Southland Regional Council Possum Monitoring Programme

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Landcare Research
Manaaki Whenua

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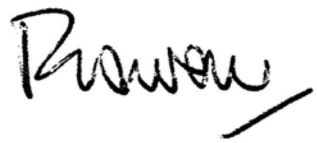

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1. Introduction

Because the number of Tb-infected livestock herds in Southland has declined significantly, the Animal Health Board has reduced substantially the funding available for possum control, and without some form of ongoing control, possum numbers and impacts on biodiversity will increase. Environment Southland therefore needs to be able to monitor regional trends in possum numbers to be able to assess objectively where and when council intervention is required and/or whether self-help schemes for managing possums are effective. Environment Southland, through Envirolink funding (ESRC124) in August–October 2008, asked Landcare Research to provide advice on a possible survey design and sampling intensity that could be used to develop a region-wide monitoring programme.

2. Background

Environment Southland is enabled under the Biosecurity and Resource Management Act to manage pests that have impacts on biosecurity and biodiversity values. Possums have been a significant pest over recent years because of the role they play as the major wildlife vector of bovine tuberculosis. At the peak of the possum control programme in Southland, possums were controlled over one million hectares, but as a consequence of the declining number of reactor herds only 160 000 ha is now under Tb-related possum control. Although not rigorously quantified, it is believed that the Tb-related possum control has delivered biodiversity benefits in at least some areas of high conservation values. In 2003, an amendment to the Resource Management Act gave councils the responsibility for maintaining biological diversity and, as a result, Environment Southland has been assessing the need to replace the possum control effort previously funded through the AHB with regional self-help schemes as one potential way of protecting the biodiversity gains delivered by the AHB-funded possum control. Regardless of such possum control programmes in place the council needs to monitor the status of possum populations in relation to the requirements in their Regional Pest Management Strategy which, for the larger part of the region, requires land occupiers to reduce possums to a maximum of 5% residual trap-catch index (RTCI; Environment Southland 2007). The council therefore needs to develop a region-wide monitoring programme that can deliver useful information (i.e. that informs management) within a cost-effective framework.

3. Objectives

- To provide advice to Environment Southland that will ensure any regionally based possum monitoring programme will include appropriate stratification and provide data with sufficient accuracy and precision to enable managers to make objective operational decisions.

4. Methods

Bruce Warburton and Guy Forrester (Landcare Research) initially met with Environment Southland staff to clarify what operational/management decisions were likely to be based on the monitoring results. This included clarification of potential stratification by habitat type and the likely accuracy and precision required (i.e. what change in possum abundance would be considered of biological significance and therefore needed to be detected). The council indicated they would want to detect changes in %RTC of between 3% and 5%.

The ability of a monitoring programme to detect a real change in the response variable, i.e. the ‘statistical power’, varies with the ‘background’ variability in the data (described here in terms of the standard deviation, SD, of the data) and the number of samples (in this case, trap lines). As a general rule, the greater the variability in what is being measured, the more samples are needed to reliably detect a real change. The common convention of setting a threshold for statistical power at 0.80 (i.e. an 80% chance of detecting a real difference of a given magnitude) was used for this analysis. A set of post-control possum trap-catch monitoring data (obtained following the NPCA trap-catch protocol, NPCA 2008) was obtained from Environment Southland to carry out a power analysis for determining the relationship between sample size and precision. These data were stratified into four habitat types: forest, forest–pasture margin, farm, and tussock, and the estimated required sample size was divided proportionally between the habitats according to their total area (see Table 1 below).

Power analyses were carried out using the Internet applet by Russ Lenth at http://www.stat.uiowa.edu/~rlenth/Power/ (accessed 27 Aug 2008). Statistical power was set at 0.8 and the standard value for a Type I error of 5% was used.

5. Results

5.1 Pooled variance

Post-control trap-catch data from four habitat strata were used to calculate a pooled standard deviation for all the RTCI data based on the variances in the data for each stratum. The pooled SD was 3.72. This value was then used to carry out the power calculations for the region as a whole, and two methods were used:

1. The same trap-catch lines were assumed to be used in successive years (i.e. permanent transects). In this case a *paired t*-test was used to determine the sample size (i.e. number of trap lines) required to detect a range of absolute differences in RTCI (Fig. 1 and 2).

2. Different lines were assumed to be used in successive years (i.e. all lines placed at random). In this case an *unpaired t*-test was used to determine the sample size (i.e. number of trap lines in X ha) required to detect a range of absolute differences in RTCI (Fig. 3 and 4).

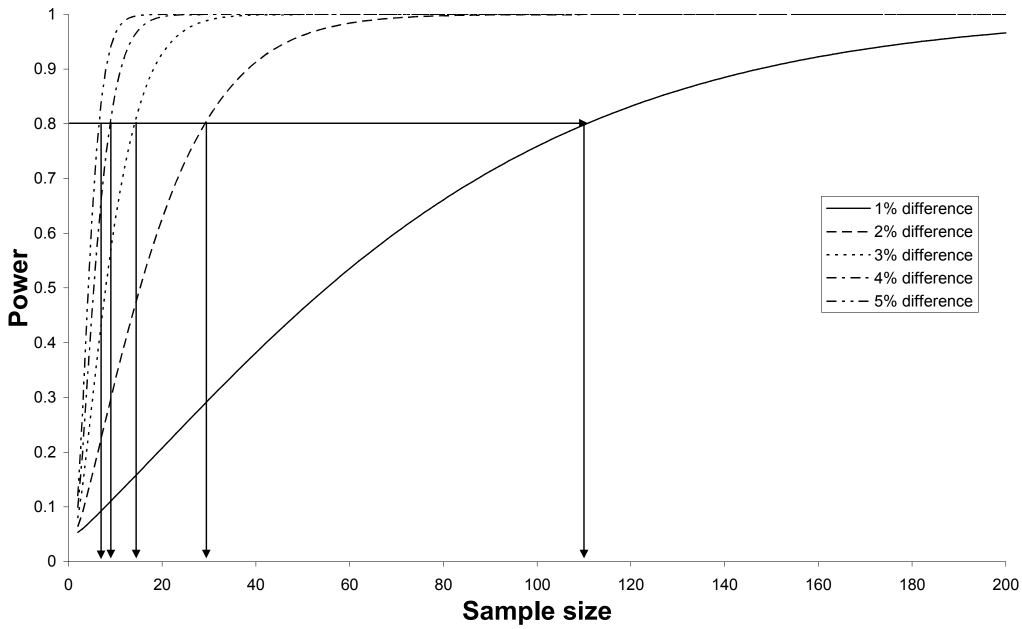

Fig. 1 Sample sizes (number of trap lines) required to detect a 1–5% difference in RTCI using a paired *t*-test. For example, about 110 lines would be required to detect a 1% change in RTCI with a statistical power of 0.8.

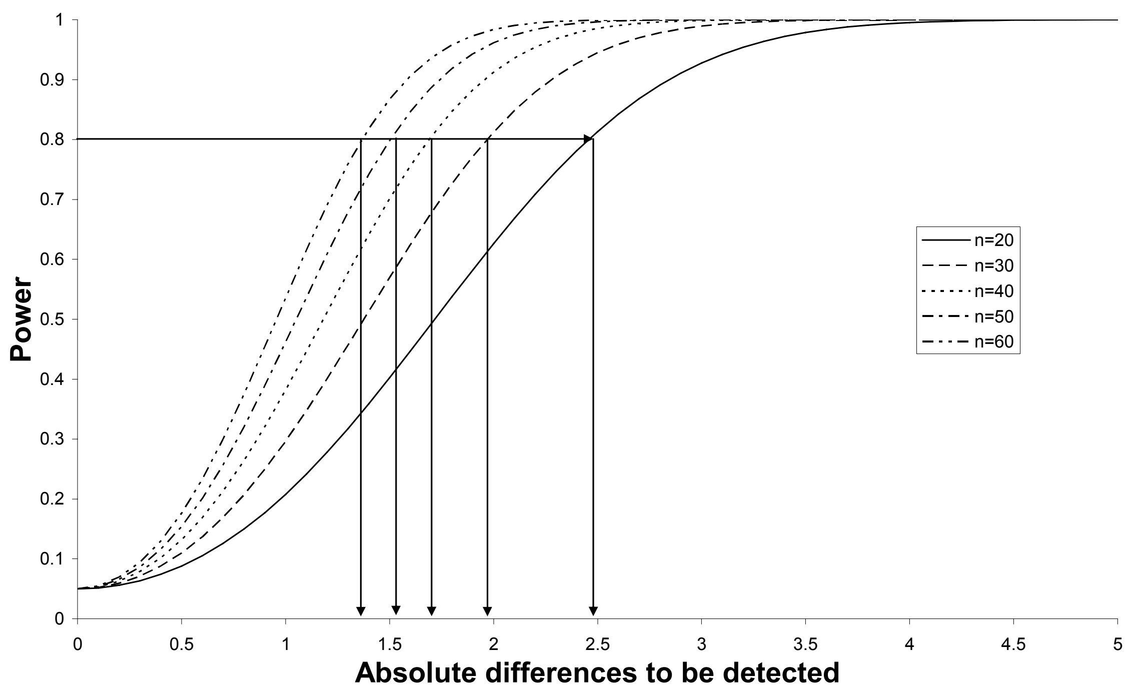

Fig. 2 Sample sizes (number of trap lines) required to detect an absolute difference in RTCI over a range of statistical power using a paired *t*-test. For example, with a statistical power of 0.8, 20 trap lines would be required to reliably detect a difference of 2.5% (e.g. a change from 3% to 5.5% RTC).

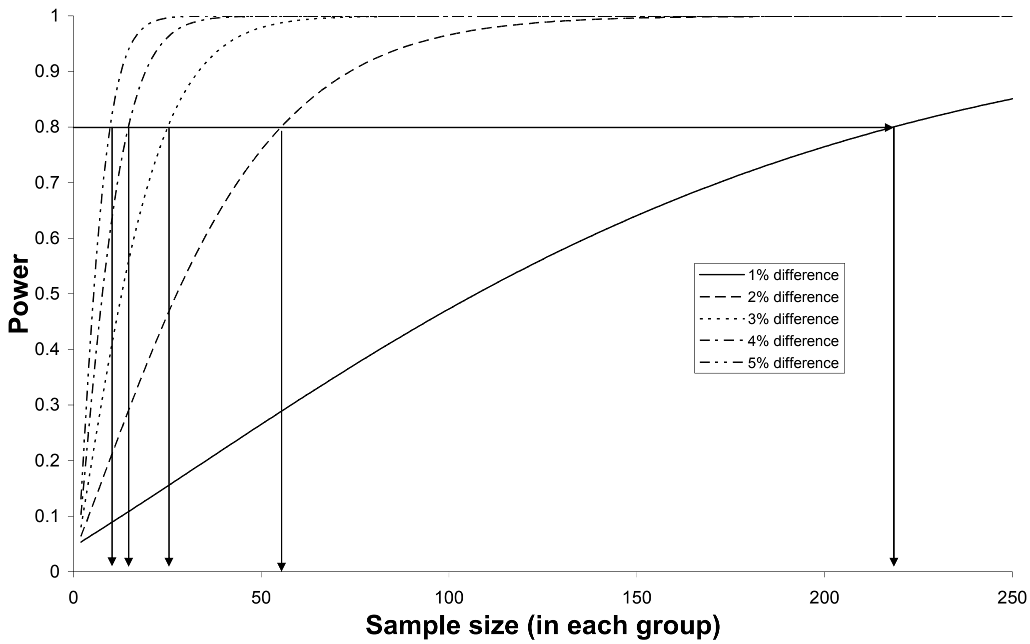

Fig. 3 Sample sizes (numbers of traplines) required to detect a 1–5% difference in RTCI using an unpaired *t*-test. For example, about 220 lines would be required to detect a 1% change with a statistical power of 0.8.

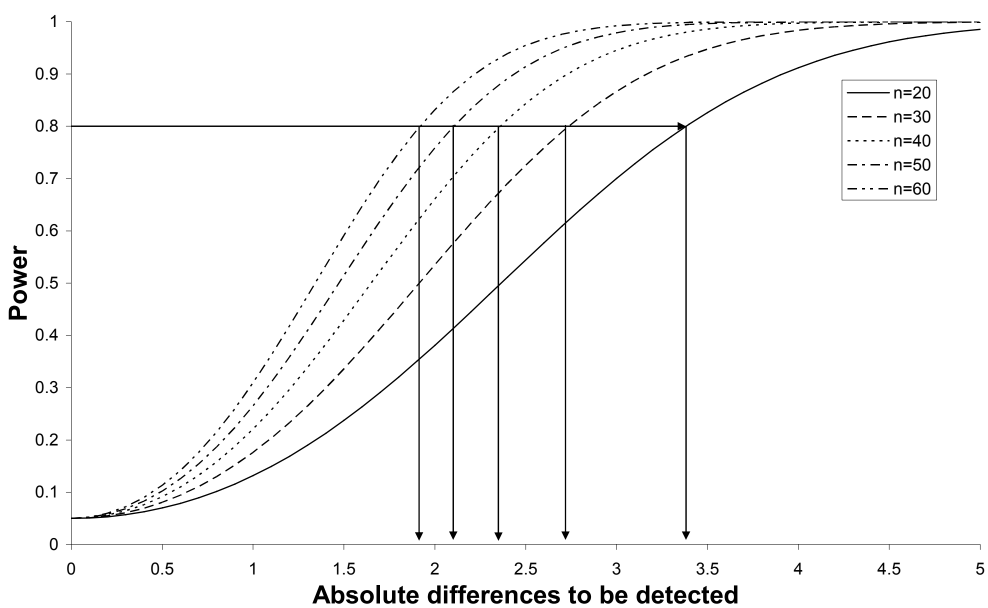

Fig. 4 Sample sizes (number of trap lines) needed to detect an absolute difference in RTCI over a range of statistical power using an unpaired *t*-test. For example, with a statistical power of 0.8, 20 trap lines could reliably detect a difference of 3.4% (a change from 3% to 6.4% RTC).

5.2 Allowing for maximum variation

As a general rule in designing experiments or monitoring programmes, the greater the background variation in what you want to measure, the more samples you need to collect to be confident of detecting a real change over and above this background variability. Because the standard deviations of the original data from the different operations in the four strata varied greatly (the maximum SD being 19.73 from operation 614 in a bush–pasture margin; the minimum non-zero SD was 0.28), the recommended number of lines when based on the pooled, or ‘average,’ SD of 3.72 is a conservative estimate. In the worst case (i.e. using the SD of 19.73), to detect a 5% difference in RTC, a sample size of 250 trap lines in each of two consecutive years would be required if we were to apply an unpaired test (different trap lines used) or about 150 should a paired *t*-test (same trap lines) be used (Fig. 5 and 6).

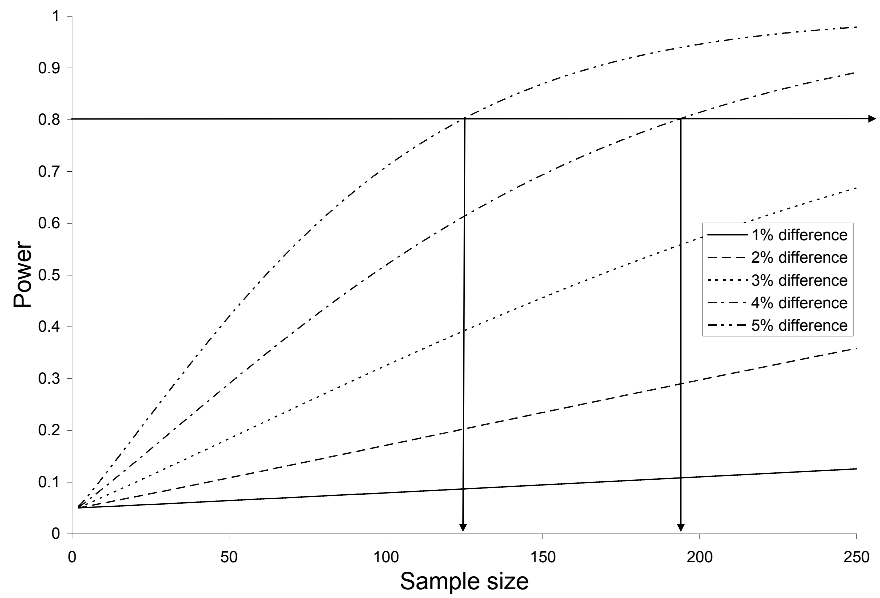

Fig. 5 Sample sizes (number of trap lines) needed to detect an absolute difference in RTCI over a range of statistical power by applying a paired *t*-test and allowing for the maximum within-site variation. For example, with a statistical power of 0.8 sample sizes of 125 or 193 trap lines would be required to detect differences of 5% or 4% in RTCI, respectively.

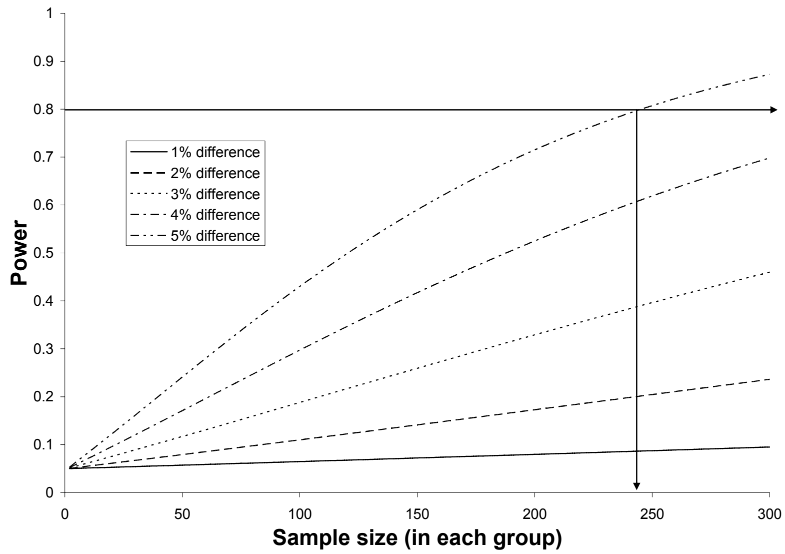

Fig. 6 Sample sizes (number of trap-lines) needed to detect absolute difference in RTCI over a range of statistical power by applying an unpaired *t*-test and allowing for the maximum within-site variation. For example, with a statistical power of 0.8 a sample size of 246 trap lines would be required to detect a difference of 5% in RTCI.

5.3 Sample size for each stratum

Based on the power analyses above, the total number of lines needed can be selected to reliably detect a level of change in RTCI considered to be biologically significant. For example, if a change in RTCI of 5% needed to be detected, 7 or 10 lines would be required for paired (same lines in consecutive years) and unpaired (different lines in consecutive years) monitoring respectively when the pooled SD = 3.72, and 125 and 246 lines respectively when the highest SD of 19.73 is used (Fig 1,3,5 &6).

These total numbers of lines can then be allocated to each stratum based on the proportional area of each stratum (Table 1). If the worst-case scenario was used (i.e. a total of 246 lines), then these 246 lines should be allocated to each stratum as detailed in Table 2.

Table 1 Area (ha) of each stratum and its proportion of the total area.

Habitat	Area (ha)	Proportion
Bush	229782.54	0.5218
Bush–pasture margin	2971.13	0.0067
Farmland	37289.56	0.0847
Tussock	170340.29	0.3868
Total	440383.52	1

Table 2 Allocation of 246 lines to habitat strata.

Habitat		Number of trap lines
Bush	246 × 0.5218	128
Bush–pasture margin	246 × 0.0067	2
Farmland	246 × 0.0847	21
Tussock	246 × 0.3868	95
Total		246

Note that if the proportional allocation of trap lines indicates a sample size of one then it is necessary to increase the sample size in that stratum to at least two so a variance can be calculated. These lines should then be located with random start points within each habitat stratum following the NPCA protocol.

It would be wise to err on the side of caution here as the data used to estimate the standard deviations of the RTCIs are not normally distributed (statistical 'normality' of the data is an assumption of these tests). Consequently, use as large a sample size as can be funded.

5.4 WaxTags® as an alternative to trap-catch

Because traps need to be set for 3 fine nights and be checked daily (i.e. 4 days of effort for each trap line), the trap-catch monitoring method is expensive relative to using an 'interference' method that requires only one check (i.e. 2 days of effort). WaxTags® have been developed for detecting the presence of possums, and a protocol has been established for using them to obtain estimates of relative abundance. Although they are not commonly used, comparison of indices obtained from using WaxTags and traps suggests WaxTag indices are sufficiently correlated to support their use (Fig. 7, Thomas et al. 2007). The use of WaxTags should, however, be restricted to monitoring possums at low densities (i.e. below RTC levels of 20%). Because WaxTags do not kill possums they can be used annually for monitoring with no risk of the monitoring impacting on possum abundance. The Bite Mark Index (BMI) as used in Fig 7 and 8 is based on placing five WaxTags in a cruciform pattern. The NPCA (2008) protocol for using WaxTags for monitoring is based on placing single tags along a line as is done when using traps, so the indices obtained using this method might differ slightly from the BMI index.

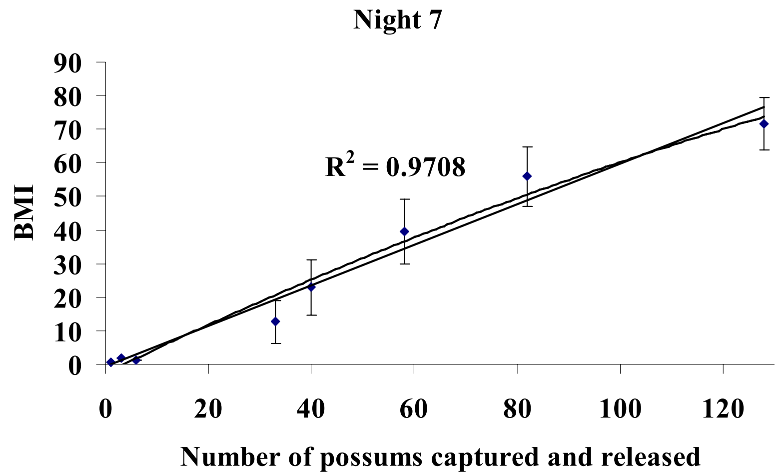

Fig. 7 Linear correlation of WaxTag® BMI indices and numbers of possums captured and released for WaxTag data collected after 7 nights and its associated R^2 value. A curvilinear line is also fitted to determine whether saturation was likely to have occurred. Error bars are 95% CI (Thomas et al. 2007).

Because Environment Southland's Pest Management Strategy has possum management outcomes expressed as RTC, WaxTag® indices can be cautiously related to RTC as shown in Fig. 8.

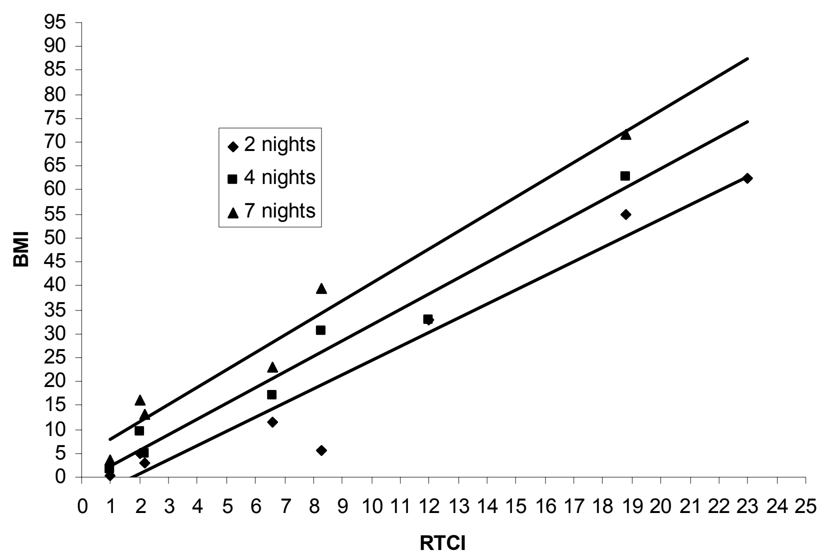

Fig. 8 Relative values of WaxTag® BMI estimates and trap catch RTCI estimates taken from studies that recorded both indices. The bottom trend line is for the 2-night BMI, the middle the 4-night BMI, and the top the 7-night BMI (Thomas et al. 2007).

6. Conclusions

- Based on the mean SD, a regional monitoring programme would need only 7 or 10 standard NPCA protocol trap lines to detect a change of 5% for paired and unpaired trap lines respectively, but if the worst-case (highly variable data) SD was used, 125 or 246 lines would be required.
- The total number of lines can be allocated to each stratum based on their proportional area.
- To reduce the cost of monitoring, WaxTags® could be used as an alternative monitoring device. A NPCA protocol has been established for using these devices.

7. Recommendations

- Environment Southland should establish a regional possum monitoring programme using the stratification and sample sizes detailed above.
- Although use of the estimated mean, or 'pooled,' SD (i.e. 3.72) indicated that only a small number of lines would be needed, it is recommended that the council either use the conservative SD of 19.73, or at least the maximum number of lines that funding can support.
- Because possum densities are very low (i.e. <2% RTC) the rate at which possum numbers will increase will be low and therefore monitoring should only be carried every 2–3 years. Different strata might have different rates of increase and the bush pasture margin stratum might need more frequent monitoring than the other strata.
- If monitoring is not carried out annually, the same trap lines can be used in subsequent surveys and the data treated as paired samples. However, if monitoring needs to be carried out annually either trap-lines should be shifted or WaxTags should be used.
- WaxTags® should be considered as a lower cost monitoring option.

8. References

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