Animal pests: tracking tunnel indices of small mammal abundance

Version 1.0

This specification was prepared by Craig Gillies in 2013.

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Inventory and monitoring toolbox: animal pests

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Department of Conservation
Te Papa Atawhai

Synopsis

This is an overview of the best practice guide for DOC staff to follow when using tracking tunnels to measure rodent and/or mustelid relative abundance (see 'DOC tracking tunnel guide v2.5.2'—docdm-1199768). The technique uses a 'run through' tunnel containing two pieces of paper or card either side of a pad coated or soaked with ink. As an animal passes through the tunnel it picks up the ink on its feet, then as it departs from the tunnel it leaves a set of footprints on the papers or cards. Tracking tunnels are set on randomly orientated lines, and results are recorded as the average percentage of tunnels containing rodent or mustelid tracks per line. The number of tunnel lines that are needed depends on the size of the study site and whether rodents or mustelids are being surveyed. Six to twenty tunnel lines are usually required, but consult table 1 in 'DOC tracking tunnel guide v2.5.2' (docdm-1199768) for more details. This technique only provides a coarse index of relative abundance of rodents or mustelids; it is not a direct measure of population density as the index can be influenced by variation in activity. The technique is best suited for providing simultaneous comparisons of the relative abundance of rodents (particularly rats) or mustelids between similar habitat areas (e.g. treatment and non-treatment), or gross changes in relative abundance over time at a single site. Hedgehogs are often detected in tracking tunnels (Jones & Sanders 2005) but it is unknown how sensitive the technique is to the presence of these animals. Initial set-up costs can be high, but the ongoing costs are somewhat less because the tracking tunnels remain permanently in place between monitoring sessions.

Assumptions

- The proportion of tunnels tracked (percentage of tunnels tracked) is related to abundance (Brown et al. 1996; Gillies & Dilks 2003).
- The relationship between the index and abundance or density is linear.
- 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.
- Staff setting up the tracking tunnel lines have ensured that the survey effort is spatially representative of the habitats within the area of interest, and that randomisation rules have been followed when deciding line direction and/or start points.

Advantages

- Cheap and easy to conduct (compared to snap trapping for monitoring the results of ongoing pest control operations).
- May be useful for comparative inference if assumptions about equal detection rates are met.
- May be the only method that can be applied in some situations.
- May be sufficient to describe basic biological patterns.
- The sampling technique is non-destructive so there are no non-target impacts, nor is the target population affected.

- The technique is independent of any management activity (e.g. trapping) so it is suited for measuring the effects of rodent or mustelid control operations.
- The technique is technologically simple so there is little chance of equipment failure.
- There is minimal observer bias because tracking papers can be checked against references or double-checked by an expert.
- Can be used for multiple small mammal species at one time.
- Good for nocturnal and cryptic small mammals.
- Once the tunnel lines are set up, surveys are easy to run, provided the lines are well marked. Volunteer labour can be used if necessary because the procedure for setting up and collecting papers is very simple.
- When the technique is standardised temporally and spatially, tracking data can be compared between sites and across time.
- The technique is in widespread use in New Zealand, and for tawa-podocarp broadleaf forests the tracking rates of ship rats have been related to conservation outcomes for some native bird species.

Disadvantages

- Method does not adjust for incomplete detectability.
- Although many factors affecting detectability can be controlled by standardisation of methods and designs (e.g. seasons, species or effort), many factors cannot be controlled (e.g. breeding status, density, etc.).
- Great care is required when interpreting trends derived from indices, particularly for small populations.
- May give spurious results if detectability is variable.
- The initial set-up costs can be high.
- The number of tunnels containing rodent or mustelid prints does not directly relate to the number of animals present. A single tunnel could be tracked by several individuals, and in some cases more than one tunnel can be tracked by the same animal.
- The technique can become saturated at high rodent or mustelid densities.
- At best the technique only provides a coarse index of relative abundance: for rats and mustelids (not detected, low abundance, normal abundance, high abundance); for mice (not detected, low to normal abundance, very high abundance).
- It is very difficult to discriminate between the prints of the different rat species and between the different mustelid species because the print sizes overlap.
- The method can be labour intensive, depending on the size of the area requiring coverage.
- Tracking tunnel surveys can be affected by heavy rain, so should only be run for rodents on fine nights. Mustelid surveys should only be run when a period of fine weather can reasonably be expected.
- One problem that often occurs is that people do not survey the site adequately, because they either use too few tunnel lines or do not sample the available habitats in a stratified and representative manner.

Suitability for inventory

Tracking tunnels should be left permanently in place to help overcome neo-phobia which can sometimes be a problem for 'one-off' surveys using traps. Therefore, provided adequate survey effort is employed (both spatially and temporally), and appropriate lures are used, tracking tunnels should be sensitive to the presence of ship rats, kiore, house mice and mustelids in an area. However, it is very difficult to discriminate between the prints of some small mammal species, in particular between: large ship rats and small Norway rats; small ship rats and kiore; large weasels and small stoats; large stoats and small ferrets (Lawrence & Brown 1973; Ratz 1997). So if it is critical that each rodent and/or mustelid species present in an area is identified, then tracking tunnels should not be used (trapping may be a better option).

Suitability for monitoring

Tracking tunnels are a useful management tool for determining the results of rodent or mustelid control operations, especially when compared with data collected simultaneously from a suitable non-treatment comparison site. Tracking tunnels can be used to indicate population trends over time at a coarse level, provided adequate survey effort is employed (both spatially and temporally), and appropriate lures are used.

Skills

Anyone with a reasonable level of physical fitness can run tracking tunnel surveys with minimal training. Workers need to:

- Be able to navigate in the bush
- Be comfortable negotiating difficult terrain

Identifying small mammal prints and calculating tracking rates both require a small amount of training. Workers need to:

- Be able to identify the tracks of all small mammals likely to be detected in tracking tunnels. Usually this skill does not take very long to acquire and a short guide is available (see 'A short guide for identifying footprints on tracking tunnel papers'—docdm-1237739).
- Be able to distinguish small mammal tracks from other marks, smears and smudges sometimes found on tracking papers or cards.
- Have a basic understanding of statistical concepts such as 'mean' and 'standard error of the mean'.
- Be able to operate appropriate computer software (usually Microsoft Excel).

Resources

Initial set-up of tunnels and lines:

- Tracking tunnel covers, bases, trays and wire pegs
- Map and/or GPS detailing where to locate tracking tunnel lines
- Compass
- Hip chain
- Flagging tape or track markers for marking tunnel locations
- Indelible ink marker for numbering tunnel markers
- Pencil and notebook
- Other equipment appropriate for the field conditions

Running a tracking tunnel survey:

- Tracking papers or cards
- Tracking ink if required
- Lure: peanut butter for rodents, fresh rabbit meat for mustelids
- Map and/or GPS detailing where to find tracking tunnels or lines
- Compass
- Pencil and notebook
- Other equipment appropriate for the field conditions

For calculating tracking rates:

- Access to a computer or calculator

Minimum attributes

These attributes are 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).

At a minimum:

- Record observer name, survey location and date tunnels were set.
- Record weather conditions.
- Record tunnel status when papers are collected ('Ok' = at least one paper or card still in the tunnel; 'Disturbed' = both papers or cards have been removed from the tunnel; or 'Not set' = tunnel missed or not set for some reason).
- Record any other small mammal sign seen on or in the tunnel (e.g. scats).
- Ensure the tunnel and line number is recorded on the papers or cards as they are removed from the tunnel.
- Identify small mammal prints on the tracking papers.

Data storage

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 plot 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.

Data can be stored in Microsoft Excel. DOC staff at sites with DME access can use a copy of 'DOC tracking tunnel calculator' (docdm-1237643) to store survey data. (Note: this will also calculate the tracking rate recorded during the survey—see 'Analysis, interpretation and reporting'.)

Analysis, interpretation and reporting

Seek statistical advice from a biometrician or suitably experienced person prior to undertaking any analysis.

Calculating the tracking rate

Identification of prints, calculation of the tracking rate, and data entry should happen at the same time back at base or in the office. The tracking rate is calculated by tallying up the percentage of tunnels containing tracks of a given species on each line (correcting for badly disturbed tunnels), then averaging this figure over all survey lines.

Results are best summarised in a spreadsheet (e.g. Microsoft Excel). Columns in the spreadsheet should include all data recorded as the papers were collected (see 'DOC tracking tunnel calculator'— docdm-1237643).

Results can be presented in a number of ways:

- The average percentage of tunnels tracked by rats, mice, or mustelids per line, usually referred to as the tracking rate.
- The proportion of tunnel lines that detected rats, mice or mustelids.
- Distribution maps of small mammal detections can be drawn.

Simple statistical comparisons can be made between standardised surveys of rodent or mustelid abundance at the same site, but these should be treated with caution because of the potential lack of biological independence between survey times (this can be mitigated by applying repeated measures approaches), and between tracking tunnels, or even survey lines.

Simple statistical comparisons can be made between standardised surveys of rodent or mustelid abundance done simultaneously at different sites. However, these should be treated with caution, especially if weather conditions at the time of the surveys were different at each site, but also because of any unknown differences in the detection rates of these small mammals in different habitats.

Case study A

Case study A: using tracking tunnels to monitor the effect of Racumin® poison on the abundance of rats in the Waipapa South management area of Pureora Forest Park

Synopsis

This case study demonstrates how tracking tunnels monitored changes in rat abundance in Waipapa, Pureora Forest Park (Mathew 2012). The study compared tracking rates of rats between Waipapa North (a non-treatment site) and Waipapa South (a site that was treated with Racumin® baits). Racumin® baits were put in bait stations set within Waipapa South on a 150 × 50 m grid in September 2005 and replenished in October 2005. Differences in tracking rates between the sites showed that Racumin® successfully reduced rat abundance.

Objectives

- To measure the effectiveness of Racumin® (coumatetralyl) paste baits at reducing rat abundance in the Waipapa South management area (c. 2400 ha) of Pureora Forest Park.

Sampling design

- Eight randomly orientated lines, each with ten tracking tunnels, were set around the Waipapa South (treatment) management area.
- Eight randomly orientated lines, each with ten tracking tunnels, were set around the nearby Waipapa North (non-treatment) management area.

- Tracking tunnel surveys were run simultaneously at both sites in August 2005 before the Racumin® was put in the stations at Waipapa South. Rodent tracking surveys were then repeated at both sites in November 2005 and January 2006.
- Tracking rates (mean percentage of tunnels tracked per line, ± standard error) for rats from both sites were then compared to assess whether or not the Racumin® reduced rat abundance in Waipapa South.

Results

The tracking tunnel indices indicate that the Racumin® poison baiting operation successfully reduced rat abundance at Waipapa South. Rat abundance remained high in the non-treatment comparison site at Waipapa North (Fig. 1).

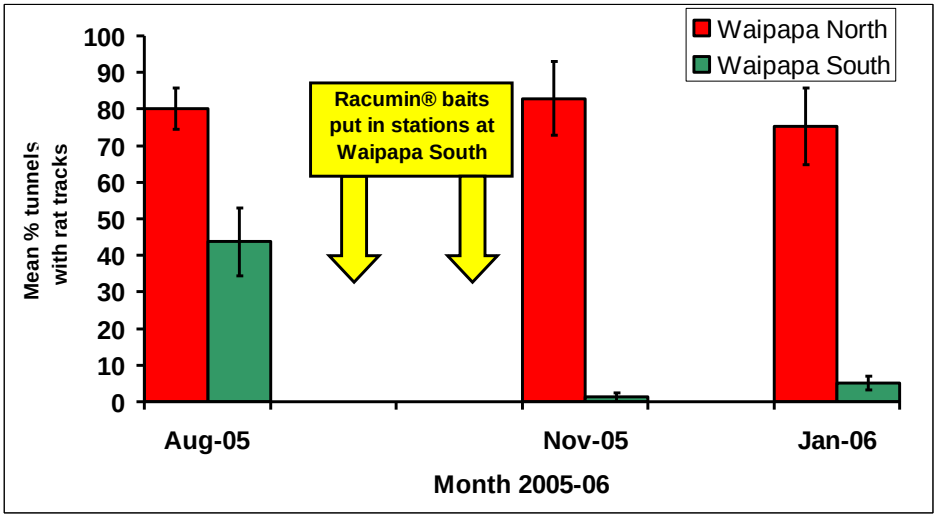

Figure 1. Comparison of tracking indices at Waipapa South (treatment) and Waipapa North (non-treatment) through a Racumin® poison baiting operation (Mathew 2012).

Limitations and points to consider

- We have presented data from the two Waipapa sites for the period immediately before and for the season after the poison operation.
- This case study demonstrates a typical scenario where tracking tunnels have been used to measure rat relative abundance through a poison operation.

References for case study A

Mathew, H. 2012: Operational report for Norway rat, ship rat control in the Waipapa (2005/2006). Unpublished Pestlink operational report, No. 0506MPT07. Department of Conservation, Maniapoto Area Office, Te Kuiti, New Zealand. 19 p.

Full details of technique and best practice

There is a national standard for using tracking tunnels to monitor rodents and mustelids: 'DOC tracking tunnel guide v2.5.2' (docdm-1199768). Below is a brief summary of the key points:

- The number of lines that is required depends on the size of the study area and whether rodents or mustelids are being surveyed. Refer to table 1 in 'DOC tracking tunnel guide v2.5.2' (docdm-1199768) for more guidance on this.
- Tracking tunnels are set along randomly orientated lines in locations that have been selected to sample a representative range of habitats present in the area of interest.
- Tracking tunnels should be left in place between surveys and should be installed at least 3 weeks (if not longer) before they are used for the first time.
- For rodent surveys, each line consists of ten tunnels spaced 50 m apart along the line.
- For mustelid surveys, each line consists of five tunnels spaced 100 m apart along the line.
- The tunnels must be baited with peanut butter for rodent surveys and with fresh rabbit meat for mustelid surveys.
- Rodent tracking tunnel surveys are conducted over 1 night; mustelid surveys are conducted over 3 nights.
- Rodent surveys must only be undertaken on fine nights. Mustelid surveys must only be undertaken when a period of fine weather can reasonably be expected.

References and further reading

Brown, K.P.; Moller, H.; Innes, J.; Alterio, N. 1996: Calibration of tunnel tracking rates to estimate relative abundance of ship rats (*Rattus rattus*) and mice (*Mus musculus*) in a New Zealand forest. *New Zealand Journal of Ecology 20*(2): 271–275.

Gillies, C.; Dilks, P. 2003. Evaluating the use of tracking tunnels to monitor mustelids as well as rodents. In Murphy, E.; Fechney, L. (Eds): What's happening with stoat research. Fifth report on the five-year stoat research programme. Department of Conservation, Wellington.

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Lawrence, M.J.; Brown, R.W. 1973: Mammals of Britain—their tracks, trail and sign. Blandford Press, London, UK.

Mathew, H. 2012: Operational report for Norway rat, ship rat control in the Waipapa (2005/2006). Unpublished Pestlink operational report, No. 0506MPT07. Department of Conservation, Maniapoto Area Office, Te Kuiti, New Zealand. 19 p.

Ratz, H. 1997: Identification of footprints of some small mammals. *Mammalia 61*(3): 431–441.

Appendix A

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

docdm-1237643	DOC tracking tunnel calculator
docdm-1199768	DOC tracking tunnel guide v2.5.2
docdm-1237739	A short guide for identifying footprints on tracking tunnel papers
docdm-146272	Standard inventory and monitoring project plan