Bats: trapping away from roosts—inventory and species identification

Version 1.0

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Contents

Inventory and monitoring toolbox: bats

DOCDM-590776

Department of Conservation
Te Papa Atawhai

Synopsis

Trapping bats in areas where they commute and forage can potentially be used to:

- Record presence of bats
- Confirm species identity
- Calculate estimates of relative abundance (captures per unit effort)
- Estimate population size and survival (mark-recapture)

Outside of New Zealand, capturing bats is often the primary means of establishing species presence, distribution and abundance in an area. Captures per unit effort are also used to estimate species richness and provide crude estimates of relative abundance (Thomas & LaVal 1988). However, because New Zealand long-tailed bats and lesser short-tailed bats are so rare, so patchily distributed, and in certain circumstances difficult to catch, we do not recommend trapping as the sole inventory technique and do not recommend using trapping in foraging and commuting areas for mark-recapture and monitoring.

The two most common tools used to catch bats are mist nets (Fig. 1) and harp traps (Fig. 2). Harp traps are specialised traps developed specifically for bats (Constantine 1958; Tuttle 1974; Tidemann & Woodside 1978). Anyone wishing to catch and handle bats must hold appropriate permits, have animal ethics approval and should be familiar with the potential health and safety issues associated with handling bats (see 'Health and safety' in the 'DOC best practice manual of conservation techniques for bats'—docdm-131465 for further information). It is also essential for workers to receive appropriate training and to meet the minimum requirements for catching and handling bats. The 'DOC best practice manual of conservation techniques for bats' (docdm-131465) provides full details of how to catch and handle long-tailed bats and lesser short-tailed bats using a range of capture techniques and tools. There are a number of particular issues around safety of the bats and of the handlers (particularly in relation to disease and parasite spread, and injury).

Trapping in areas used by foraging and commuting bats has limited value as an inventory method because capture rates are generally too low to make the exercise worthwhile. Compared with other methods, trapping is very labour-intensive in most situations and may not be worthwhile for the quantity and quality of information gathered. For simple presence/absence and distribution surveys, it is often more cost effective to put out automatic detection and recording devices (see 'Bats: counting away from roosts—automatic bat detectors'—docdm-590733). If trapping is to be used for inventory, it should be done in conjunction with other inventory methods. For example, anecdotal/casual sighting records, reports and databases should be consulted to narrow down search areas, and bat detectors should be used to identify areas of high bat activity to improve rates of capture.

Trapping is very useful for positive species identification in the hand because it is sometimes difficult to distinguish between recorded calls of long-tailed bats and lesser short-tailed bats.

Trapping is also a necessary precursor for more rigorous inventory and monitoring methods such as those that involve radio-tracking of bats. For example, the proportion of radio-tagged bats alive can be

used to calculate survival estimates both in foraging areas and at roost sites (see 'Bats: trapping at roosts—estimating survival and productivity'—docdm-590867). Radio-tracking is almost always necessary to find roost sites. Once found, a range of more robust inventory and monitory methods can be conducted. The 'Introduction to bat monitoring' (docdm-590958) contains summary tables of methods that can be used at roost sites.

Figure 1. Simple mist net set-up for catching bats. Illustration by T.P. McOwat, reproduced with permission, Bat Workers' Manual ©, JNCC 2004. ISBN 1861075588.

Figure 2. A harp trap—designed specifically for trapping bats.

Assumptions

- Bats will be caught if they are present in an area.
- The number of bats caught relates in some way to the number of bats present in an area.

Advantages

- Trapping and capture ensures reliable identification of long-tailed and lesser short-tailed bats.
- Mist nets are cheap compared with automated bat detection and recording systems.
- Mist nets are lightweight, compact and easy to carry.
- Lesser short-tailed bats are relatively easy to catch in mist nets.
- Harp traps are easy to set up and operate, and do not require constant checking—at certain times of the year (see 'Full details of technique and best practice').
- Having bats in the hand enables bat workers to collect a range of other information such as:
    - Data on age, sex, reproductive condition
    - Body mass measurements and a range of morphometric measurements
    - Samples for genetic analyses

Disadvantages

- We do not know how capture rates relate to relative abundance of bats. Indices of abundance such as captures per unit effort, and mark-recapture estimates using trapping on foraging grounds have not been tested with New Zealand bats; they are likely to provide crude estimates, at best.
- Trapping is very labour-intensive in most situations and, compared with other methods, may not be worthwhile for the quantity and quality of information gathered.
- Trapping and handling of bats requires considerable skill and training.
- As all trapping techniques involve handling and disturbance to bats, surveys may require ethics approval and a permit. For more information on such requirements contact the DOC Bat Recovery Group leader or the DOC conservancy bat contact (see 'Bat Recovery Group contacts'—docdm-132033).
- Mist nets require constant monitoring to ensure bats do not become badly entangled and stressed, injuring themselves as they struggle. Bats can also chew the nets to find a way out, reducing the value of the nets for future use.
- Long-tailed bats can very easily detect and avoid traps (away from roost sites). They tend to be difficult to catch in mist nets (< 0.01 long-tailed bats per net per hour were caught in a study in the Eglinton Valley, Fiordland; O'Donnell & Sedgeley 1999) and are only caught in harp traps that have been sited optimally (see 'Skills').
- Harp traps are relatively expensive ($1500) and are large, heavy and awkward to carry over long distances.

- Lesser short-tailed bats can climb out of harp traps.
- Capture rates of bats will decline if the same site is trapped over several days, probably because bats learn that the trap is present.
- Capture rates can differ between males and females, and among different age classes.
- Bat activity levels (and therefore capture rates) are influenced by environmental conditions and time of year. For example, during winter and in cold, rainy or windy weather conditions, capture rates will be especially low. During January to March there will be more bats flying, as this is when young of the year become independent.
- Capture rates may vary among habitat types.

Suitability for inventory

Trapping in areas used by foraging and commuting bats generally has limited value as an inventory technique in New Zealand because long-tailed bats and lesser short-tailed bats are rare and patchily distributed, and capture rates are generally low. Trapping bats is very labour-intensive in most situations and may not be worthwhile for the quantity and quality of information gathered compared with other methods. For simple presence/absence and distribution surveys, it is often more cost-effective to put out multiple automatic bat detector and recording units to detect presence of bats. For more details on using bat detectors automatically, see 'Bats: counting away from roosts—automatic bat detectors' (docdm-590733).

Trapping is very useful for positive species identification in the hand because it is sometimes difficult to distinguish between calls of long-tailed bats and lesser short-tailed bats recorded on automated bat detector recording units.

Suitability for monitoring

Trapping generally has limited value as a monitoring technique for all the reasons listed in the 'Suitability for inventory' section. Although, potentially, catch per unit effort and mark-recapture away from roost sites could be used to estimate relative abundance, survival and population size, these estimates are likely to be crude. Likewise, power to detect changes in populations using catch per unit effort or mark-recapture is likely to be very low because capture rates are generally low. Therefore, we do not recommend using trapping away from roost sites for monitoring unless it is part of a research programme to assess the relationships between capture rates and population indices (i.e. calibration trials in areas where bats are relatively common).

However, trapping directly at roost sites can be used for monitoring purposes. For further details of this approach, see 'Bats: trapping at roosts—estimating population size' (docdm-590819) and 'Bats: trapping at roosts—estimating survival and productivity' (docdm-590867).

Skills

Workers require skills to:

- Identify areas of bat activity by using bat detectors to survey for bat calls. See ‘Bats: counting away from roosts—bat detectors on line transects’ (docdm-590701) and ‘Bats: counting away from roosts—automatic bat detectors’ (docdm-590733) for more information.
- Distinguish between long-tailed bats and lesser short-tailed bats by their calls. For more information, see ‘Background to bat detectors’ in the ‘DOC best practice manual of conservation techniques for bats’ (docdm-131465).
- Set up harp traps or construct mist net rigs in areas of bat activity. Training may be needed on ways to optimise capture rates. The section ‘Catching bats’ in the ‘DOC best practice manual of conservation techniques for bats’ (docdm-131465) provides details on trap construction and placement.
- Remove bats from traps and handle bats competently and humanely. Bats are easy to remove from harp traps, but are sometimes difficult to remove from mist nets because they can become very entangled. Anyone wishing to catch bats must receive appropriate training and must meet the minimum requirements outlined in the section ‘Catching bats’ in the ‘DOC best practice manual of conservation techniques for bats’ (docdm-131465).
- Identify species in the hand; measure, age, and sex bats. Anyone wishing to handle bats must meet the minimum requirements outlined in the section ‘Handling, examining, measuring and releasing bats’ in the ‘DOC best practice manual of conservation techniques for bats’ (docdm-131465). Information on distinguishing between long-tailed bats and lesser short-tailed bats in the hand can be found in the ‘Species identification in the hand’ section of the ‘DOC best practice manual of conservation techniques for bats’.
- Work comfortably at night, in the dark.
- Demonstrate a sound level of bushcraft.
- Demonstrate a basic level of rope-work to construct mist net rigs and possibly some rope-climbing skills to set traps high in the forest canopy.

Resources

Trapping bats requires considerable resources in terms of equipment and time required to set up and run the traps. Lesser short-tailed bats can be caught in mist net rigs that are only one or two nets high. However, several rigs are required to optimise trapping success. Long-tailed bats fly much higher than lesser short-tailed bats. Large mist net rigs 3–10 nets high are often required, and, because trapping rates are so low, several rigs are necessary. Carefully positioned harp traps can be more successful at catching long-tailed bats, but again, several traps are required to optimise capture success. Mist nets can sometimes take a long time to set up and they require constant supervision. Preliminary research and bat detector surveys are also required to find localities where bats are present.

Marking and processing bats, once caught, requires little equipment (holding bags, callipers, Pesola balance, fur-trimmer, clipboards and recording sheets, headlamps), but a reasonably large pool of

skilled workers must be on hand in case numerous bats are caught at once. Bats need to be removed from nets quickly and processed without delay.

The DOC automatic bat detector and recording system (known as automatic bat monitors, or ABMs) can be purchased or may be borrowed from the DOC Electronics Workshop in Wellington. DOC also owns several harp traps, but these are dedicated to long-term research projects and are only occasionally available for borrowing. New harp traps can be purchased from an Australian manufacturer called Faunatech[1]. Many projects use mist nets for birds, but it is not recommended that bird mist nets are borrowed and used for bats because bats can chew large holes in the mesh. Nets and holding bags that have been used for birds should not be used for bats (and vice versa) unless they have been thoroughly cleaned and disinfected. See 'Full details of technique and best practice' for more details.

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).

Minimum attributes to record:

- Observer's name
- Location name and GPS coordinates
- Date
- Weather conditions
- Type of traps used (i.e. harp trap or mist net); include information such as number of traps and length of net if planning to calculate number of captures per net metre per hour
- Start time and start temperature
- The time when each bat is caught
- Species, age, sex and reproductive condition of every bat caught
- The finish time and temperature
- Tally of the total number bats caught in the trapping session

Additional attributes

If interested in body condition, record body mass (weight, g) and forearm length (mm) (see O'Donnell 2002).

Minimum attributes can be recorded on the following standardised field sheets:

[1] http://www.faunatech.com.au/

- ‘Bat specimen record form’ (docdm-141173). This form should be used to record bat specimens found in traps.
- ‘Summary sheet for bat captures’ (docdm-167011). This sheet should be used to summarise the number of captures of wild bats on foraging grounds.
- ‘Trapping record’ (docdm-167012). This document contains a form to be used to record individual bat traps.

Data storage

Information should be collected, consolidated and securely stored as soon as practical, preferably immediately on return from the field. The key steps involved are data entry, storage and maintenance for later analyses. 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 and will usually be in the form of spreadsheets, databases, summary sheets or other filing systems. All data, whether they be data sheets, metadata or site access descriptions, should be copied and/or backed up, with the copy stored at a separate location for security purposes. Losing data (particularly prior to analysis) is a disaster.

Survey results are best summarised in a spreadsheet (e.g. Microsoft Excel). Columns in the spreadsheet should include all data recorded on the original field sheet because the influences of factors such as location, observer, weather, etc. need to be accounted for in any analysis.

At present, there are no standardised spreadsheets or databases maintained by DOC specifically for storing bat trapping data. However, sightings could be recorded in the DOC bat database. Each DOC conservancy should have a separate Excel spreadsheet for this purpose. Access rights are held by the conservancy bat contact (see ‘Bat Recovery Group contacts’—docdm-132033). If a conservancy has not set up its own spreadsheet, one can be created using the ‘National bat database template’ (docdm-213136). See the ‘Canterbury Conservancy bat database’ (docdm-213179) for an example of a spreadsheet containing data. Many of the data entry fields will not be relevant, but there are fields for location, GPS coordinates and for comments that could be used to describe survey results (Fig. 3).

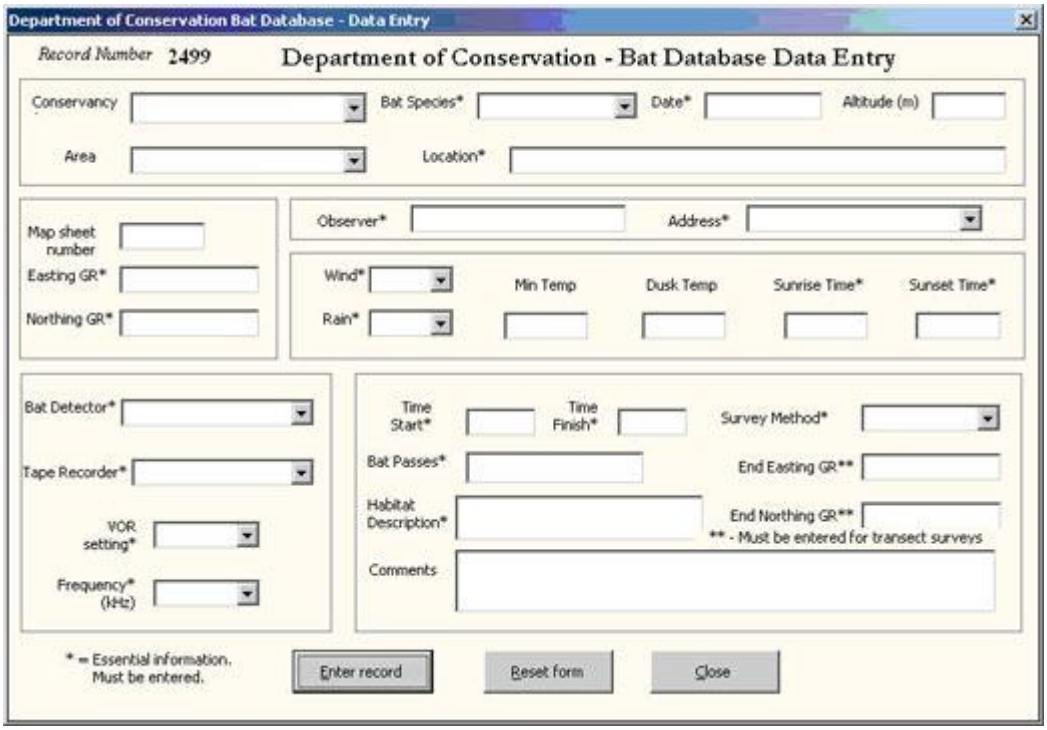

Figure 3. Data entry page from the DOC bat database.

Analysis, interpretation and reporting

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

This method measures:

- Presence of bats
- Confirmation of species' identity

Simple statistics, as below, can be reported for a study area:

- Total number of bats caught and sub-total by age, sex and reproductive condition.
- Captures per harp trap or mist net per hour or per night.
- Captures per net metre per hour.
- Average body condition. This index of body condition is calculated by dividing body mass by the individual's forearm length, then multiplying by the mean forearm length for the total sample of bats that is being examined (O'Donnell 2002).

The scope for interpretation is limited and depends on objectives of the trapping work. For example, capture of bats in an area confirms presence but not absence. After capturing many bats in an area in a short time you may be able to infer something about population size, but capturing few bats does not imply that the population is small, because capture rates are influenced by many factors.

Case study A

Case study A: trapping as part of an inventory of bats on Putauhinu Island, near Stewart Island

Synopsis

Researchers studying tītī (*Puffinus griseus*) on Putauhinu Island off Stewart Island in 1998 reported unidentified bats. Because the island was next to Big South Cape, the island where the last sighting of greater short-tailed bats (*Mystacina robusta*) was made in 1967, DOC identified this island as a priority for a bat survey.

Objectives

To confirm the presence of bats on the island and identify the species of any bats present.

Sampling design and methods

A survey was undertaken in 1999. Mist netting was used (12 m nets, one net high, spaced along walking tracks) in conjunction with DOC ABMs and hand-held bat detectors over several nights (O'Donnell 1999).

Results

No bats were trapped in > 40 net hours, but *Mystacina* calls were detected on 2 nights using the automatic detectors.

Limitations and points to consider

This case study illustrates that trapping is very labour-intensive compared with using bat detectors. However, this study also illustrates the usefulness of trapping for species identification. The bat calls recorded using the simple automatic bat detector and recording system did not contain enough information to confirm which species of *Mystacina* was present. It is unlikely that any new record of a greater short-tailed bat will be accepted unless it is caught and identified in the hand.

References for case study A

O'Donnell, C.F.J. 1999: Search for pekapeka (bats) on Putauhinu Island, Southern Tītī Islands, 6–9 November 1999. Report to the Department of Conservation, Invercargill (unpublished).

Case study B

Case study B: trapping used to re-discover lesser short-tailed bats in the South Island

Synopsis

Previously, the last record of lesser short-tailed bats in the South Island was of one found dead on a cyanide bait in the Roaring Lion River, North-west Nelson, in 1977 (Daniel 1990). DOC West Coast Conservancy staff conducted a survey for lesser short-tailed bats in 1995–96. Survey effort was focused around Karamea after the discovery of an old photograph of a lesser short-tailed bat that had been caught by a cat in the area in 1957 (J. Lyall, pers. comm.). Surveys were initially conducted using DOC ABMs. Echolocation calls were recorded from 26 of 128 sites surveyed in the Ōpārara area in January and February 1996.

Calls of both long-tailed bats and lesser short-tailed bats were recorded. Because there is some overlap in frequency of the calls of the two species, it is sometimes difficult to distinguish the calls when using simple recordings. Therefore, mist nets were used to trap bats and confirm species identity in the hand.

Objectives

To use trapping to confirm the presence of lesser short-tailed bats in the Ōpārara area.

Sampling design and methods

Mist nets were erected at two sites in the Ōpārara Basin on 27 March 1996, close to where calls had been recorded.

Results

Twenty lesser-short-tailed bats were netted, but four of these escaped. Lesser short-tailed bats were caught at both sites from within half an hour of darkness until the nets were closed at c. 2300 hrs (J. Lyall, pers. comm.).

Limitations and points to consider

This case study illustrates how trapping can be used effectively to confirm species identification. The trapping project resulted in rediscovery of lesser short-tailed bats in the South Island.

References for case study B

Hayes, J.P. 1997: Temporal variation in activity of bats and the design of echolocation-monitoring studies. *Journal of Mammalogy 78*: 514–524.

O'Donnell, C.F.J.; Christie, J.; Corben, C.; Sedgeley, J.A.; Simpson, W. 1999: Rediscovery of short-tailed bats (*Mystacina* sp.) in Fiordland, New Zealand: preliminary observations of taxonomy, echolocation calls, population size, home range, and habitat use. *New Zealand Journal of Ecology 23*: 21–30.

O'Donnell, C.F.J.; Christie, J.E.; Simpson, W. 2006: Habitat use and nocturnal activity of lesser short-tailed bats (*Mystacina tuberculata*) in comparison with long-tailed bats (*Chalinolobus tuberculatus*) in temperate rainforest. *New Zealand Journal of Zoology 33*: 113–124.

O'Donnell C.; Sedgeley, J. 1994: An automatic monitoring system for recording bat activity. *Department of Conservation Technical Series No. 5*. Department of Conservation, Wellington.

Full details of technique and best practice

Anyone wishing to catch and handle bats must hold appropriate permits, have animal ethics approval and should be familiar with the potential health and safety issues associated with handling bats. For more information on such requirements contact the DOC Bat Recovery Group leader or the DOC conservancy bat contact (see 'Bat Recovery Group contacts'—docdm-132033). It is also essential for workers to receive appropriate training and to meet the minimum requirements outlined in the following sections of the 'DOC best practice manual of conservation techniques for bats' (docdm-131465) :

- 'Health and safety'
- 'Catching bats'
- 'Handling, examining, measuring and releasing bats'
- 'Species identification in the hand'

The best practice health and safety guidelines for catching and handling bats are aimed at protecting the bat handlers and the bats themselves. The main points are summarised below, but anyone planning to work on a project that will involve routine handling of bats must read the 'Health and safety' section in the 'DOC best practice manual of conservation techniques for bats' (docdm-131465) for more details about the potential health risks of handling bats.

Best practice health and safety guidelines for catching and handling bats

- Anyone planning to handle bats must read the 'Health and safety' section.
- It is a requirement that gloves must be worn when handling lesser short-tailed bats. However, it is almost impossible to remove bats from a fine mist net wearing a pair of gloves. As an alternative, one glove (or a bat bag) can be worn on the hand used to restrain the bat, and the other hand can be left bare to manipulate the net. See 'Handling, examining, measuring and releasing bats'.
- Nets must be monitored at all times. Mist netting in areas of high bat activity must be undertaken by a minimum of two people. See 'Catching bats'.
- Harp traps positioned on the ground can be set up at dusk and checked at dawn, provided bats are released before it is too light. However, it is preferable to check the traps several times

during the night so bats are not kept for unnecessarily long periods of time. During the breeding season, harp traps must be checked several times each night, to enable captured lactating females and young to be reunited as soon as possible. See 'Catching bats'.

- Nets and harp trap bags must be checked thoroughly for bats before they are furled or dismantled. Bats can look very small when in a net, especially if they are at the top of a high mist net rig—they can be mistaken for leaves. See 'Catching bats'.
- It is recommended that nets and harp trap bags and handling bags are either thoroughly dried in the sun, washed, or disinfected (NapiSan, Virkon, TriGene) between sites to minimise the possibility of transfer of parasites and diseases between sites. Nets and holding bags that have been used for birds should not be used for bats (and vice versa) unless they have been thoroughly cleaned as above. See 'Catching bats' for further information on disease surveillance and hygiene precautions.

Although there is a best practice for trapping per se, there is no best practice for trapping on foraging grounds as a method for either inventory or monitoring. If trapping on foraging grounds is to be used as one of a combination of techniques for inventory, then trapping conditions should be optimised to improve rates. Many factors contribute to the potential success of a trapping programme such as correct set-up and placement of traps and handling of bats. The section on 'Catching bats' provides full details of how to effectively catch and handle long-tailed bats and lesser short-tailed bat using a range of capture techniques and tools. It also provides detailed information on trap construction, trap placement and other ways of optimising capture rates. For example, trapping in suitable weather will improve capture rates. Temperatures ≥ 7°C are preferable, and trapping in winter and during rainy and windy conditions should be avoided. Trapping should be focused in summer months, particularly January and February when more bats including young-of-the-year are flying. Capture rates of bats will decline if the same site is trapped over several days, probably because bats learn that traps are present. Therefore, traps should be moved regularly to new positions.

References and further reading

Constantine, D.G. 1958: An automatic bat-collecting device. *Journal of Wildlife Management 22*: 17–22.

Daniel, M.J. 1990: Order Chiroptera. Pp. 114–137 in King, C.M. (Ed.): The handbook of New Zealand mammals. Oxford University Press, Auckland.

O'Donnell, C.F.J. 1999: Search for pekapeka (bats) on Putauhinu Island, Southern Tītī Islands, 6–9 November 1999. Report to the Department of Conservation, Invercargill (unpublished).

O'Donnell, C.F.J. 2002: Timing of breeding, productivity and survival of long-tailed bats *Chalinolobus tuberculatus* (Chiroptera: Vespertilionidae) in cold-temperate rainforest in New Zealand. *Journal of Zoology (London) 257*: 311–323.

O'Donnell, C.F.J.; Sedgeley, J.A. 1999: Use of roosts by the long-tailed bat, *Chalinolobus tuberculatus*, in temperate rainforest in New Zealand. *Journal of Mammalogy 80*: 913–923.

Thomas, D.W.; LaVal, R.K. 1988: Survey and census methods. Pp. 77–89 in Kunz, T.H. (Ed.): Ecological and behavioral methods for the study of bats. Smithsonian Institution Press, Washington, DC.

Tidemann, C.R.; Woodside, D.P. 1978: A collapsible bat-trap and a comparison of results obtained with the trap and with mist-nets. *Australian Wildlife Research 5*: 355–362.

Tuttle, M.D. 1974: An improved trap for bats. *Journal of Mammalogy 55*: 475–477.

Appendix A

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

docdm-132033	Bat Recovery Group contacts
docdm-141173	Bat specimen record form
docdm-590733	Bats: counting away from roosts—automatic bat detectors
docdm-590701	Bats: counting away from roosts—bat detectors on line transects
docdm-590819	Bats: trapping at roosts—estimating population size
docdm-590867	Bats: trapping at roosts—estimating survival and productivity
docdm-213179	Canterbury Conservancy bat database
docdm-131465	DOC best practice manual of conservation techniques for bats
docdm-590958	Introduction to bat monitoring
docdm-213136	National bat database template
docdm-146272	Standard inventory and monitoring project plan
docdm-167011	Summary sheet for bat captures
docdm-167012	Trapping record