# Animal pests: residual trap catch index for possums

Version 1.0

This specification was prepared by Al Glen in 2014.

## Contents







Department of Conservation
*Te Papa Atawhai*

# Synopsis

Monitoring of possum numbers is important to decide where and when to do control, and to determine whether control has been effective (Thomas et al. 2003). A relationship between percentage trap-catch and relative possum density was first reported by Batcheler et al. (1967). Various leg-hold trapping index methods were used until a standard protocol was developed in 1996 (Thomas et al. 2003). This method specification explains the method broadly. For detailed, step-by-step instructions, readers should consult the National Pest Control Agencies (NPCA) guidelines[1] (NPCA 2011).

Residual trap catch index (RTCI) was developed to provide a standardised method for estimating relative densities of possums (NPCA 2011). RTCI is the percentage of trap-nights in which a possum was captured. It is expressed as a mean with associated estimates of variation (e.g. range or confidence intervals) (NPCA 2011).

By estimating RTCI before and after a possum control operation it is possible to estimate the percentage kill rate with associated confidence intervals. RTCI estimates are often used as performance assessment criteria for contractors doing possum control (NPCA 2011), to decide when to initiate control, and to decide whether a possum control operation has met its targets, or follow-up control is needed (Brown & Thomas 2000). The level of population reduction required depends on the conservation values being protected. RTCI targets in conservation operations are typically < 3% or < 5%. Possum abundance indices are most informative when complemented by data on damage caused by possums (e.g. Sweetapple et al. 2002; Gormley et al. 2012). Possum abundance and impacts should therefore be monitored together in an integrated monitoring programme. Residual possum densities required for conservation will vary depending on how sensitive local species/ecosystems are to possum impacts (Reddiex et al. 2007). For example, RTCI of 3% or less was required to protect mistletoe at Hauhungaroa (Sweetapple et al. 2002); common broadleaf species at Matamateaonga could tolerate possum densities up to 25% RTCI (Nugent et al. 2001).

# Assumptions

- Trap lines are placed randomly within suitable habitat.
- Trapping is conducted in fine weather.
- The relationship between the index and abundance or density is linear. This assumption is unlikely to hold true when possum density is very high or very low (see ‘Disadvantages’).
- A constant fraction of individuals is counted between areas at the same time, between areas over time, or within an area over time if survey conditions are standardised.
- The population remains demographically closed throughout the survey period.

[1] http://www.npca.org.nz/index.php/publications/a-best-practice

## Advantages

- May be sufficient to describe basic biological patterns.
- May be useful for comparative inference if strong assumptions about equal detection rates are met.
- Despite some behavioural differences following a control operation, very few possums are consistently untrappable (Morgan et al. 2007).
- RTCI results are useful for predicting management outcomes such as reduced damage to native vegetation (e.g. Sweetapple et al. 2002; Gormley et al. 2012).
- Can be used to monitor effectiveness of possum control.

## Disadvantages

- This method does not adjust for incomplete detectability, and may give spurious results without adjusting for variation in detectability.
- Although many factors affecting detectability can be controlled by standardisation of methods and designs (e.g. season, time of day, observer, species, effort), many factors (e.g. breeding status, density, etc.) cannot.
- Great care is required when interpreting trends derived from indices, particularly for small populations. When possums are at very low density (RTCI < 2%), trapping data contain many zeroes, which creates problems for statistical analysis (Brown & Thomas 2000; Forsyth et al. 2003).
- Trapping is expensive, labour-intensive, and the bulk and weight of traps prevents large numbers from being set, which limits the precision of trapping results (Thomas et al. 2003).
- Spatial coverage of trapping may be interrupted by human dwellings or landforms such as deep gullies, cliffs, etc.
- The relationship between RTCI and density is approximately linear when RTCI is around 5%. However, at much higher (> 10%) or lower (< 2%) densities, the relationship is not linear, thus violating the assumptions of a population index (Forsyth et al. 2003).
- Capture probability varies seasonally (Forsyth et al. 2003).
- Changes in possum home range size and trappability could influence the rates at which they encounter and interact with traps (Arthur et al. 2002). There is potential for RTCI to underestimate post-control densities of possums if surviving animals tend to be less trappable (Arthur et al. 2002; Forsyth et al. 2003; Monks & Tompkins 2012; Rouco et al. 2013). The likelihood of this can be reduced by waiting approximately 2 months after control before trapping (e.g. Bishop 2010).
- The standard procedure of correcting the number of trap nights by 0.5 for every sprung trap probably underestimates the effects of trap interference. However, this is unlikely to have a substantial effect on RTCI estimates (Cowan & Forrester 2012).
- Non-target species, e.g. ground birds, are at risk of being caught.

## Suitability for inventory

It is appropriate to use this method in the following situations for inventory:

- When information is sought on:
  - Presence and/or distribution of possums within an area (except where possums are expected to be at very low density)
  - The approximate abundance of possums (e.g. high, low, very low) as opposed to a precise population estimate
- When there is little risk of capturing domestic animals and native birds
- When permission to trap is obtained from occupiers of any dwellings within 150 m

## Suitability for monitoring

It is appropriate to use this method in the following situations for monitoring:

- When information is sought on:
  - The need for possum control
  - The effectiveness of previous possum control
  - Trends in possum abundance over time at the same site
- To monitor population trends over time the same lines should be used each time. Sampling should be repeated no more than once per year, in the same season each time (Forsyth et al. 2003; NPCA 2011).
- When kiwi and weka are not present.

## Skills

This method requires the following skills and training. Training courses are available from the NPCA.

### Designing a monitoring programme

Staff preparing field plans will require computing skills, e.g. Excel, Word, geographic information systems (GIS).

### Field monitoring

Field staff will require skills in:

- Maintaining and operating leg-hold traps
- Navigating in the field using maps, compass, hip chain and/or GIS
- Handling animals and humanely despatching introduced or badly injured animals

### Information management

Staff involved in collating and analysing monitoring data will require skills in:

- Collating, analysing and storing data using Excel
- Word processing
- Preparing scientific reports

## Resources

### Designing a monitoring programme

- If working on conservation estate, a trapping permit must be obtained from DOC (does not apply to DOC trapping operations).

### Field monitoring

- Leg-hold traps (No.1 double-coil spring traps)
- GPS and/or maps, compass and hip chain
- Backing boards (where suitable trees or logs are not available for setting traps)
- Leaning boards or other brackets (where raised sets are required due to presence of kiwi or weka)
- Scales able to measure an 800-g animal, accurate to within 50 g
- Heavy duty pack (for carrying traps)
- Notebook and pencil
- Flagging tape
- Hammer and nails
- Other equipment appropriate to field conditions (tent, etc.)

### Information management

- Computer with data analysis software (e.g. Excel, R)
- Data storage/backup facilities (e.g. external hard drives, server)

## Minimum attributes

Consistent measurement and recording of these attributes is critical for the implementation of the method. Other attributes may be optional depending on your objective. For more information refer to 'Full details of technique and best practice'.

DOC staff must complete a 'Standard inventory and monitoring project plan' (docdm-146272).

Three nights of trapping are required so that results from different studies are comparable (Webster et al. 1999).

A standardised trapping datasheet is provided in the NPCA guidelines (NPCA 2011, p. 25). Minimum data to record include:

- Name of field operator
- Location of start of trap line, and direction of the line
- Monitoring period
- Trap line number
- Stratum
- Habitat
- Survey type (pre-control / post-control / maintenance)
- Date of each trapping night, and whether rain fell on that night
- Trapping outcome for each trap

Possible trapping outcomes and the way they should be recorded are listed in the NPCA guidelines (NPCA 2011, p. 24). Weight must be accurately recorded for any possum classed as a back rider. These are normally less than 800 g but the definition may vary and should be stated in the field plan (NPCA 2011).

Trap records should be recorded on paper or electronically, and should be accompanied by written details of any other relevant information, e.g. weather events, reasons for discarding planned trap lines or deviating from planned compass bearing (NPCA 2011).

# Data storage

Original data records should be retained along with any explanatory information (metadata) necessary to understand the dataset. The final report should state where the original data and any associated analysis material are stored (NPCA 2011).

Forward copies of completed survey sheets to the survey administrator, or enter data into an appropriate spreadsheet as soon as possible. Collate, consolidate and store survey information securely, also as soon as possible, and preferably immediately on return from the field. The key steps here are data entry, storage and maintenance for later analysis, followed by copying and data backup for security.

Summarise the results in a spreadsheet or equivalent. Arrange data as ‘column variables’—i.e. arrange data from each field on the data sheet (date, time, location, plot designation, number seen, identity, etc.) in columns, with each row representing the occasion on which a given survey point was sampled.

If data storage is designed well at the outset, it will make the job of analysis and interpretation much easier. Before storing data, check for missing information and errors, and ensure metadata are recorded.

Storage tools can be either manual or electronic systems (or both, preferably). They will usually be summary sheets, other physical filing systems, or electronic spreadsheets and databases. Use appropriate file formats such as .xls, .txt, .dbf or specific analysis software formats. Copy and/or backup all data, whether electronic, data sheets, metadata or site access descriptions, preferably offline if the primary storage location is part of a networked system. Store the copy at a separate location for security purposes.

# Analysis, interpretation and reporting

Standardised analysis and interpretation allows comparisons to be made at different sites and at different times. Follow these instructions when analysing and interpreting data.

## Calculating Residual Trap Catch Index

RTCI can be calculated automatically using an Excel spreadsheet, which is freely available from NPCA online.[2] The spreadsheet is designed for trained users who hold a possum population monitoring Designer's Certificate. Detailed instructions to calculate RTCI manually are provided in the NPCA guidelines (NPCA 2011, pp. 28–30). It is recommended that RTCI figures be rounded to one decimal place (NPCA 2011). Seek statistical advice from a biometrician or suitably experienced person prior to undertaking any analysis.

Decisions should not be based on RTCI without also considering confidence intervals (Brown & Thomas 2000). Confidence intervals are estimated by the Excel spreadsheet referred to above. However, a number of authors have found shortcomings with the standard method. For example, the method has a tendency to underestimate the upper and lower confidence limits (Brown & Thomas 2000; Coleman & Morgan 2002). The standard protocol can also deliver a lower confidence interval that is negative or zero, which does not make biological sense (e.g. Commins 2005). A variety of bootstrap methods are available that can avoid these problems (Brown & Thomas 2000; Webster & Caley 2001). It is recommended that the standard protocol (and the Excel spreadsheet for automatic caculation of RTCI) be altered to use Hall's skewness-corrected confidence intervals (Hall 1992; Webster & Caley 2001).

Ramsey & Ball (2004) found that RTCI increased in a linear fashion with possum density between 0.1 and 2.0 possums per hectare (roughly equivalent to RTCI between 1% and 10%). Therefore patterns in RTCI can only be interpreted within this range. RTCI values outside this range can still indicate whether possum density is high or low, but cannot be interpreted more precisely, e.g. if RTCI = 60 this does not mean possum density is twice as high as an area where RTCI = 30. At very low population densities (e.g. RTCI < 2%) it may be more appropriate to measure the proportion of

[2] http://www.npca.org.nz/index.php/templates/rtci-calculation (Note: raw data must be stored separately – this spreadsheet is for data analysis, not storage)

a survey area that contains possums instead of relying on RTCI (Brown & Thomas 2000). Zero trap-catch indicates a 99% probability that the true population is < 1% RTCI (Ramsey & Ball 2004).

The precision of RTCI estimates can be improved by using higher numbers of shorter trap lines (Webster et al. 1999; Ramsey & Ball 2004); however, this can increase costs. Therefore the standard protocol is recommended in most cases as a reasonable compromise between cost and precision. However, increased numbers of trap lines can be considered if the population is known to be highly patchy.

# Case study A

**Case study A: RTCI results after controlling possums in 25,000 ha in Waitutu, Fiordland National Park**

## Synopsis

In 2010, possum control was carried out over 25,000 ha of Waitutu Forest, Fiordland National Park, using 1080 bait distributed from aircraft. The relative abundance of possums was estimated using the NPCA protocol before and after control. Before control, trap catch was 13.5 ± 3.4%. RTCI after control was 0.1 ± 0.0%, indicating a kill rate of 99.5%.

## Objectives

- To monitor possum distribution and abundance in the Waitutu Forest, Fiordland National Park, before and after a control operation.

## Sampling design and methods

In 2009, four sample areas were chosen to represent the range of topography, aspect and vegetation types in the north of the Waitutu Forest. Each sample area was 230–350 ha in size, and contained five lines of ten traps. Trap catch was monitored over 3 fine nights in March 2009. Results were analysed using the RTCI calculation template available through the NPCA website[3] (Jacques 2009).

In October 2010, possum control was carried out using baits distributed by aircraft over 25 000 ha of Waitutu Forest. Initially the area was pre-fed with cereal baits at a rate of 1 kg/ha. Cereal baits containing 1080 poison were then applied at 2 kg/ha (Bishop 2010).

After control, RTCI was monitored using the standard methods set out in the NPCA protocol. Post-control monitoring was conducted around 2 months after the poisoning operation. This timing was planned to minimise the possibility that RTCI would be biased low (e.g. due to temporary trap-shyness) while still taking place before possums had an opportunity to reinvade the control area (Bishop 2010). Traps were set along 55 lines with randomly generated starting points in six sample areas. The sample areas were chosen to give broad coverage of the control area, sample most

[3] http://www.npca.org.nz/index.php/templates/rtci-calculation

habitat types, and to take advantage of existing infrastructure and helicopter landing sites (Bishop 2010).

### Results

Before possum control, the average RTCI over the four sample areas was 13.5 ± 3.4%. Possums appeared to be more abundant in some areas than others; RTCI in individual areas ranged from 8.7 ± 3.4% to 17.5 ± 7.1% (Jacques 2009). After possum control, only one possum was trapped across all six sampling areas, giving an RTCI of 0.1 ± 0.0% and a kill rate of 99.5% (Bishop 2010).

### Limitations and points to consider

While the results reported here indicate that control was highly successful in reducing possum numbers, additional monitoring would be required to determine whether this had positive outcomes for conservation values in the control area. Case study B provides an example of biodiversity benefits associated with reduced RTCI.

### References for case study A

Bishop, C. 2010: Waitutu post control possum monitoring 2010. Department of Conservation, Wellington (unpublished). DOCDM-792427

Jacques, P. 2009: Waitutu possum monitor March 2009 report. Department of Conservation, Wellington (unpublished). DOCDM-416965

## Case study B

**Case study B: Native mistletoe species are particularly sensitive to possum browse. This case study describes the relationship between possum abundances (as assessed by RTCI) and *Tupeia antarctica* populations.**

### Synopsis

Browsing by possums has been a factor in declines of mistletoe species in New Zealand (Payton 2000). Sweetapple et al. (2002) described changes in a population of mistletoe (*Tupeia antarctica*) plants before and after a possum poisoning operation in the central North Island. The relative abundance of possums before and after control was estimated using RTCI. Browse was low on mistletoe after possum control had reduced possums to low RTCI levels. As the possum population recovered, RTCI increased steadily and browsing impacts on mistletoe increased significantly.

### Objectives

- To determine the effects of possum control (and subsequent possum population recovery) on a population of mistletoe.

## Sampling design and methods

Sweetapple et al. (2002) estimated the relative abundance of possums in Pureora Forest Park, central North Island, before and after possums were controlled using poison baits. In 1994, prior to possum control, six transects of 23 traps were used according to the standard trap-catch method (Warburton 1996). After the control operation, trapping was repeated in 1995 and then each year from 1998–2000 using 4–12 transects of 20 or 23 traps (Sweetapple et al. 2002).

Mistletoe plants were located by systematic searches, and monitoring plots were established around each of 13 host trees found. Accessible plants were marked and measured. Where possible, the same plants were re-measured after 1 and 2 years. Mistletoe plants that could not be reached were visually assessed for foliage cover, possum browse damage and number of fruits present (Sweetapple et al. 2002).

## Results

The capture rate of possums fell from 24.2% before the control operation to 0% immediately after. RTCI steadily increased over the following 5 years to 7.7% (Sweetapple et al. 2002). Mistletoe plants were first detected in 1995, the year after the control operation.

As possum numbers recovered after control, the percentage of mistletoe plants browsed by possums increased from 3% to 76%. Over the same period, foliage cover of mistletoe fell from 50% to 16%, while the mean size of plants declined by over 50%.

## Limitations and points to consider

Although RTCI of possums fell markedly after control and increased over the following years, the study did not report confidence intervals associated with these estimates. However, the differences in RTCI between years were statistically significant (Sweetapple et al. 2002). RTCI was not monitored using the exact numbers of trap lines and traps per line recommended in these guidelines. However, this study illustrates the value of measuring outcomes (biodiversity responses) as well as results (changes in possum numbers).

## References for case study B

Payton, I. 2000: Damage to native forests. Pp. 111–125 in Montague, T.L. (Ed.): The brushtail possum: biology, impact and management of an introduced marsupial. Manaaki Whenua Press, Lincoln.

Sweetapple, P.J.; Nugent, G.; Whitford, J.; Knightbridge, P.I. 2002: Mistletoe (*Tupeia antarctica*) recovery and decline following possum control in a New Zealand forest. *New Zealand Journal of Ecology 26*: 61–71.

Warburton, B. 1996: Trap-catch for monitoring possum populations. Landcare Research, Lincoln.

# Full details of technique and best practice

Below we briefly outline the process for measuring and using RTCI. For detailed, step-by-step instructions, readers should consult the NPCA guidelines (NPCA 2011).

We include greater detail only where variations to the NPCA guidelines are recommended.

## Planning

Define the area to be monitored and its size in hectares. RTCI will be estimated based on traps placed within this boundary (NPCA 2011). If there are clearly identifiable areas in which possum density is likely to be different, the management area may be divided into strata (e.g. based on habitat types). The default habitat classes for stratification are:

1. Continuous habitat (e.g. large forest or tussock areas)
2. Farmland (other areas characterised by patchy habitat)
3. Bush-pasture margins

Each stratum is marked on the map, and its area calculated in hectares.

The area of potential possum habitat (anywhere that possums may be able to nest) is calculated to determine the number of trap lines needed (NPCA 2011). The NPCA guidelines (NPCA 2011, pp. 6–8) contain detailed procedures for estimating habitat area in continuous habitat, farmland and bush-pasture margins.

Trapping normally takes place over 3 nights with each trap line consisting of 10 traps spaced 20 m apart. However, this can be varied for logistical reasons, and the NPCA guidelines include a table with different numbers of trapping nights, trapping lines and traps per line that will provide similar precision (NPCA 2011, p. 8). There are also detailed instructions as to the minimum number of trap lines required in different situations (NPCA 2011).

Once the locations of trap lines have been chosen, a field plan is written for operational staff. This details whether line placement is random or systematic, assigns each line to a stratum, and provides map coordinates for each line (NPCA 2011).

## Trapping procedures

Trapping is carried out using No. 1 double-coil spring traps, and trap lures are a mixture of flour and icing sugar spread in a strip (or ‘blaze’) above the trap (NPCA 2011). The trap site should be cleared of any vegetation that may entangle a trapped possum (NPCA 2011).

Leg-hold traps can harm native birds, and are not recommended for use in areas where kiwi (*Apteryx* spp.) or weka (*Gallirallus australis*) occur. The risk of capturing ground birds can be reduced by setting traps on a platform above the ground (NPCA 2011). However, traps set in this way have lower capture rates than traps set on the ground (Thomas & Brown 2000; Thomas et al. 2003; Nugent et al. 2010). Leg-hold trapping also involves risks to the welfare of possums as bones can be broken.

Kea (*Nestor notabilis*) are also a non-target species that are occasionally captured in leg-hold traps, although this is uncommon. To minimise risk to kea it is recommended not to use traps in non-forested sub-alpine environments where kea are known to occur. Alternative index methods are available to estimate possum abundance in these areas. In forested areas, risk to kea can also be minimised by ensuring that possum carcasses are not left near trap lines, as these can attract kea.

Trapping should continue for 3 nights of fine weather (defined as no rainfall within 4 h after dark), and traps must be checked daily within 12 h of sunrise (NPCA 2011). If any native birds are captured these should be released unless they are severely injured (e.g. broken limb). Dead or seriously injured native birds should be taken to the nearest DOC office (NPCA 2011).

In tussock grasslands, where there is a lack of trees on which to place a blaze of flour and icing sugar, backing boards should be used instead. These are roughly twice as effective at catching possums as traps where the lure is placed on the ground (Warburton & Yockney 2009).

## References and further reading

Arthur, T.; Ramsey, D.; Efford, M. 2002: Changes in possum behaviour at reduced density–a review. Contract Report LC0102/102. Landcare Research, Lincoln.

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Bishop, C. 2010: Waitutu Post Control Possum Monitoring 2010. Department of Conservation, Wellington (unpublished). DOCDM-792427

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Sweetapple, P.J.; Nugent, G.; Whitford, J.; Knightbridge, P.I. 2002: Mistletoe (*Tupeia antarctica*) recovery and decline following possum control in a New Zealand forest. *New Zealand Journal of Ecology 26*: 61–71.

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# Appendix A

The following Department of Conservation documents are referred to in this method:

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|---|---|
| docdm-146272 | Standard inventory and monitoring project plan |
| docdm-416965 | Waitutu possum monitor March 2009 report |
| docdm-792427 | Waitutu post control possum monitoring 2010 |