

Translocation of juvenile Chatham Islands tomtits (*Petroica macrocephala chathamensis*) from Rangatira and Pitt Islands to Chatham Island

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Abstract The Chatham Islands tomtit (*Petroica macrocephala chathamensis*) is a small forest passerine with a threat ranking of nationally endangered. It is restricted to 2 islands of the Chathams group that are free of introduced predators (Rangatira and Mangere Islands), and 1 with mice (*Mus musculus*) and feral cats (*Felis catus*) (Pitt Island). We carried out a translocation of 35 juvenile tomtits from Rangatira (10 male, 10 female) and Pitt Islands (6 male, 9 female) to Awatotara Valley, Chatham Island in January 2011. Mean weight at capture of Pitt Island tomtits was lighter than that of the Rangatira Island tomtits. Tomtits were held captive in aviaries for 1-3 days on the source islands and 2-4 days at the release site. Weight loss of tomtits in captivity prior to transfer averaged 1.8% of body mass per day held and was more pronounced in birds sourced from Rangatira than Pitt Island. Two birds died during the first night after transfer, but the other 33 were released in apparently good health. Eighteen of the released birds were seen at least once, and 11 regularly until 28 March (at least 55 days after release). During the following 12 days, all 11 of these tomtits disappeared. We discuss possible reasons for their disappearance, and aspects of the translocation that may be useful for future translocations of tomtits and other species with a similar ecology.

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INTRODUCTION

The Chatham Islands tomtit (*Petroica macrocephala chathamensis*) is a small (10-14 g) and sexually dimorphic forest passerine. It is resident and males are territorial year round (Heather & Robertson 2005). It has a threat ranking of Nationally

Endangered (Miskelly *et al.* 2008). In 2001, the total population, distributed on 3 islands, was estimated to number 800-1000 birds (Powlesland *et al.* 2001). Tomtits are present on 2 islands free of introduced predators: Rangatira I (218 ha, 200-300 birds) and Mangere I (113 ha, 70-100 birds). In addition, tomtits are present on Pitt I (6203 ha, c. 500 birds), where mice (*Mus musculus*), feral cats (*Felis catus*) and buff weka (*Gallirallus australis hectori*) were present.

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The species was last recorded on Chatham I (90650 ha) in 1976 (L. Howell, *pers. comm. in* Powlesland *et al.* 2001) and is now presumed to be extirpated. Since there are still extensive areas of shrublands and forest on the island, habitats utilised by tomtits, we suspect that the extinction of the subspecies on the island occurred as a result of predation by introduced mammalian predators, especially rat (*Rattus* spp.) species. Three rat species occur on Chatham I, ship rat (*R. rattus*), kiore (*R. exulans*), and Norway rat (*R. norvegicus*) (King 2005), although the latter seems to be confined to coastal areas and near human habitation (RGP, *pers. obs.*). Ship rats are known to take eggs, chicks and adults of a variety of small forest passerines, including roosting adults (King 2005). In addition, the brushtail possum (*Trichosurus vulpecula*) is widespread in forests of Chatham I, and also preys on eggs, nestlings and adult birds (King 2005). The fencing of forest patches to exclude farmed and feral stock, promoting forest regeneration, may have resulted in improved habitat quality for forest birds, including tomtits. The Awatotara Covenant (70 ha) is one such area and was fenced in 1992 (Dilks *et al.* 2010).

Chatham Islands tomtits were translocated from Rangatira I to Mangere I in 1987, and the population became self-sustaining (D.V. Merton, *pers. comm.*). The translocation consisted of 8 birds (7 adults and 1 juvenile), that were hard released on the day of capture. A second translocation of the subspecies was carried out in 1998 from Rangatira I to the Tuku Conservation Covenant, Chatham I, consisting of 25 birds (20 adults, 5 juveniles) (MB, *unpubl. data*). Again the process involved capture, transfer and hard release on the same day. No monitoring of the birds during the first few weeks after release occurred, and none were seen or heard in the release area subsequently.

There have been 4 other translocations of other subspecies of the tomtit on the New Zealand mainland. In 2001-04, several transfers resulted in 51 tomtits (39 male, 12 female) being taken from Akatarawa Forest of Hutt Valley and Kapiti I (Empson & Fastier 2013). The tomtits were held in aviaries at the capture sites, and then hard released into the predator-proof fenced Zealandia-Karori Sanctuary (Empson & Fastier 2013). While tomtits bred successfully in and adjacent to the sanctuary for several years, a self-sustaining population did not eventuate. In 2004, 32 tomtits (19 males, 13 females) were translocated from the Hunua Ranges, Auckland, to predator-free Tiritiri Matangi I. They were translocated on the day of capture and hard released (Parker *et al.* 2004). None of these birds were seen on the island 5 months later at the start of the 2004/05 breeding season (K. Parker, *pers. comm.*). At least 1 is known to have returned to its capture

site involving a flight of at least 56 km, with at least 1 over sea flight of 10 km (Parker *et al.* 2004). The third translocation involved the transfer of 6 adults in 2004 from Blumine I to Maud I, Marlborough Sounds, an island free of introduced mammalian predators. The birds were transferred on the day of capture and hard released. Although unbanded tomtits were subsequently seen on Maud I up until 2010, none have been seen since (B. Cash, *pers. comm.*). During 2007-2008, 26 tomtits (16 males, 10 females) were translocated from Maungataniwha Pine Forest to Cape Sanctuary, Hawkes Bay (Ward-Smith 2011). The birds were transferred on the day of capture, and either hard released that day or held overnight in transfer boxes and released the following morning. Tomtits bred successfully within a few months of being transferred, and a population has established (T. Ward-Smith, *pers. comm.*). Therefore, of 6 tomtit translocations, just 2 have been successful, and 3 of the unsuccessful projects involved translocations to sites free of introduced mammalian predators.

In 2009, the Chatham Islands Taiko Trust sought and received permission from the Department of Conservation to translocate tomtits from Rangatira I and from the Ellen Elizabeth Preece Conservation Covenant (EEPCC) (fenced to exclude weka and feral cats, but mice are present), Pitt Is to Awatotara Valley, Chatham I. Selection of the release site followed on-going possum and rat control there since 2008 (Tuanui & Tuanui 2009), and the successful translocation of Chatham Islands tui (*Prothemadera novaeseelandiae chathamensis*) to it during 2009-2010 (E. Tuanui & M. Bell, *unpubl. data*). The reasons for attempting to re-establish tomtits on Chatham I were to improve the long-term conservation status of the subspecies, and to engage the community in conservation initiatives so that future generations could see tomtits (Rangatira and Mangere Is are nature reserves and are not accessible to the public, and it can be difficult to travel to Pitt I). This paper details the translocation and monitoring procedures, and the outcome of the project.

METHODS

Capture

Mist-nets (30 mm mesh size) were used to capture most tomtits. Nets were erected along paths through forest where juveniles were encountered. Tomtits either flew into nets of their own accord or, on Rangatira I where they were used to receiving mealworm larvae (*Tenebrio molitor*) from researchers, flew into nets when trying to retrieve mealworms thrown on to the ground on the opposite side of the net. In addition, 2 birds that fed readily on mealworms were caught under drop-traps. On capture, 15 of 20 tomtits from Rangatira

I and 14 of 15 from EEPCC, Pitt I, were weighed, and all were individually colour-banded, and then taken individually in cloth bags and released in an aviary.

Juveniles only

Evidence from previous translocations of tomtits was the need to overcome the dispersal of tomtits from the release site as much as possible. We suspected that this occurred because adults attempted to return to their territories, even if it involved over sea flight. It was decided to tackle this problem by translocating only juveniles in late summer before they established themselves on territories. Tomtits were identified as juveniles by lack of wing moult (most adults were in moult at the time), unworn primaries, and pale streaking on their crowns (Higgins & Peter 2002). We attempted to capture 20 juvenile tomtits of an even sex ratio from both Rangatira I and Pitt I.

Maintenance in captivity

Tomtits were held in aviaries both at the capture sites and the release site. At each of the 2 capture sites, tomtits were held in a single aviary that was located under forest canopy. About half the roof of each aviary was covered with corrugated iron to provide shelter during rain. Several branches with many twigs and foliage were secured in each aviary to provide ample perches and cover for subordinate birds to hide. The floors were covered with a thick layer of forest leaf litter gathered not long before the first tomtits were released into each aviary. In addition, 2 buckets of freshly-gathered litter were spread in each aviary each morning as a source of natural prey for the birds. Water was supplied in a shallow container with a rock that gently sloped into the water so that birds were readily able to access water for drinking and bathing. The tomtits were provided with mealworm larvae soon after dawn and through to dusk at 1.5-hourly intervals. A total of 6 large to 10 medium-sized larvae were given per bird per feeding. The larvae were provided at 3 sites in each aviary (ground cleared of litter, tops of broad, flat stumps). While mealworm larvae made up the bulk of the captive birds' diet, slaters (Isopoda) and earthworms were offered. While tomtits readily fed on slaters, most slaters quickly sought cover and so avoided being captured. Captive birds were frequently watched after provision of food to determine all were feeding, and that no fights or persistent chases were occurring.

All 15 tomtits from Rangatira I that were weighed on initial capture were also re-weighed when re-captured in the aviary prior to transfer. Seven of the 14 birds weighed at initial capture on Pitt I were also re-weighed prior to transfer.

The Awatotara aviaries were tents, each composed of 3 sections off a central portion, set up with a water container, perches and foliage-covered branches, as were the aviaries on Rangatira and Pitt Is. The same husbandry practices were followed in the Awatotara Valley as was carried out on the islands.

To improve the chances of monitoring tomtit survival after release, each time the captive birds were approached to be fed a tapping sound was made. We hoped that the birds would associate the sound with a food reward, and so would approach us after release for mealworm larvae. Training with mealworms occurred while birds were captive for 1-2 days on Rangatira and Pitt Is, and continued while the birds were captive for 2-4 days at the release site. As birds were fed after release, we have classified this as a type of soft or delayed release (Parker *et al.* 2012).

Transfer

On the day of translocation, tomtits were fed at least twice before re-capture. Hand-nets were used to recapture birds. Birds were then weighed, and placed into boxes, with 2 birds per box. The boxes were pet carry-boxes containing forest litter and upright branches with many twigs and foliage that loosely filled each box. This vegetation provided the birds with ample perches and some cushioning in the event of sudden bumps during transportation. No water or food was provided, although there may have been a few prey items in the litter.

The transfer of the Rangatira tomtits on 21 Jan 2011 took about 4 hours: 3 hours by boat to Owenga, and then an hour by vehicle and being carried by hand in the boxes to aviaries in Awatotara Valley, Chatham I. The 20 tomtits were distributed between 2 aviaries, with a mix of males and females in each. The Pitt I tomtits were transferred in 2 batches, 9 on 25 Jan and 6 on 28 Jan. respectively. These tomtits were transferred by plane and vehicle, the process taking about 2 hours.

Monitoring survival

Following the first release of tomtits on 25 Jan various parts of the Awatotara Valley were searched for tomtits every few days until 12 Feb, after which they were carried out weekly to fortnightly. Searches involved walking the tracks and stopping at 50-100 m intervals where the habitat was suitable for tomtits or going off-track if tomtit contact calls were heard. At each search site, the mealworm container lid was tapped against the container to attract any tomtits nearby. During the Oct and Nov searches, Chatham Islands tomtit fullsong was broadcast for about 30 seconds at 100-200 m intervals along tracks.

Table 1. Factors influencing changes in weight of Chatham Islands tomtits (*Petroica macrocephala chathamensis*) while in captivity prior to translocation to Awatotara Valley, Chatham I, Jan 2011. *k* = number of parameters; AICc = Akaike's information criterion corrected for small sample size.

Model	<i>k</i>	Log likelihood	AICc	ΔAICc	AIC weight	Cumulative weight
Source	3	-76.29	159.92	0.00	0.40	0.40
Days captive + source	4	-75.64	161.64	1.72	0.17	0.57
Null	2	-78.54	161.72	1.80	0.16	0.73
Sex + source	4	-76.28	162.92	3.00	0.09	0.82
Sex	3	-78.28	163.89	3.97	0.05	0.87
Days captive * sex	5	-75.12	164.00	4.07	0.05	0.92
Days captive	3	-78.52	164.37	4.45	0.04	0.97
Sex * source	5	-76.14	166.03	6.11	0.02	0.99
Days captive + sex	4	-78.27	166.89	6.97	0.01	1.00
Days captive * source	5	-78.23	170.20	10.28	0.00	1.00

Weather records

Daily weather records for the Chatham I during 28 Mar to 10 Apr 2011 were obtained for station 6191 (43.95° S, 176.57° W) from the National Climate Database, National Institute of Water & Atmospheric Research.

Pest control

Sporadic control of possum and cat populations in the Awatotara Valley has occurred since 1994. Residual trap catch (RTC) rates for possums have tended to remain greater than 5%, but following control efforts in Jan-Feb 2011, the RTC was 0.0% in Feb 2011 (Tuanui & Tuanui 2012). Cat control using cage traps was carried out during Feb-Mar 2011 (Tuanui & Tuanui 2012). It is unknown to what extent the cat population was controlled by this trapping as there is no independent method of assessing cat numbers.

Kiore made up 12-14% of rats trapped in the Awatotara Valley during 1993-94. Ship rats comprised the remainder of the catch, and the numbers of both species peaked in late summer-autumn (Powlesland *et al.* 1995). During Jan-Feb 2011, rats in the lower Awatotara Valley were killed as a result of by-catch in possum traps, and from poisoning using diphacinone impregnated paste (RatAbate®) distributed in bait stations. Rat population indices before and after control efforts, using 32 tracking tunnels (presence/absence of rat footprints), were 68.7% and 3.1%, respectively (Tuanui & Tuanui 2012). A similar rat poisoning programme was carried out in the upper Awatotara Valley in Feb 2011, but no monitoring of rat population indices before and after the operation was undertaken (Tuanui & Tuanui 2012).

Statistics

We evaluated whether the number of days tomtits were held in captivity prior to transfer to Chatham I, source population (Pitt or Rangatira I) or sex influenced weight change (actual change divided by weight on initial capture) while in captivity using Akaike's Information Criterion corrected for small sample sizes (AICc; Burnham & Anderson 2002). Our dataset comprised the 22 birds that were weighed both at initial capture and again prior to transfer (7 from Pitt I and 15 from Rangatira I). The candidate model set considered included the null model, single factor models (for days in captivity, source and sex), 2-factor additive models and 2-factor interaction models (Table 1). The full model was not considered due to the overparameterisation it would involve given the small sample size. Statistical analyses were undertaken using the programme R (Version 2.12.1; R Development Core Team 2010).

RESULTS

Capture and weight changes in captivity

On Rangatira I, 10 male and 10 female juveniles were caught during 3 days (18-20 Jan). In comparison it took 6 days (22-27 Jan) to capture 15 tomtits, 6 males and 9 females, in the EEPCC, Pitt I. Mean capture weight of tomtits was 12.73 g (s.d. = 0.80, *n* = 15) for birds sourced from Rangatira I and 11.79 g (s.d. = 1.03, *n* = 14) for birds sourced from Pitt I (Student's *t*-test: *P* > 0.05).

Source island had the greatest influence on weight change of tomtits while in captivity prior to transfer, with time in captivity and sex having a lesser influence (Table 1). A model containing source island

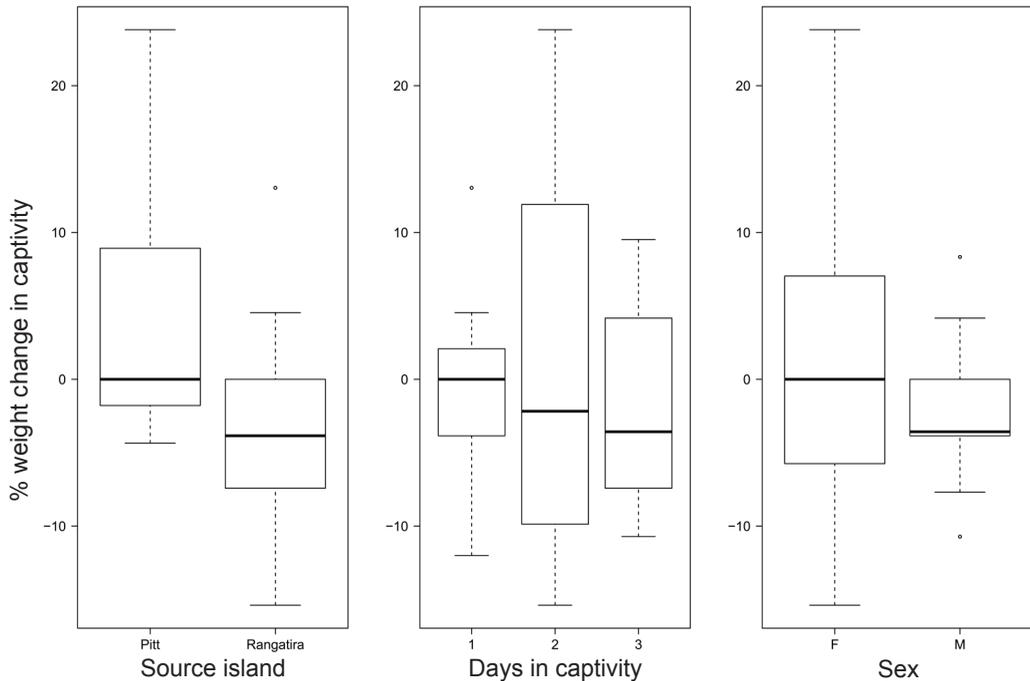


Fig. 1. Comparison of weight change in captivity (%) relative to 1) source island, 2) time in captivity, and 3) sex for Chatham Islands tomtits translocated to the Awatotara Valley, Chatham I, Jan 2011. Data presented relate to the 22 birds weighed both at capture and prior to transfer (7 from Pitt I and 15 from Rangatira I).

alone was the top-ranking model based on AIC model selection (AIC weight = 0.40), followed by a model containing time in captivity and source (AIC weight = 0.17; Table 1). Weight decrease in captivity (corrected for initial capture weight) was greater for tomtits sourced from Rangatira I than Pitt I (Fig. 1). Weight loss in captivity also appeared to increase slightly with time in captivity (model-averaged estimate = 1.8% per day held), and there was a weak trend for weight loss being more pronounced for males than females (Table 1; Fig. 1).

Transfer

Two of the Rangatira birds, a male and a female, died during the 1st night in the Awatotara aviaries, but the other 33 birds (15 male, 18 female) were released in apparently good condition. The Rangatira tomtits were released on 25 Jan, 4 days after arrival. The release involved opening the aviary door, providing mealworms on the ground outside, and allowing the birds to come out at their own pace. Most left within 15 minutes, fed on mealworms and then foraged in the understorey and canopy around the aviaries before dispersing. At least 2 returned to the aviary after feeding, and another was found inside the following day. The Pitt I tomtits were released in 2 batches, the 1st on 27 Jan, 2 days after arrival, and the 2nd on 1 Feb, 4 days after arrival.

Survival

Fifteen of the 33 tomtits (45.4%), 5 males (33.3%) and 10 females (55.6%), were not seen following release. Of the other 18 birds (10 male, 8 female), 11 (9 male, 2 female) were seen on all or most days that an extensive search was made through the Awatotara and adjacent Kiringe Valleys (8, 10 & 12 Feb, 7, 20 & 28 Mar 2011) (Fig. 2). Overall, 9 of 15 males and just 2 of 18 females were evident on 28 Mar, 55 days after the last release of tomtits on 1 Feb. Apparent survival of females (11.1%) was lower than that of males (60.0%) (Fisher Exact test: $P = 0.038$). Each of the 11 tomtits that were evident on 28 Mar was invariably seen in the same general location during each of these 6 searches, and they readily approached observers and fed on offered mealworm larvae. On 3 Apr just 3 tomtits were seen, and on 10 Apr none were observed (Fig. 2). Although further extensive searches were made on 19 May, *c.* 1 Jun, 1, 20, 26 and 28 Oct and 4 Nov, no tomtits were seen or heard. We did not resurvey the source populations to determine whether any of the translocated tomtits returned to Rangatira or Pitt Is.

Daily weather records for Chatham I during 28 Mar-10 Apr 2011, when the tomtits disappeared, indicate mild temperatures (12.0-18.0 °C maximum, 5.7-14.7 °C minimum), little rainfall (0.0-13.5 mm),

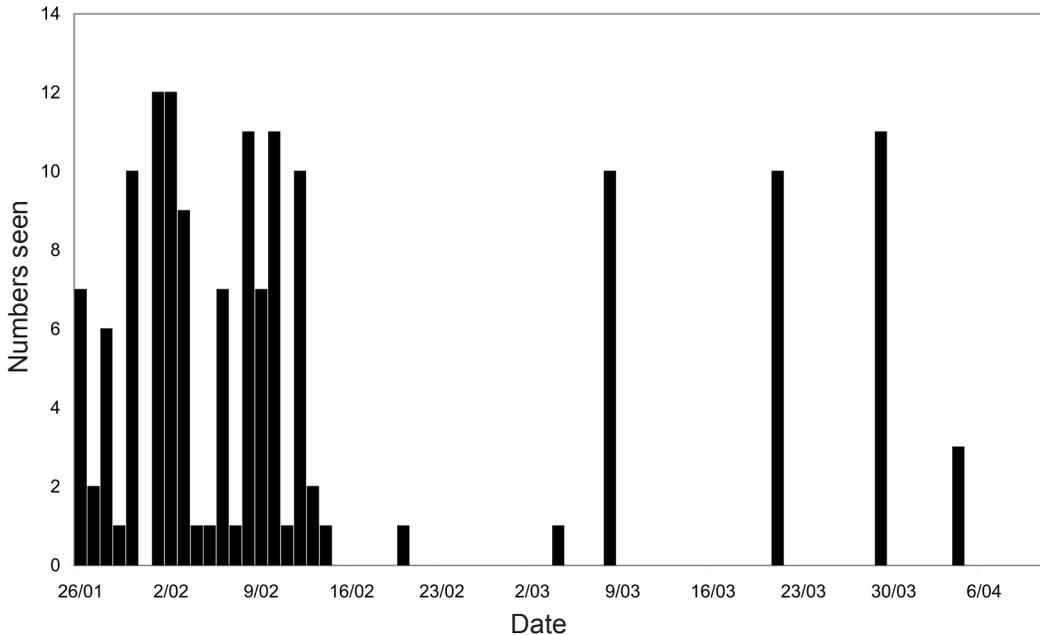


Fig 2. Number of translocated Chatham Islands tomtits seen in the Awatotara Valley, Chatham I, following releases on 25 Jan ($n = 18$), 27 Jan ($n = 9$) and 1 Feb 2011 ($n = 6$).

but strong winds (8.8–27.3 m/sec maximum gust speed). On 7 of the 14 days, the maximum wind gust speed was of gale or storm force (> 17.2 m/sec) with regard to the Beaufort scale.

DISCUSSION

Thirty-five juvenile tomtits were transferred from Rangatira and Pitt Is to Awatotara Valley, Chatham I in Jan 2011. Tomtits were held captive in aviaries for 1–3 days on the source islands and 2–4 days at the release site. Two birds died during the first night after transfer, but the other 33 were released in apparently good health. Eighteen of the released birds were seen at least once, and 11 regularly until 28 Mar (at least 55 days after release). During the following 12 days, all 11 of these tomtits disappeared, resulting in the failure of the translocation.

Although there were ample juveniles present in EEPCC, Pitt I, they proved more difficult to capture than those on Rangatira I, probably because researchers had not studied *Petroica* species at this site and so the tomtits were not used to feeding on mealworm larvae offered to them.

The lower mean capture weights of the Pitt I tomtits compared to that of the Rangatira I tomtits probably reflects a difference in invertebrate prey availability between the 2 islands. Rangatira I has a mosaic of forest, shrub and vine habitats covering much of the island, no introduced mammals, and the nutrient input from hundreds of thousands of

breeding seabirds (Miskelly 2008). In contrast, the EEPCC, Pitt I has a developing forest following the exclusion of grazing stock in 2001, mice and few breeding seabirds (Miskelly 2008). The impact of mice on invertebrates is likely to have resulted in fewer invertebrates or lower biomass being available to tomtits in the EEPCC than on Rangatira I (King 2005; Towns *et al.* 2009). However, birds from Rangatira I lost more weight in the 1–3 days in captivity prior to transfer than the Pitt I birds. This may have occurred because of the stress associated with having 20 birds in the aviary on Rangatira I, and a maximum of 9 in the Pitt I aviary. In addition to weight loss, stress can have other detrimental consequences, such as increased vulnerability to disease, starvation and predation (Parker *et al.* 2012). Whether any of these factors contributed to the disappearance of the tomtits translocated to Chatham I is unknown.

The weight loss of tomtits during confinement in captivity for up to 3 days (and estimated at 1.8% of body mass per day held) may have been sufficient to impact on their survival following release. To investigate this concern would require a more detailed study involving suitable numbers of birds.

The loss of 2 tomtits in captivity in the Awatotara Valley was probably as a result of stress endured during the transfer from Rangatira I to the valley. In future, reducing the transport time, and isolating birds from vibration and noise when being transported by boat should be a priority consideration.

The apparent lower survival of females (11.1%) than males (60.0%) until 28 Mar 2011 in the Awatotara Valley appears unrelated to weight loss while in captivity (Fig. 1). In comparison, the survival of male (20.5%, $n = 39$) and female (16.7%, $n = 12$) North Island tomtits (*Petroica macrocephala toitoi*) for at least 2 months after release that had been translocated to Zealandia-Karori Sanctuary (Empson & Fastier 2013) was not significantly different (Fisher Exact test: $P = 0.731$). However, in this case there were complicating factors; tomtits came from 2 sites (Kapiti I and Akatarawas), were captured over 4 years, and from May to Sep (Empson & Fastier 2013). It is possible that the greater mortality of females in Awatotara Valley actually reflects dispersal beyond the study site, or that they remained inconspicuous. Most males quickly claimed an area of forest habitat, by the day after release for 4 males, which they defended vigorously against other tomtits, including females. This almost exclusive use of an area is typical male behaviour among New Zealand *Petroica* species during the non-breeding season (Steer & Burns 2008), such that some paired females are often found in areas not commonly used by their mates (RGP, *pers. obs.*). Therefore, it is possible that more female tomtits were present in the Awatotara Valley than our monitoring results suggest.

Given the quick establishment of some males to specific areas in which they were repeatedly relocated for nearly 2 months (until 28 Mar), the disappearance of these tomtits and any others by 10 Apr is puzzling (Fig. 2). It seems unlikely that they would all abandon their territories during, at most, a 12-day period and go elsewhere without any being encountered during searches for them. While daily maximum wind gusts of gale and storm force occurred during the period, that temperatures were mild and little rainfall fell suggests that weather was probably not a contributing factor to the disappearance of the tomtits. Also, while it cannot be discounted, because the longer-surviving 11 tomtits were well spaced through the valley, it seems unlikely that a feral cat(s) would have managed to find and kill all these birds within a fortnight. This leaves rat predation as a possible explanation. When present, kiore (70–80 / ha in forest on Tiritiri Matangi I) and ship rat (2–6 / ha in North I podocarp-hardwood forests) can occur at moderate to high densities (King 2005), and populations tend to peak in autumn (Powlesland *et al.* 1995; King 2005), which coincide with the time when the Chatham Islands tomtits disappeared. Ship rats are known to prey on passerines in the non-breeding season (Bell 1978; Dilks *et al.* 2003).

While this project failed to re-establish the Chatham Islands tomtit on Chatham I, there were 2 aspects of it that may be useful during future translocations of tomtits (*Petroica macrocephala*),

and perhaps other species. The transfer of juvenile tomtits to reduce the tendency of homing seems to have been reasonably successful, with at least a third of the birds remaining close to the release area for several weeks. The other aspect was training the captive birds to approach observers once released for a food reward so as to improve our ability to locate them and monitor their survival. All but 1 of the 18 birds that were seen after release were able to be fed mealworms, which meant less time searching for them, and that they approached us reasonably closely and for sufficient time for us to be able to determine their colour band combinations.

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