Trap-catch for Monitoring Possum Populations

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1. Introduction

Monitoring the success of aerial or ground-based control programmes against possums is an integral part of most operational procedures. The reasons for monitoring possum populations and for justifying the necessary expenditure are varied, but may include the need to:

- know whether the control goals (e.g., 80% kill or a residual catch of 5%) are achieved;
- know whether the control funds are being spent efficiently;
- compare the cost-effectiveness of different control methods;
- determine the rate of population recovery and/or population trends;
- determine if control is necessary (i.e., if a 'trigger' level has been reached).

One method used for monitoring possum populations is based on numbers caught in leg-hold traps. The specific protocol followed by pest managers when carrying out trap-catch monitoring can vary (e.g., number of traps used, trap spacing), and potentially limits the extent to which the index can be compared between areas and operators.

The following protocol for using the trap-catch method for monitoring possum populations seeks to standardise the method used in New Zealand, to ensure:

- that minimum sampling standards are followed;
- that the results obtained are sufficiently robust to satisfy population sampling theory and management requirements;
- that the indices are obtained efficiently; and
- that variations between operators, area, and pest control agencies are minimised.

This report records the recommendations arising from a workshop on trap-catch methodologies held at Lincoln in September 1995 for the Animal Health Board. Representatives at the workshop were W. Fleury (Department of Conservation, Wanganui); C. Frampton (Centre for Computing and Biometrics, Lincoln University); R. Lorigan (Environment Waikato, Taupo); D. Meenken (Wellington Regional Council, Masterton); and R. Walker (MAF Quality Management, Invermay).

2. Background

Trap-catch methodologies have been used by pest managers and wildlife researchers throughout the world for many years to monitor the relative numbers of a wide range of small to medium-sized animals. The method commonly used for monitoring possum populations relies on a proportion of the individuals in a population being captured in leg-hold traps: the higher the average catch per trap over three nights, the higher the density. How robust the method is depends on how variable the capture probabilities of individuals are, particularly over time and/or at different densities. Some methods for analysing trap-catch data calculate capture probabilities, but current usage in New Zealand favours either percent catch or the mean number of possums caught per trap.

The usual aim of monitoring possum populations is to achieve an acceptable *accuracy* and *precision* of relative density or percent kill at minimal cost. For most possum control situations, a kill estimate with a precision of ± 10-15 % is acceptable, and sampling effort should be sufficient to achieve this outcome.

The protocol outlined below aims to standardise the trap-catch procedure, to ensure that sampling will achieve an acceptable level of *accuracy*, that precision will be within the desired limits of 10-15%, that observer biases are minimised, and that monitoring funds are spent efficiently.

3. Glossary of terms

The following terms are used commonly in this report and have been italicised when used.

Management area	-	the total area within which possums are to be managed. It may include areas other than typical possum habitat (e.g., areas of developed pasture).
Treatment area	-	the part of the management area that will be directly treated with poison or traps.
Non-treatment area	-	an experimental control area used to monitor natural changes in possum numbers or changes in behaviour.
Strata	-	parts of the treatment area that have clearly different possum densities (often because of vegetation differences) or are receiving different control methods.
Trap-site	-	a tree, fence post, log, or other attachment site that will hold a fence staple
Trap-patch	-	an area of possum habitat on farmland which has been defined as being large enough to take a 20-trap sampling line.
Trap-night	-	trapping effort represented by one trap set for one night.
Lure	-	usually a mixture of flour, icing sugar, and a flavouring agent.
Index (population)	-	a number that relates to population density, but is not the actual density.
% kill	-	the percentage of a population killed during a control operation (100 minus % survival).
% survival	-	the percentage of a population surviving a control operation.

Residual catch	-	the *index* (e.g., % catch) obtained following a control operation; it is the same as the post-control catch.
Accuracy	-	how close the estimated kill is to the actual kill.
Precision	-	a measure of how much the kill estimate would vary if monitoring was repeated. The better the precision the smaller the confidence limits.
Confidence limits (95%)	-	the lower and upper values within which the true kill will lie in 95% of instances.

4. Method

Step:

4.1 Define the *management area*

Draw on a map the outer limits of the *management area* in which possum density is to be assessed. This area need not include a *non-treatment area* as the trap-catch method assumes that the chance of catching a possum does not change significantly between the pre- and post-control monitoring.

4.2 Define the *treatment area*

If the *management area* is not uniform possum habitat, and only parts of it will be poisoned or trapped, divide it into *treatment area* and non-treatment area (not the same as an experimental control non-treatment area). If all the management area is to be controlled, then *management area = treatment area.*

4.3 Stratification

If the *treatment area* is to receive different control methods in different parts (e.g., aerial 1080 and ground hunters), then separate the *treatment area* into *strata* based on the control method used. Where the *treatment area* has different habitats likely to contain significantly different possum densities, then separate the *treatment area* and/or *strata* (previously selected on the basis of the control method) into *strata* based on habitat differences. Divide the *treatment area* into *strata* only where any one *stratum* makes up more than 10% of the total *treatment area,* unless the *strata* are based on different control methods.

4.4 Number of traps

The number of traps, lines of traps, and how the traps and/or lines are distributed across the area to be monitored cannot be rigidly set for all operations because of variations in:

- the homogeneity (uniformity) of the possum population through the treatment area;
- the uniformity of the kill achieved over the treatment area;

- the actual kill achieved;
- the practical limitations of access to all parts of the area for locating individual traps or the start of trap lines.

The recommended number of traps and of lines is based on the level of precision that has been achieved in past operations (Table 1).

Table 1. Currently recommended minimum numbers of traps for monitoring possum populations.

Size of *treatment area* (ha)	**Option 1** **Where the %kill is likely to be >80% over the total *treatment area* (i.e., using aerial baiting with GPS)**	**Option 2** **Where the % kill is likely to be <80% and/or the control treatment is not uniform (i.e., contract hunters, GPS not used, poor weather likely)**
< 50	40	40
50-100	50	50
101-500	100	100
501-1000	200	200
1001-5000	200	400
5001-10 000	300	Add 100 traps for each additional 2000 ha
>10 000	400	

4.5 Number of traps and lines

Each line should contain a maximum of twenty traps. The number of lines should not be less than five, and should be maximised, with more lines of fewer traps used where possible. The selected number of traps and lines must remain consistent between pre-control and post-control population assessments. If capture rates are to be compared between operations or between areas, then the choice of trap number per line must be restricted to 20.

4.6 Placement of lines

The sampling design chosen will be based on key assumptions that influence the analysis of the results. These assumptions should be understood before progressing further.

The sampling units (trap-lines) must be located in the *treatment area* independently of the population or the treatment. Ideally, all traps should be located randomly (i.e., each trap-line comprising a single trap), but because this is quite impractical and not cost-effective one of

two other sampling methods based on trap-lines must be used. The first method is preferable; however, practicalities and cost may dictate that method 2 is used, although the results will be less precise. Method 2 must only be used if the random location of lines poses unacceptably high monitoring costs, and only in areas that require more than 5 trap lines. For smaller areas, all lines should be randomly located.

Method 1. Randomly locate the origin of each trap-line (see section 4.7). For analysis, the line is the sampling unit, not the trap.

Method 2. Where random location of lines is not practical, cluster 2 or 3 lines about a randomly located point and locate each line within the cluster so that one person can check more than one trap-line per day. It is important that the lines within the randomly located clusters are >200 m apart to ensure that they are not affecting the catch on other lines. The cluster then becomes the sampling unit, not the individual lines.

4.7 Random selection of starting points

On a map of the *treatment area*, use either the map grid squares or the North/South and East/West axes to select starting points of lines. If using the grid squares, number each of them randomly to select the numbers required. If a random number generator is not available simply write the numbers on separate pieces of paper and select them as in a lottery. If you use the axes, number each 200-500-m point along the axes (the scale will depend on the size of the treatment area) and then select two random numbers (one for the north/south and one for the east/west). If you use grid squares, randomly locate the starting point within the grid square by using a random selection of distances along the north/south and east/west axes of each square. It is not necessary to randomly choose compass bearings, but the bearing chosen should be the same for all lines (i.e., do not choose a direction for each line such that the line samples the easiest country for the trapper to walk through). To ensure that lines are spread throughout the *treatment area*, divide the area into 2-4 blocks and randomly locate lines within these blocks. If the selected starting point and compass bearing results in the trap-line being located within 200 m of another line, or outside the *treatment area*, pick a new random starting point.

Randomly select the starting points for the pre-control lines first, and then:

(1) if the control area is large enough, place the post-control lines parallel to, but spaced 200-250 m from the pre-control lines (i.e., as pre- and post-control pairs); or

(2) if the area being monitored is too narrow to enable parallel lines to be used, then randomly select starting points as for the pre-control lines.

Where the *treatment area* has been divided into *strata*, ensure that the proportion of lines allocated to each stratum is in the same proportion as the *strata* contribute to the total *treatment area* (i.e., if a *treatment area* is divided into two *strata*, one making up 30% of the area and the other 70%, then place 30% and 70% of the lines in these strata respectively).

When monitoring a area with scattered patches of scrub or forest (e.g., bush gullies or isolated possum habitat on farmland), more than one patch may have to be used before 20 traps can be set. Each of these *trap-patches* (either a single or several patches of possum habitat) can then be randomly selected.

All lines should follow a compass bearing, to avoid concentrating sampling in easily accessible areas. This requirement can be waived only when trapping narrow or small patches of possum habitat on farmland, where the lines must follow the distribution of the limited trappable habitat.

4.8 Trapping

Traps should be set at 20-m intervals on the *trap-site* (i.e., the nearest tree or fence post that will hold a fence staple). Do not search for possum sign before or after measuring off the 20 m and adjust your trap spacing accordingly. Hipchains are recommended for measuring the distance between traps. If these are not available, then pacing out the distance will suffice **provided** that the operator does not search for possum sign and allow this to influence trap spacing.

Victor No.1 unpadded traps should be used wherever possible. If others must be used because of availability, ensure that the same trap type is used for pre-control and post-control surveys in each management area. The same trappers should also be employed.

Lures may be used, but any lure used in the control operation (generally cinnamon) must be avoided. Spread flour lure behind the trap up the trunk of the tree for 10-20 cm to make a white blaze.

If monitoring is being carried out on Department of Conservation (DoC) land or where kiwi and/or weka occur, follow the DoC guidelines for setting traps. The effect of modified trap sets on capture rates of possums is unknown, therefore comparisons of capture rates should not be attempted between areas, and especially not between pre-control and post-control operations where the trap-set types have been changed.

Where Victor No.1 traps are used, the trigger plate tension should be adjusted to a release pressure of 500 g. This will minimise the number of non-target captures, especially of rats.

4.9 Trap checking

Traps must be run for three fine nights (i.e. with weather unlikely to significantly influence possum activity) and checked daily. Although it is not always possible to predict stable fine weather, long-range forecasts should be used to maximise the chances of achieving this requirement. If trapping has started and rain falls on the third night, then trap-catch from the first two nights can be used for calculating an *index* of density. If it rains heavily on the second night, and catch rate is likely to be significantly reduced, then monitoring should be started again using a new set of pre-control lines.

All possums and non-target species must be killed as quickly as possible and removed from the trap; leave carcasses at least 5 m from the *trap-site.* If non-target native species are caught uninjured or with only minor injuries (i.e., no broken limbs), then release them. Seriously injured or dead native birds should be taken to the nearest DoC office if possible.

4.10 Recording

Trapping results must be recorded daily on a standardised form (see Appendix 1). For practical convenience recording in the field can be done on a note pad, but records must then be transcribed onto the standardised form, preferably at the end of each day's work to minimise the possibility of errors.

4.11 Reporting

Reporting of monitoring results should be standardised to ensure that all relevant information is recorded and filed. A coversheet should accompany all reporting, and include:

- name of the area;
- size of the *management* and/or *treatment area*;
- date of pre-control monitoring;
- date of post-control monitoring;
- date(s) of control operation;
- control operation type (aerial 1080/contract hunters/other);
- names of staff responsible for monitoring;
- copy of weather forecast for monitoring periods;
- trap type used;
- set type used;
- number of lines and compass bearing;
- map with location of trap-lines;
- trap spacing;
- lure used;
- number of traps per line;
- number of *trap-nights*;
- weather on each *trap-night.*

The report should include:

- name of staff/organisation who calculated the *percent kill* and *confidence limits*;
- *percent kill* and/or *percent survival;*
- *confidence limits*;
- the status of the current population in relation to initial starting *index,* if appropriate (i.e., for maintenance control in Tb areas). Graph this, if a series of monitoring surveys has been carried out.

5. Residual catch

If trap-catch monitoring is used to estimate the residual population following control, then the above protocol can be used for this. The choice of what *residual catch* is required to achieve a particular management outcome is outside the scope of this protocol.

6. Maintenance monitoring

Currently, possum populations receiving ongoing maintenance control are monitored at about 12-month intervals. To improve the robustness of the monitoring it is preferable to trap at the same sites each year. However, it is not known if three nights' trapping will have a significant effect on the recovery rate of a possum population about a trap-line. Consequently, maintenance monitoring should be carried out on new randomly selected lines each year. If the size of the area is limiting, then lines can be repeated after three years on the assumption that the possum population will have recovered from any trapping effect.

Appendix 1: Standardised trap-catch summary recording form

TRAP-CATCH DATA COVERSHEET

Area name:_____ **Area size:**_____

Survey period:_____ **Date of control operation:**_____

Survey: pre-control/post-control/maintenance(circle one)

Operator:_____ **Number of lines:**_____

Trap type(s) used:_____ **Lure used:** _____

Trap spacing:_____ **Trap-set used** (ground/leaning board):_____

_____**Compass bearing (if constant):**_____

Summary Table

Line	Number of traps set	Number of traps sprung, empty and non-targets	Number of possums	Weather	
1				Night 1	
2				Night 2	
3				Night 3	
4				Notes:	
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Appendix 2: Standardised trap-catch daily recording form

TRAP-CATCH DATA RECORD SHEET

Area:_____ **Survey period:**_____

Survey: pre-control/post-control/maintenance (circle one)

Trap	Line no.: Operator: Night 1	2	3	Trap	Line no.: Operator: Night 1	2	3	Trap	Line no.: Operator: Night 1	2	3
1				1				1			
2				2				2			
3				3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Codes: P = possum; S = sprung but empty; B = bird; R = rat; H = hedgehog; O = other.

Appendix 3: Method for analysing trap-catch data.

Follow the steps below for the pre- and post-control monitoring.

(1) For each line, count the total number of possums captured.

(2) If the number of traps is the same for all lines then use the number of possums captured per line. If the number of traps varies between lines because of unforeseen problems, then divide the number of possums captured on each line by the number of traps on the line (this will give you the mean number of possums captured per trap).

(3) Using either the total possums captured per line or the mean number captured per trap, calculate the mean catch per line. That is:

Example 1. Equal trap numbers on all trap-lines.

Line	Number of traps	Possums captured
1	20	20
2	20	43
3	20	22
4	20	18
5	20	13
Total	100	115
$Mean_{pre}$ 115/5 = 23.2 (5 = no. of lines)		

Example 2. Unequal trap numbers on trap-lines.

Line	Number of traps	Possums captured	Mean possums captured per trap
1	20	20	1.0
2	18	43	2.39
3	19	22	1.16
4	20	18	0.9
5	17	13	0.76
Total	94	115	6.21
$Mean_{pre}$ = 1.24			

(4) Repeat steps 1-3 for post-control monitoring (i.e., determine $Mean_{post}$).

(5) Calculate the % kill thus:

(Appendix 3 Cont.)

$$\%\ kill = \left(1 - \frac{Mean_{Post}}{Mean_{Pre}}\right) 100$$

(6) Calculate the confidence intervals for the % kill.

You need to calculate the standard error (se) of the mean number of possums before you can calculate the standard error of the % kill. The standard error (se) is the standard deviation divided by the square root of the number of lines. For example, using the data in the example 1 table, enter each of the 'possum captured' values into a calculator that can calculate the standard deviation (sd). Thus, for example 1, the sd = 11.563 and the se = $11.563/\sqrt{5}$ = 5.171. On Casio calculators sd is represented by the σ_{n-1} key not σ_n, and on Sharp calculators by S_x not σ_x.

Thus, standard error of the % kill =

$$\sqrt{\left[\frac{se_{post}^2}{mean_{pre}^2}\right] + \left[\frac{\left(se_{pre}^2\right)\left(mean_{post}^2\right)}{mean_{pre}^4}\right]}$$

(7) The 95% confidence limits for the % kill are therefore:

% kill ± 1.96 x standard error of the % kill.