48, 0.68, 0.8, 1 and 0.15, 0.25, 0.5, 0.66, 0.81 respectively). The Westland podocarp forest site (*RTCI* = 8.3%) gave the highest *PAI* estimates of 0.28, 0.82, 1.53, 1.97 and 2.12 for the 1 – 10 night sampling periods respectively (Fig. 6).

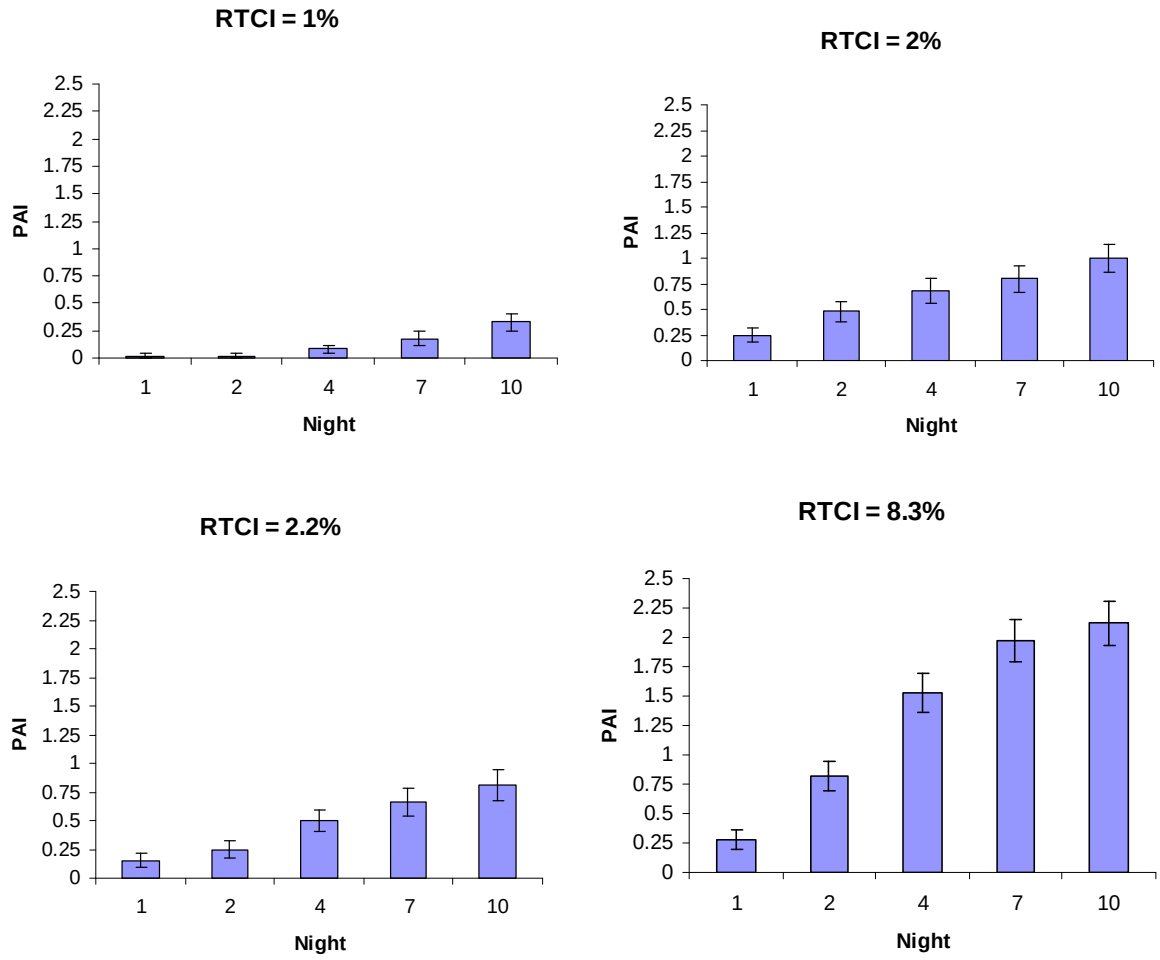

Figure 6. *Possum activity indices (PAI) for the 5 nightly sampling periods at the four study sites. PAI is calculated as the mean number of tags bitten per cruciform. The sites are North Island podocarp forest (RTCI = 1%). Westland bush/pasture margin (RTCI = 2%) North Island farm scrub (RTCI = 2.2%) and South Island podocarp forest (RTCI = 8.3%). Error bars are ± SEM.*

5.6 Advantages of Waxtag station lines

Lines of Waxtag stations had a number of advantages over lines of leg-hold traps for possum monitoring other than their increased sensitivity. They can be safely used in the presence of ground birds such as kiwi and weka. Also considerable time savings can be made when using lines of Waxtags compared to lines of traps because Waxtag lines do not need to be checked daily, and being lightweight, more can be located in the field per day (Fraser et al 2004). This translates to larger sample sizes and increased precision. If the field layout used in this study (stations rather than lines) is used for possum monitoring sample sizes will be even larger, further improving precision.

6. Conclusions

- Waxtag stations can provide a safer alternative to leg-hold traps for monitoring low-density possum populations at sites where ground birds such as kiwi or weka are present.
- Lines of Waxtag stations over 7 and 10 nights were more effective at indicating the presence of possums (i.e. better sensitivity) than leg-hold trap lines set for 3 nights. This supports previous research findings.
- Up to 50% of leg-hold trap lines can fail to detect the presence of possums when *RTCI* levels are low.
- Waxtag stations are not suitable for monitoring possum populations with high possum densities because of problems of device saturation.
- Monitoring possums with Waxtag stations will improve the precision of possum population estimates because larger sample sizes can be achieved when using the same labour input as used with the trap-catch method.
- The *TSI* and *PAI* estimates appear to be closely related to *RTCI* estimates although the small sample size of 4 does not provide certainty.

7. Recommendations

- Waxtag stations should be considered as an alternative to lines of leg-hold traps for monitoring low-density possum populations especially where ground birds are present.
- Waxtag stations should be used for possum monitoring where the AHB requires a accurate estimate of possum presence following control operations. The method would be suited to "input" based control operations conducted in areas where *RTCI* indicate low possum densities but Tb levels still persist.
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- *TSI* and *PAI* disease reduction targets should be defined separately from *RTCI* targets but the relationship between the two estimates defined in this study can be used as a guide.
- Further trials comparing *TSI* and *PAI* estimates with *RTCI* estimates should be undertaken especially at the 1 to 5% *RTCI* levels to further strengthen the findings from this study. This could be undertaken in collaboration with possum monitoring

contractors and DOC staff to save costs.

- Trials should be undertaken to evaluate the reliability of Waxtag stations to monitor contractor performance compared to the current *RTCI* method.
- The relationship between *TSI* and *PAI* estimates and absolute possum densities should be determined as proposed for objective 2 of this study.
- Consideration should be given to supporting the production of a standard protocol for the use of Waxtag stations for possum monitoring so that use of the method will be consistent throughout New Zealand.

8. Acknowledgements

We thank Shaun Ogilvie (Lincoln University) for helpful discussions during the course of this work. We would also like to thank Rodney Warne and Brendon Christensen, Department of Conservation, Bay of Plenty Conservancy for their assistance to find the very low possum density study site. Also Kevin Nicholas and staff at EPRO Ltd for helping us find a suitable central North Island farm/scrub site. Finally we would like to thank Carl Cooper and Steve Henderson and Northland Regional Council, for their ongoing help and faith in the ability of the WaxTag concept to offer a more cost-effective method for possum monitoring.

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