Possum monitoring using raised leg-hold traps

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PEST CONTROL RESEARCH

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Abstract

The Department of Conservation currently measures possum (*Trichosurus vulpecula*) population abundance with leg-hold traps set on the ground. Protected flightless birds, such as the native weka (*Gallirallus australis*) and kiwi (*Apteryx* spp.), are at risk of being maimed or killed if caught in these traps. Consequently the Department has specified that traps be raised above the ground on platforms or brackets to prevent bird captures. However, there is concern that raised traps do not catch possums as often as the traps set on the ground so that comparisons of population indices gained from ground and raised sets may not be valid. Field trials were conducted in three habitat types using ground and raised sets to determine whether differences occurred in catch rates. The trials used the survey intensity recommended for possum monitoring specified in the NPCA trap-catch protocol. Also, the feasibility of using a calibration index to 'correct' the raised-set population indices so they can be compared to ground-set indices was examined. The results showed that there was no significant differences in catch rates in forest. Capture trends indicated that significant differences could occur if sample sizes were larger. Therefore comparisons of population indices from ground and raised sets were not considered valid, and separate protocols for their use are recommended. A standardised protocol for raised traps is recommended. The use of a calibration index is not feasible because the error associated with its calculation makes it meaningless. The study highlighted the need to include error estimates when making comparisons of population indices. Consideration needs to be given to investigating the use of alternative monitoring devices that do not pose a risk to native birds and give more precise estimates of population indices by providing larger sample sizes.

1. Introduction

The Department of Conservation (DOC), Science and Research Unit, contracted Canterbury University and Pest Control Research to compare possum population indices calculated from captures in leg-hold traps set on the ground (ground sets), and raised above the ground at heights of 350 mm and 700 mm (raised sets). An initial survey was conducted to determine the current methods used by DOC staff for raised sets. These results were used to select the most practical method for field trials. Field trials were conducted from January to March 2000 in three habitat types at Fiordland, Rotorua, and Galatea.

2. Background

The use of standard methods to calculate possum (*Trichosurus vulpecula*) population indices is an important component of effective control of possums in New Zealand's native forests. The methods need to provide field managers with indices that can be compared regionally so that the limited resources available for control can be allocated to priority areas. A standard protocol has been developed (NPCA 2000) with this aim and is used by DOC throughout New Zealand. The protocol outlines a method to estimate relative possum abundance from the proportion of ground set leg-hold traps that catch possums. When the estimates are undertaken after possum control they are known as the residual trap-catch or RTC. Residual refers to the residual population remaining and is commonly targeted at 5%, but can be as low as 0.5%. The levels specified are generally considered suitable to obtain a significant reduction in damage to the native flora and fauna.

The use of leg-hold traps puts flightless birds such as the native weka (*Gallirallus australis*) and kiwi (*Apteryx* spp.) at risk of capture and can either kill or permanently maim them. Consequently, DOC has specified that traps that are set in the areas where these birds are present must be raised above the ground by 700 mm. Traps can be set either on platforms or brackets attached directly to tree trunks or to sloping boards set at 38^{o} to the ground. These guidelines were based on trap-sets used in the possum eradication programme on Kapiti Island (Sherley 1992) and on bait station trials carried out on kiwi in the Wellington Zoo (Robinson 1983, unpublished report). However, further trials found that 700 mm was not high enough to prevent the capture of weka and a height of 1000 mm or greater has been recommended where these birds are present (Thomson et al. 1996). It is generally perceived that traps set above ground do not capture as many possums as traps set on the ground. In an attempt to increase possum captures trap-heights have been lowered to 350 mm in some areas, e.g. Waikaremoana.

Concern has been expressed about the comparability of population indices from ground and raised sets. If they are not comparable, erroneous results could lead to areas not being allocated resources for possum control and conservation values being compromised. There have been requests from DOC field staff for research trials to be undertaken to compare population indices gained from ground and raised sets. These have been requested to determine whether any significant differences occur between catches and whether a calibration index can be applied to adjust the raised-set indices so that they are comparable with ground-set indicies.

The research question for this study was to determine whether there are meaningful differences in trap-catches between ground and raised sets. Differences are expected because the behaviour of possums caught in traps that are set on the ground is likely to be different from that of possums caught in raised traps. Consequently, there are likely to be significant differences in catch rates and, provided the sample size is large enough (i.e. many trap-lines), these differences could be shown to be statistically significant. However, the question of interest for DOC is whether a difference in ground- and raised-set catch rates will have a meaningful effect on possum monitoring results when the level of trapping effort currently undertaken is used.

Therefore, this study was conducted using sample sizes that characterise standard DOC monitoring operations.

3. Objectives

- To survey DOC staff to determine methods used for raised sets and select the most suitable methods for field trials.
- To compare RTC estimates and capture characteristics for raised sets with standard ground sets.
- To determine the feasibility of using a calibration index to correct RTC estimates from raised sets so they can be compared with estimates from ground sets.

4. Methods

4.1 Survey to determine suitable methods

A total of 85 DOC area offices and field centres throughout New Zealand were sent a questionnaire that asked the following questions:

1. Do you use raised sets for possum population monitoring? (If yes please complete the following questions, if no please answer no and return the questionnaire).
2. At what height do you place traps when monitoring possums?
3. Where do you place the flour lure in relation to the trap, i.e. above or below the trap or both above and below?
4. What device do you use to attach the trap to the tree, e.g. Scott Board, L. Bracket, or other?
5. Do you use poles or ramps when monitoring possums to improve capture rates? If so please state what type.

Data from the questionnaire were tabulated to determine the current usage of raised sets for possum monitoring by DOC staff. The data were also used to decide on what was considered the most cost-effective raising device and the best method for placement of the flour lure when using raised trap-sets in this study.

4.2 Comparisons of RTC estimates and capture characteristics

4.2.1 Study sites

Fieldwork was conducted at three study sites of approximately 500 ha that represented habitats where DOC commonly undertakes possum monitoring. These were: beech forest in the Eglinton and Hollyford Valleys (Fiordland, 11–17 December 1999), mixed podocarp forest at Rotoehu Forest (21–23 January) and forest/pasture margin at Galatea (6–9 March 2000). The sites were chosen because they had recently undergone possum control, using a variety of methods, and were known to contain low possum numbers, characteristic of areas that are monitored to determine RTC levels.

4.2.2 Numbers of traps and location of trap-lines

The number of traps and trap-lines was set to be representative of current DOC monitoring effort, i.e. 10 trap-lines for areas of 501−1000 ha. Ten trap-lines per study site were established along compass bearings and were located so that they were at least 200 m apart to ensure that possum captures had minimal influence on catch rates on adjacent lines (NPCA 2000). Each trap-line contained 21 Victor No. 1 traps located at 20-m intervals measured with a hip-chain. Trap heights were either the standard ground set, as specified in the trap-catch protocol (NPCA 2000), 700 mm as specified by DOC for use where ground birds are present, or 350 mm identified as being used in the questionnaire. The trap-lines contained seven groups of three traps, which were set at the three trap heights. Trap-heights within the groups were allocated randomly using a list of random numbers to eliminate possible biases that could occur by setting certain trap-sets at favoured sites.

The raised trap-sets at the beech and mixed podocarp sites were located on trees, whereas the raised trap-sets at the forest/pasture site were located on fence posts. Traps were set for 3 fine nights giving 630 trap-nights for each set type. Traps were checked daily and notes kept on the number of possums captured, the number of possum escapes, the number of sprung traps, and the number of non-targets captured, as specified by the protocol. In addition, information on sex, maturity, bone fractures (determined by palpating the leg bones), leg caught, and whether the trap remained on the bracket when it captured a possum, was recorded.

4.2.3 Method for raised sets

Metal L-brackets were chosen as the trial method for raising traps above the ground. L-brackets that contained two prongs were manufactured specifically for the trial. The coil springs on the trap could be pushed onto the prongs, which held the trap firmly and allowed it to be bent so that the trap could remain horizontal regardless of the angle of the tree. This method of attachment allowed the trap to fall to the ground when a possum was captured. All traps had 400-mm chains that were nailed half-way between the ground and trap so that captured possums could fall to the ground after capture.

Flour lure, as specified in the trap-catch protocol (NPCA 2000), was used for trap-sets. Flour placement for the ground sets remained as specified but for the raised sets it was placed 100 mm from the ground up to and beside the trap. A further ‘white blaze’ was located 100 mm above the trap up to 500 mm.

4.2.4 Statistical analysis

Estimates of RTC for the ground and raised sets were calculated for each habitat type using the method described in the trap-catch protocol (NPCA 2000). The RTC estimates were compared to determine whether there were significant differences within each habitat type using analysis of variance (ANOVA).

Capture characteristics, i.e. percentages of males captured, percentages of immature possums captured, percentages with broken bones, percentages of possums captured

by the rear leg, and percentages of possum escapes (identified from possum fur in sprung traps), were compared to determine whether significant differences occurred between the three set types. For these analyses data from the three habitat types were pooled.

4.3 Feasibility of using a calibration index

The feasibility of using a calibration index to 'correct' RTC estimates calculated from raised-set data so they are comparable with RTC estimates calculated from ground-set data was examined.

Data from the field trials were used to calculate two separate indices, one from the combined data from the two forest habitats at Fiordland and Rotoehu, where the traps were set on trees, and the other from the data from the forest/pasture habitat at Galatea, where the traps were set on fence posts. The indices were calculated as the ratio of the average ground-set RTC to the average raised-set RTC. Because the ratio is an estimate of the calibration index, the degree of uncertainty about it, or statistically, the associated measure of variance of the ratio, was calculated (Mood et al. 1974).

The feasibility of using the index was determined by calculating a 'corrected' RTC estimate from raised set data and examining the width of its 95% confidence intervals to determine whether they are able to give managers useful data to provide meaningful comparisons.

5. Results

5.1 Survey to determine suitable methods

Thirty-three replies were received from the questionnaire and 25 (76%) indicated that they used raised sets for possum monitoring. The most common height used for the raised sets was 700 mm (45%) but a range of other heights was also used (Table 1). Two respondents indicated that two heights were used in the same operation, i.e. 700 and 350 mm, and 700 and 400 mm.

Table 1. Heights used for raised sets

Height (mm)	Usage	Percentage (%)
150	1	4
300	1	4
350	5	17
400	1	4
400–600	1	4
500–600	1	4
700	13	45
750	1	4
1000	2	7
Knee Height	2	7

Respondents used four types of raising devices (Table 2). These were:

1. Scott Boards: i.e. a piece of 8-mm 240 × 195 mm plywood wedged onto the tree using three nails. The trap is held firmly on the board using rubber bands made from tyre tubes.
2. L-brackets: small brackets approximately 45 × 45 mm designed to hold the trap either by the springs or trap-base extension so that it sits at right angles to the tree.
3. Spikes: a metal spike that is hammered into the tree and holds the trap either by the springs or trap-base extension.
4. Ramps: a pole or board resting at an angle against the tree. The trap is attached at the top end of the ramp.

Table 2. Raising devices used.

Device	Usage	Percentage
Scott Board	18	66
L-bracket	7	26
Spike	1	4
Ramp	1	4

Three positions were identified for the placement of the flour lure, these were:

1. Above and below the raised set.
2. Above and below but when below the flour lure is placed to one side.
3. Above only.

Sixteen respondents (46%) placed the flour lure both above and below the raised set and 4 (16%) placed it to one side, (the opposite side to the trap-chain). The remaining 10 respondents (38%) placed the flour lure above the trap only.

5.2 Comparisons of RTC estimates and capture characteristics

5.2.1 RTC estimates

There were no significant differences in catch rates from the ground or raised sets in the two forest habitats for Fiordland ($P = 0.21$) and for Rotoehu ($P = 0.33$). However, significantly more possums were caught in ground sets at the forest/pasture margin site at Galatea compared with traps raised to 350 mm ($P = 0.03$) (Figure 1). At Galatea traps set at 350 mm had the lowest catch rate, whereas the catch rate was lowest for the 700 mm set-traps in the two forest sites. The low rate for the 350 mm set-traps at Galatea could have been because traps were set on fence posts. In the forest sites the traps were on trees and there may be behavioural differences associated with possums climbing tree trunks compared with climbing fence posts.

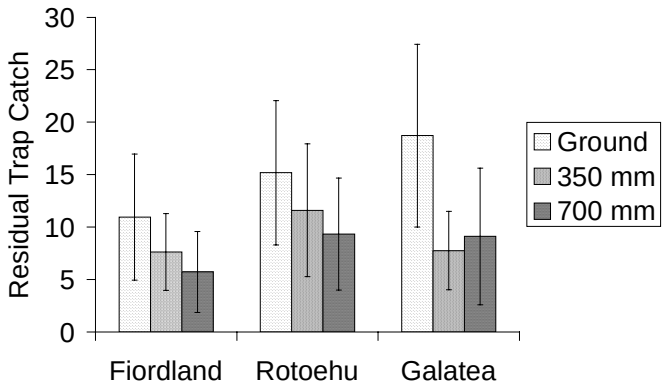

Figure 1. RTC of the three trap-set heights (error bars are 95% C.L.s).

5.2.2 Capture Characteristics

Percentages of males captured

There were no significant differences in the percentages of males and females captured in ground or raised sets (P = 0.58 for the ground sets, P = 0.99 for the 350-mm sets, and P = 0.25 for the 700-mm sets) (Figure 2).

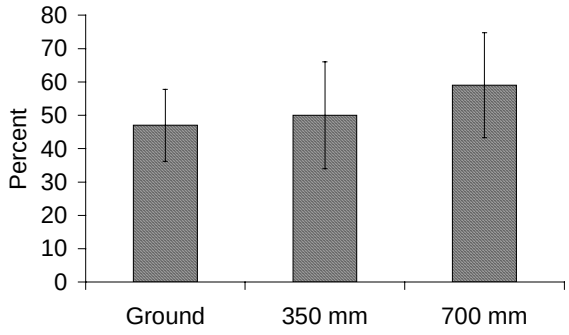

Figure 2. Percentages of males captured in traps located at different heights. (n = 85 for ground, n = 40 for 350-mm, and n = 39 for 700-mm heights, error bars are 95% C.L.s).

Percentages of immature animals captured

Percentages of immature animals captured in the 350-mm sets did not differ significantly from the percentages captured in the ground sets, (P = 0.45). Significantly more immature animals were captured in the 700-mm sets than on the ground (P < 01) (Figure 3).

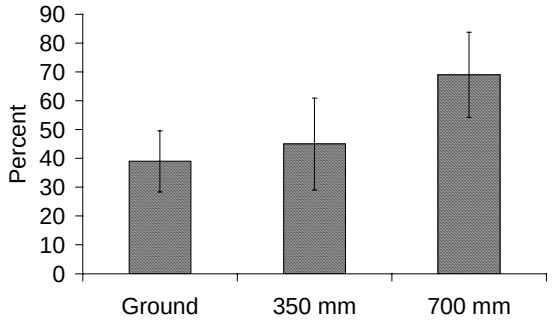

Figure 3. Percentages of immature possums caught in sets located at the three heights. (n = 84 for ground, n = 40 for 300-mm, and n = 40 for 700-mm heights, error bars are 95% C.L.s).

Percentages of possums with broken bones

There were no significant differences between traps set on the ground and raised to 350 mm in the percentage of caught possums that had broken bones (P = 0.12). Significantly more possums received broken bones when raised sets were used at 700 mm compared with the ground sets ($P < 0.01$) (Figure 4). Nine traps that captured possums at 350 mm and 700 mm remained attached to the brackets and 6 of these possums had broken bones most likely caused by possums being unable to fall to the ground following capture.

These estimates of the incidence of broken bones are likely to be conservative, as palpation of the leg bones was not able to detect hairline fractures that may have been present. A comparison of broken bones with a study that identified fractures using X-ray in addition to palpation (Warburton 1992) gave a broken bone incidence that was nearly twice this study when using ground set Victor No. 1 traps (11% c.f. 6% in this study).

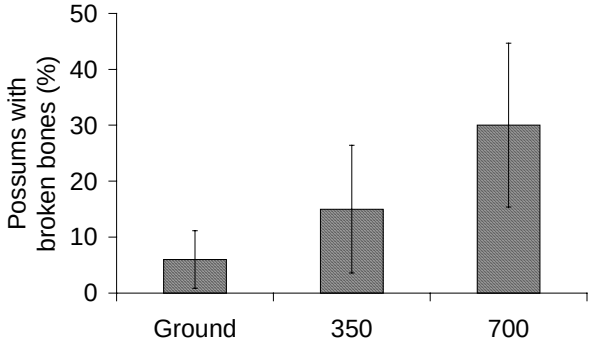

Figure 4. Percentages of possums captured that had broken bones. (n = 84 for ground, n = 40 for 350-mm, and n = 40 for 700-mm heights, error bars are 95% C.L.s).

Percentages of traps recording possum escapes

There were no significant differences in the percentages of possum escapes compared with traps set on the ground for traps set at 350 mm, (P = 0.48) and for traps sets set at 700 mm, (P = 0.68) (Figure 5).

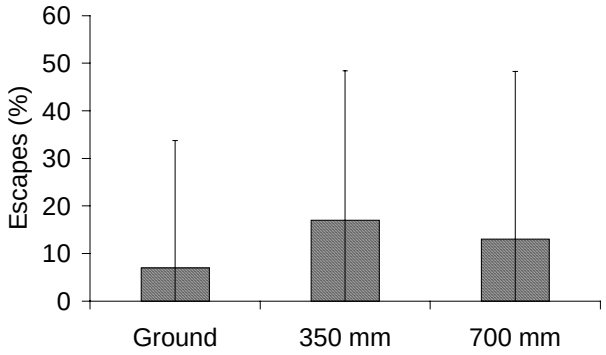

Figure 5. Percentages of traps recorded with possum escapes. (n = 6 for ground, n = 8 for 350-mm, and n = 6 for 700-mm respectively, error bars are 95% C.L.s).

Percentages of possums captured by the back leg

There were no significant differences in the percentages of possums captured by their back legs in traps set on the ground and raised-traps (P = 0.08 for 350 mm and P = 0.39 for 700 mm) (Figure 6).

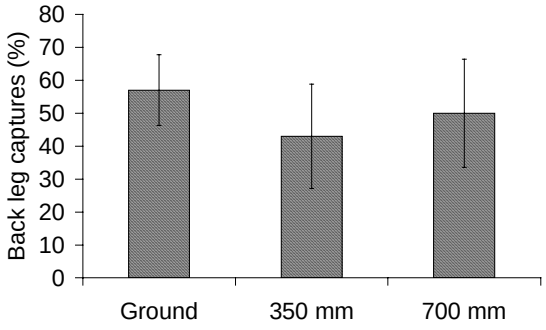

Figure 6. Percentages of possums captured by their back leg for the three trap-sets. (n = 84 for ground, n = 40 for 350-mm and n = 38 for 700-mm, error bars are 95% C.L.s).

5.3 Feasibility of using a calibration index

The calculated calibration indices and their associated estimated variances for the forest habitat and forest/pasture margin habitat are shown in Table 3.

Table 3. Calibration indices and variance for raised sets.

Set height	Forest		Forest/pasture margin	
	Ratio to ground	Variance	Ratio to ground	Variance
350 mm	1.36	0.36	2.42	3.81
700 mm	1.74	0.78	2.06	3.07

As an example of the use of these calibration indexes, the 700-mm data from Fiordland is 'corrected' using the index 1.74 and its variance of 0.78. The data gave

an ‘uncorrected’ RTC estimate of 5.71% with a variance of 29.23. The ‘corrected’ RTC estimate is calculated as follows:

$$\begin{aligned} \text{‘corrected’ RTC'} &= \text{‘uncorrected’ RTC} \times \text{index} \\ &= 5.71\% \times 1.74 \\ &= 9.935\% \end{aligned}$$

The precision, or reliability, of the corrected RTC needs to be calculated. This can be estimated by a 95% confidence interval. Firstly, the half width of the 95% confidence interval for the ‘uncorrected’ RTC is calculated:

$$\begin{aligned} CI_{\text{half-width}} &= t_{0.05/2,\,9} \times \text{se} \\ &= 2.26 \times \sqrt{(29.23/10)} \\ &= 3.86 \end{aligned}$$

Therefore the limits of the ‘uncorrected’ 95% confidence interval range from 1.85% to 9.58% (5.71% ±3.86%).

To calculate the 95% confidence interval of the ‘corrected’ RTC estimate the variance of the product of the RTC × index is used. Assuming the estimated RTC and calibration index are independent this is estimated using the method described by Mood et al. 1994:

$$\begin{aligned} \text{var}(\text{RTC} \times \text{index}) &= \text{RTC}^2\,\text{var}(\text{index}) + \text{index}^2\,\text{var}(\text{RTC}) + \text{var}(\text{index})\,\text{var}(\text{RTC}) \\ &= 5.71^2 \times 0.78 + 1.74^2 \times 29.23 + 0.78 \times 29.23 \\ &= 136.19 \end{aligned}$$

The half width of the 95% confidence interval of the ‘corrected’ RTC is estimated as:

$$\begin{aligned} CI_{\text{half-width}} &= t_{0.05/2,\,9} \times \text{se} \\ &= 2.26 \times \sqrt{(136.19/10)} \\ &= 8.34 \end{aligned}$$

The 95% confidence interval for the corrected RTC is now from 1.59% to 18.28%. The interval is more than twice as wide as the original ‘uncorrected’ RTC 95% confidence interval. The entire uncorrected interval is contained within the corrected interval (Figure 7).

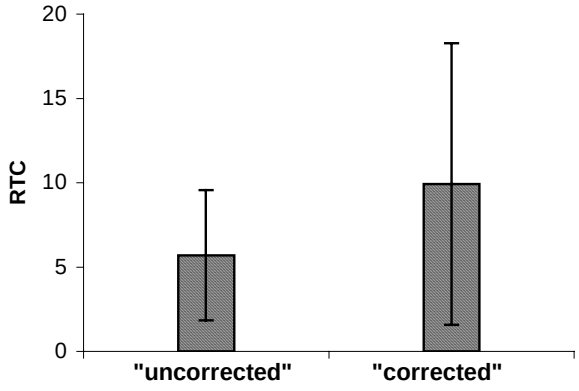

Figure 7. ‘Uncorrected’ and ‘corrected’ RTC *estimates from the Fiordland 700-mm raised set data and their associated 95% confidence intervals.*

6. Conclusions

Despite there being no statistically significant differences in capture rates between the ground and raised sets in the forest habitat, the trends in the capture data suggest that possum captures reduce when trap-sets are raised. It is likely that a larger sample size would have provided data to show that significant reductions do occur. These conclusions are consistent with a related study (Henderson et al. 1999) that showed that possums eat significantly less bait from bait stations that are raised above the ground compared with the amount eaten from bait stations at ground level. Consequently direct comparisons of raised-set RTC estimates with ground-set RTC estimates are likely to be invalid. However, in reality, the lack of precision and the large 95% confidence intervals associated with RTC estimates from low-density possum populations make comparisons between areas difficult, regardless of whether they are obtained from raised sets or not (see Brown & Thomas 2000). The use of alternative sampling devices that are able to provide larger sample sizes would improve the precision of population indices and increase the validity of regional comparisons (Brown & Thomas 2000). Also devices could be chosen that do not threaten the safety of native ground birds.

The increased error associated with applying a calibration index to 'correct' the RTC estimates from the raised-set data makes direct comparison with ground-set RTC estimates impractical. Typically, RTC estimates from low-density populations have wide 95% confidence intervals (Brown & Thomas 2000). The width of the 95% confidence interval will widen further when the calibration index and associated variance are used. When the increased width of the 95% confidence interval around the 'corrected' RTC estimate includes the estimate of the 'uncorrected' RTC, the effect of the adjustment is difficult to interpret.

The problem of an increased width of the 95% confidence interval when the calibration index is applied is due to the size of the estimated variance of the index. The variance could be reduced if a larger study were conducted, (i.e. more trap-lines). However, the cost of such a study would likely outweigh the advantages of having directly comparable results from ground- and raised-set possum monitoring operations. A more realistic approach would be to specify separate target levels for ground and raised-set monitoring. More immediate gains in monitoring consistency could be made by ensuring raised-set monitoring operations were comparable. DOC staff are using a range of devices and methods to set and lure raised traps and there are advantages in standardising these methods so that results can be comparable.

The capture of significantly more immature possums in the 700 mm sets compared with ground sets also suggests that direct comparisons between ground and raised sets may not be valid. Differences in capture rates could be due to some behavioural effect, e.g. immature possums may be more likely to climb trees to investigate the raised sets compared with mature possums.

The larger proportion of possums with broken bones raises humaneness issues when using raised sets. The high proportion of possums with broken bones in the traps that remained attached to the L-bracket suggests that the failure of the trap to be released from the raising device is the likely cause of the broken bones. In future, devices used to elevate traps will need to be tested to ensure they release the trap immediately after

a possum is captured if bone breakages are to remain at the same level as recorded from ground sets.

7. Recommendations

- Comparison of RTC estimates calculated from ground and raised sets should not be made without reference to their associated 95% confidence intervals.

- The use of a calibration index to 'correct' RTC estimates is not recommended because the error associated with calculating the index is likely to make the 95% confidence intervals larger. Separate target RTC's should be specified for ground and raised sets.

- Raising devices and methods for setting raised traps, including set height, should be standardised so that raised set operations are comparable.

- Studies should be undertaken to investigate the use of alternative monitoring devices that provide larger sample sizes and do not threaten native birds.

- A cost-effective raising device that gives similar incidences of broken bones as ground-set traps should be developed and tested.

8. Acknowledgements

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