Protocols for monitoring New Zealand robins (*Petroica australis*)

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CONTENTS

ABSTRACT

The New Zealand robin (*Petroica australis*) is forest-inhabiting, territorial and mainly insectivorous. Populations should be monitored in some Conservancies because of their regionally threatened status. Releases of robins, both on predator-free islands and at mainland sites, need to be monitored to determine their fate and the cause(s) of any failures. In addition, robin populations at sites where mammals are controlled or eradicated using poison baits, whether broadcast or in bait stations, need to be monitored because robins have been found dead and tested positive for sodium monofluoroacetate (1080) and brodifacoum after such operations. The robin is an ideal species to monitor because it can be trained with a food reward to approach observers, readily captured and banded for individual recognition, the ratio of distinguishable paired to unpaired males provides a measure of population 'health', and nesting success can be readily determined. This document sets out the protocols for monitoring robins in order to measure population or ecosystem health, and to determine the impact (costs and benefits) of a management programme on a population.

1. INTRODUCTION

New Zealand robin (Toutouwai)

The robin stands about 10 cm tall, weighs about 35 g, and individuals are often inquisitive and confiding. The plumage is grey to black above, with a variable amount of white on the breast and belly (whitish-yellow on some South Island males), and there is a white spot (usually hidden) at the base of the bill; legs are long and thin and stance is upright. Generally the sexes are distinguishable: males being black above whereas females are grey. However, one-year old male North Island robins often look like females. Juveniles are similar in colour to females, except that when newly independent they often have no white breast patch.

There are three subspecies. The North Island robin (*P. a. longipes*) is confined largely to forests, both native and plantations of introduced species, in the central North Island, and the islands of Little Barrier, Kapiti, Mokoia, Tiritiri Matangi, Mana and Moturua. It has also recently been released on the mainland at Trounson Kauri Park Scenic Reserve where rodent (*Rattus* spp.) and possum (*Trichosurus vulpecula*) populations are controlled to low levels. The South Island robin (*P. a. australis*) is reasonably common in Buller, Nelson and coastal Marlborough, but is patchily distributed south of Arthur's Pass. It is present on the Chetwodes, Motuara, Allports and Blumine Islands of the Marlborough Sounds, and Entry, Breaksea and Hawea Islands of Fiordland. The Stewart Island robin (*P. a. rakiura*) is patchily distributed on Stewart Island and occurs on some outliers, including Pohowaitai, Poutama, Pukeoka, Motunui and Tamaitemioka Islands.

Robin diet consists mainly of small (<5 mm long) invertebrates, although they will readily kill and break up large invertebrates, such as stick insects, wetas and earthworms. Often portions of large prey are cached for retrieval later that

day or the next. Small fruit are occasionally eaten, mainly in autumn. Robins spend much time searching for prey by hopping about on the ground or scanning from a low perch. However, where canopy trees are well covered by epiphytes, such as mosses and filmy ferns, robins will search the festooned trunks and branches for prey.

Robins are territorial year round, and usually retain the same partner from year to year. During the non-breeding season — March to July — the main call heard is the *downscale*, a series of loud notes of descending frequency which start in rapid succession and finish slowly. In contrast, during the breeding season males sing *full song* which is loud and clear, usually given from the canopy or an emergent tree, and often sustained for periods of more than 30 minutes except for brief pauses.

Robins start breeding when six to 12 months old. The male offers food to his mate (courtship feeding), particularly while she is nest building and incubating — duties she alone undertakes. The nest — usually in a branch-branch fork, branch-trunk fork, top of a tree-fern or in an epiphyte — is a bulky structure of small twigs and mosses bound with cobwebs, and lined with fine grasses or fern scales. One to four eggs (usually two or three) are incubated for about 18 days, and the chicks leave the nest at about 21 days. Pairs are able to rear two broods within a season, and a few early nesters can rear a third brood. However, on the main islands predators raid more than 50% of nests, and pairs may re-nest up to 10 times. When the nest contents are preyed upon, a replacement clutch is often laid in a new nest within a fortnight. A female that loses her clutch or brood to a predator, or has dependent fledglings being cared for by her mate, will sometimes renest with a bachelor nearby.

2. WHY MONITOR ROBINS?

While still reasonably widely distributed and locally common, the species has declined dramatically since European settlement, primarily due to habitat loss (forests being converted to farmland or plantation forests), and predation by introduced mammalian predators. Presently the species is considered regionally threatened (Bell 1986). Thus, in some Conservancies, the species is worthy of being monitored for its own sake.

Where robins are present in forests that are regularly (3–5 year intervals) subjected to aerial possum control operations, the robin population should be monitored. This is regardless of whether the bait is carrot or cereal and the poison is 1080 or brodifacoum. This is because robins have been seen pecking carrot and pollard baits (Spurr 1991, Lloyd & Hackwell 1993, Spurr & Powlesland 1997). Dead robins found after 1080 possum control operations (Spurr & Powlesland 1997) have tested positive for the toxin. Whether the robins die as a result of eating the baits (primary poisoning) or eating invertebrates that have eaten baits (secondary poisoning) is not yet known. Robin populations have declined briefly when their habitats have been subject to rodent eradication programmes using brodifacoum in cereal baits (Kapiti Island — R. Empson pers. comm.; Mokoia Island — K. Owen pers. comm.).

Robins have been transferred to several mammal-free islands, either to reintroduce them to former habitat after revegetation or predator removal, or to establish a population at a 'safe' site. These releases of robins should be monitored to determine their fate so that if a population fails to eventuate, the cause(s) can be determined.

Robin nests are no more prone to predation than the nests of other forest-dwelling native and introduced passerines (Moors 1983). The levels of predation are such that a small proportion of robin nesting attempts result in successful fledging of chicks. For example, at Pureora Forest Park in 1995–96, at least 55.6% of 18 nesting attempts failed because of predation (Powlesland *et al*. unpubl. data). Of 43 North Island robin nests found at Kaharoa during the 1993–94 season, at least 60% failed as a result of predation (Brown 1994). At Kowhai Bush, Kaikoura, of 626 South Island robin nests found during 1971–76, the contents of 57% were preyed upon (Moors & Flack 1979). Taking all failures into account, nesting success evident in the three studies was just 22% at Pureora (Powlesland *et al*. unpubl. data), 16.3% at Kaharoa (Brown 1994) and 32% at Kowhai Bush (Flack 1979).

In addition to the loss of eggs and chicks, females are occasionally killed at the nest. In most mainland populations of robins, the sex ratio is skewed in favour of males; sometimes as high as one female to 1.5–2.0 males (Brown 1994, Powlesland *et al*. unpubl. data). Females alone incubate the eggs and brood the young, and so are more vulnerable to predators than males in the nesting season. Unpaired males are distinguishable from paired males in the nesting season because the former spend more time (c. 30% of the day) than paired males (2–15%) giving full song (Powlesland 1983). The continued presence of robin populations on the main islands is probably due largely to the species' ability to renest quickly several times during a nesting season. Brown (1994) recorded one pair of robins at Kaharoa having 10 nesting attempts in one season without success.

Because robins are prone to predation by introduced mammalian predators during the nesting season, and can be readily studied, the species is a useful indicator of 'general predator impacts' both in terms of possible predator impacts on other forest bird species more difficult to monitor, and to quantify the impacts on non-target species of management actions to reduce predator populations.

The species is relatively easy to monitor because:

1. Many robins are inquisitive and **can be trained to approach observers** when a particular noise is made in their territory (e.g., clapping, tapping a lid against a container) and by rewarding them with food. Thus, once trained, many individuals will approach within a few minutes of an observer entering their territories and making a noise. Even if not fed for several months, trained robins will approach closely when visited again.
2. Individuals trained to approach for food can be **readily captured and colour bands fitted for individual recognition**. Adult robins can be captured using a clap-trap (manually or electronically operated), a hand-net, or a mist net, and nestlings can be banded in the nest when 10–13 days old. Capture in a mist net is usually achieved by feeding the bird beside the net and scaring it into the net, or by attracting it through the net site using

taped song. It is important not to band an individual before it has been fed several times and approaches you to be fed. Robins soon get over the experience of capture and banding; a few will approach for food within a few minutes of being released, and most will do so when visited the next day. Because robins approach closely and spend much time on or close to the ground, their band combinations can be readily determined with binoculars, even though they live in forest.

3. Paired and unpaired males can be distinguished. The ratio of the numbers of birds in these categories **provides a measure of population 'health'**. The proportion of unpaired males reflects the intensity of predation pressure on nesting females. In addition, the sex of an individual can be determined, particularly once it is banded and its interactions with its partner and neighbours is monitored. It should be noted that some females can be very cryptic in the non-breeding season when their mates may be particularly aggressive towards them, and at certain stages (nest-building, incubation) of the nesting cycle.

4. **Nesting success can be readily determined** because nests can be found and closely monitored without the robins deserting their clutches or broods. If the male can be fed then the nest can be located by feeding him, following and watching where he goes to feed his mate, and then observing her go back to the nest. However, it is not always that easy! Sometimes females can be reluctant to return to their nests while you remain in sight near the nest and are adept at taking you away from the nest and then disappearing! However, with experience and perseverance most nests can be found.

Nest heights vary from about a metre off the ground to high in the canopy. Nest locations can be marked nearby with flagging tape and checked every few days without fear of the pairs abandoning them. A ladder is useful to get up to nests to check their contents if it is practical to carry one through the vegetation. Even if the nest is too high to be able to get to it to check the contents, the behaviour of the birds will indicate whether it is still viable and whether it contains eggs (only the female will go to it) or nestlings (both parents go to nest with food). Fledglings are reasonably vulnerable to predators during their first week out of the nest so do not be surprised if one or all of a brood disappears then.

3. PROTOCOLS FOR MONITORING ROBINS

3.1 To estimate individual mortality and nesting success as a measure of population and ecosystem health

***Objectives*:**

1. To determine the mortality of banded individuals each month, and especially of females during the nesting season.
2. To determine the total number of paired and unpaired males, and of females in a defined area (ideally should include at least 30 robins) just before nesting starts.

3. To determine the nesting success of at least 10 pairs (proportion of successful nests, mean number of fledglings per pair per annum).

***Assumption*:**

1. It is assumed that the rodent and possum populations at the study site will be surveyed by standard indexing methods. Rodent monitoring is usually carried out at six weekly intervals during the nesting season, and possum monitoring just before nesting starts.
2. The sample of robins is representative of the population/ecosystem.
3. That once a banded robin disappears that previously came to be fed, then it has died. Alternatively, there are statistical packages available, such as SURGE, to estimate mortality.

***Methods*:**

1. Obtain handling and banding permit, size B metal and colour bands, banding pliers, and mist-net (30 mm x 2.6 m x 9 m) from the Banding Office, Department of Conservation, P.O. Box 10420, Wellington.
2. Obtain poles for the mist net.
3. Obtain a clap-trap[1], and/or make a hand-net (good for catching dependent fledglings).
4. Obtain a supply of mealworms[2] or another readily available invertebrate food that the robins will eat.
5. Obtain a portable cassette tape recorder, tapes, and taped calls of robins either from Cognita (former Conservation Design Centre), Nelson, or preferably by taping calls at your study area.
6. Grid the study area with taped lines at about 100 m intervals, and with each line being numbered at 50 m intervals so that people can determine where they are when they see/hear a robin.
7. Colour-band for individual recognition and monitor at least 30 robins.
8. The colour-banded birds should be in as confined an area as possible so that at least 75% of the robins are banded. This will enable the territories of **all** robins (banded and unbanded) to be readily determined and the approximate boundaries mapped.

If you are unfamiliar with any of the techniques mentioned above, such as mist netting, and handling and banding of birds, it is vital that you obtain 'in-the-field' training in these techniques from an experienced person.

From our experience at Pureora, if the birds had not been banded we would not have believed some of the movements and territory shifts that we have seen. A few territorial males, paired or unpaired, in the non-breeding season, sometimes wander far (up to a kilometre) from their territories, later returning to them. We have had two instances of bachelor males abandoning their territories and establishing elsewhere. A female will occasionally desert her partner after the predation of her clutch or brood and pair with another male elsewhere. We have had one instance of a female abandoning her mate and fledglings to rear a brood with a neighbouring bachelor.

9. Monitor the presence/absence of banded and unbanded birds in each territory once a week. Keep a tick sheet or similar of birds seen/not seen for each day of field work. Towards the end of the month make repeated efforts to locate known but unseen/unidentified banded birds. Therefore, you

should end up with a spreadsheet showing which robins are present each month.

10. When monitoring nesting success and fledglings reared, check pairs at least once weekly until it is evident they are nesting. Once the nest has been found, check at least every third day. Maintain a tick sheet so that it is evident where in the nesting cycle each pair is and when they next need to be checked.

Occasionally, eggs are preyed on during egg-laying or early incubation and this is sometimes difficult to detect when the male is feeding fledglings from a previous brood and if the female rarely comes to you to be fed. Thus, monitoring the nesting behaviour of pairs that have dependent fledglings needs to be frequent (2–3 times per week) until the nest is found if you are to find most nests in situations when a high proportion are failing due to predations.

Duration of nesting stages:

Nest building	2–5 days
Pre-lay	2–7 days
Egg-laying	2–4 days [2–3 eggs, unusually 4]
Incubation	c. 18 days [usually starts with pentultimate egg]
Nestling	c. 21 days
Re-nesting after predation	3–10 days
Re-nesting after fledging chicks	5–25 days

[1]*Contact for the purchase of manually operated clap-traps is Norm Marsh, Wanganui Conservancy. Electronically operated clap-traps are available from Herman Weenink, Technical Services Bureau, c/o Science & Research, STIS, DoC, Wellington.*

[2]*I know of only one mealworm (Tenebrio larvae) supplier: Biosuppliers, 201 Eskdale Road, Birkenhead, Auckland (email: bugs@biosupp.ak.planet.gen.nz). Cost is about $40/2000 large larvae (includes p&p). It is relatively easy to grow a few (contact author for details), but not to ensure a supply of hundreds each week.*

3.2 To determine the mortality of robins during a conservation management programme and the time taken for the population's recovery

[The following example is for an aerial 1080 possum control operation]

***Objectives*:**

1. To determine the mortality of robins during a management action (e.g., aerial 1080 possum control operation or translocation to new habitat) in comparison with the normal mortality rate.
   a. % mortality of banded birds.
2. If birds disappear or are found dead, determine the time taken for the recovery of the population to its previous level.
   a. determine the number of robins within a defined area before the operation and at yearly intervals thereafter.
3. If appropriate, determine the impact of the operation on the target species (possums and rats) just before and during 2–4 weeks after the operation (would need to be later for an operation using brodifacoum as the toxin).

4. Monitor rainfall after the operation until at least 150 ml have fallen or until baits are non-toxic.
5. Monitor deterioration of poison baits and dead possums to determine when they become non-toxic.

Methods:

A. Before the bait drop

Carry out methods 1 to 6 in section 3.1 above, then continue as follows:

7. Select two study areas (non-treatment, treatment) that are reasonably similar in vegetation type and topography, and in which robins can be monitored. This is necessary if you are doing a short-term study. If a long-term study is being carried out, such that the species is being monitored rigorously every fortnight or month for at least a year before the poison drop, then with suitable survey procedures, a non-treatment area is not essential. However, the results will be more defendable if monitoring of robins in a non-treatment area is carried out.
8. Grid the study areas with taped lines at about 100 m intervals, and with each line being numbered at 50 m intervals so that people can determine where they are when they see or hear a robin.
9. Obtain or draw large scale maps of the study areas to mark general locations of robin territories on them.
10. Capture and band at least 30 robins in each study area in as confined an area as possible so that at least 75% of known birds are banded. Having a high proportion of birds banded in a defined area will assist territory mapping and post 1080 operation monitoring. At the time of the management operation there need to be **at least 20, and preferably 30**, banded robins in each study area that are known, from previous monitoring, to readily appear when the sound is made that they have been trained to respond to.
11. Determine the boundaries of all robin territories within a defined area, including those of unbanded birds.
12. Monitor the presence/absence of banded and unbanded birds once a week ('**a survey**') for at least a month prior to the expected date of the operation. Continue the weekly monitoring if the drop is delayed. Be particular about what you record, e.g.:
    a. heard bird in Rimu Territory but not seen;
    b. saw bird in Rimu Territory but unable to determine whether banded;
    c. saw banded bird in Rimu Territory but unable to determine identity;
    d. saw M-Y/R in Rimu Territory.

Keep a tick sheet of birds seen/not seen each **survey** and towards the end of the survey make repeated attempts to locate known but unseen or unidentified banded birds. It is important to decide what constitutes a **survey** for your project. It may mean a search that is completed within a day (which includes the initial search and then going back to locate any missed on the first check), two days, a week, or whatever. However, whatever you decide should be adhered to for all surveys, whether before or after the management action.

13. During the month prior to the expected poison drop, carry out standard index trapping for possums. Consult with your Wild Animal Management staff and use the approved national protocol for indexing possum populations (see 'Trap-Catch for Monitoring Possum Populations', Version 3.0, by Bruce Warburton).

    In brief, this is what is required:

    - Randomly select the starting points of lines (on a map of the treatment area, use North-South and East-West axes to select starting points.
    - Measure the maximum distance between the N and S, and E and W boundaries in mm. Select a random number between 1 and the maximum distance for both the N–S and E–W boundaries. The random starting point is the intersection of these two lines). The compass bearing for all lines should be the same.
    - Set five lines each of 20 soft catch traps (e.g., Victor No. 1) through areas of 50–500 ha to be spread with baits; larger areas require more lines.
    - Set the traps at 20 m intervals (above ground where kiwi or weka are present) along the measured (use a hipchain to measure accurately, and retrieve the cotton to prevent birds getting entangled in it) and flagged compass lines.
    - Smear lure (mixture of 10 kg white flour with 2 kg icing sugar) on the tree/shrub/stake that each trap is attached to.
    - Operate lines for three dry nights (300 trap nights), preferably consecutive fine nights.
    - Kill the possums and dispose of them at least five metres from the traps.
    - Replace lure daily if necessary.
    - Record results for each trap (untouched, sprung and no captive, identity of non-target captures, possum [colour, adult/juv.], rat [species — see Cunningham & Moors 1996]
    - Determine % trap-catch, percent kill and 95% confidence limits (see Warburton 1996 for calculation methods).

If no one in the team has prior experience of possum trapping, you will need to organise a training session (in the field) on setting traps with someone who has.

14. During the month prior to the expected poison drop, carry out a standard index of abundance for rodents by monitoring foot-print tracking occurrence in baited tracking tunnels (see King & Edgar 1977, Innes *et al.* 1995):

    - Set out 100 (if area allows) numbered tracking tunnels (timber base thickness 30 mm x width 65 mm x length 605 mm, coreflute[1] cover — height 125 mm x same width as base, containing a standard rodent tracking tray[2]) at 50 m intervals through each study area. Place a 5 mm thick piece of sponge in the centre section of each tray and soak with food colouring[3]. Place numbered (tunnel number) pieces of brown wrapping paper in either end of the tray. Bait each tunnel with 5 mm^3 of peanut butter on the timber base at both ends.
    - Remove papers after one dry night, and calculate percentage of tunnels with foot prints of each species (rat, mouse, mustelid, etc). Store papers for future reference.

[1]*Coreflute is manufactured by Mico Wakefield, 314 Neilson Street, Private Bag 92-910, Onehunga, Auckland (09-6341299). Sheets are 1800 mm x 1200 mm x 4 mm. Cost is about $12.80 per sheet; 10 sheets are required for 100 covers. Dimensions for each cover are 600 mm long x 125 mm high x 65 mm wide at top.*

[2]*Standard rodent tracking trays available from Jurgen Fiedler Plastics, NZ Forest Research Institute campus, Sala Street, P.O. Box 6071, Rotorua (07-3475712). Cost is about $7.85 each. Dimensions: 540 mm x 65 mm; the three sections are 180 mm x 65 mm.*

[3]*Use Hansells food colouring, available in 500 ml bottles, dilute 3 water:1 colouring.*

15. Approximately one week prior to the scheduled bait drop, collect samples of toxic cereal bait to determine size, 1080 loading, and degree of fracture, breakage and dust in the material. Samples to be collected as specified in 'Draft Protocol for 1080 pellet audits of Animal Control Products — Issue 2, June 1995'. In addition, note the general condition of pellets (e.g., mouldy or not). Retain samples frozen.

B. Day of Drop

1. Monitor poison drop:
   - Date.
   - Weather on the day.
   - Collect toxic carrot bait samples (2 kg samples at five different times during production) just prior to it being loaded into aircraft for later use to determine weight/size frequency distribution and toxic loading. Store frozen.
   - Check distribution and weights of baits on the ground; walk the taped lines and see if there are areas without baits, and individually weigh 50 baits.
   - Ensure you will get access to GPS data from the aircraft dropping the bait to assess coverage.

C. After the Poison drop

1. Set up an experiment on the day of the drop or next day to monitor degradation of baits:
   - Place 30–50 baits under wire-mesh covers (to protect from possums, rats and non-targets) at each of 5 marked sites.
   - Remove 5 baits from each mesh cover after about 25, 50, 75, 100, 125 and 150 mm of rain and store in freezer in labelled plastic bags. Note texture and intactness of baits under each mesh when baits are removed. Get 2 of the 5 samples of baits analysed for toxin loading after each set of samples have been collected.
2. Monitor daily rainfall until at least 150 mm has fallen or analyses indicate the baits are non-toxic (baits should be non-toxic after 150 mm!).
3. Collect and store frozen individually in a plastic bag any non-target dead animals found, with date and location indicated on plastic (waterproof) paper. Ideally all birds should be analysed for toxin.
4. Mark and monitor the rate of degradation of up to 10 dead possums and 10 rats until just bones are left (will need to be individually marked and protected from scavengers under wire-mesh).

5. Monitor presence/absence of the banded and known unbanded territorial robins in the treatment and non-treatment study areas weekly for four weeks after 1080 operations (several months after a brodifacoum operation), starting one week after the poison drop. This will indicate robin mortality (cost to the population) as a result of the poison operation.
6. Repeat indexing of possum and rat populations in the study areas between two and four weeks after the 1080 poison drop.
7. To determine the level of benefit (improved nesting success and/or reduced adult mortality) to a robin population as a result of a poison operation (reduced predator levels) it is necessary to determine the total number of robins in the defined areas of the two study areas one year, and probably two years, after the operation. In other words repeat task A8.

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