

## Garden birds at Rangiora, Christchurch, and Kaikōura, South Island, New Zealand: results from banding 1961–2016

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**Abstract:** Birds were banded in gardens at Rangiora 1961–1977, Christchurch 1977–2000, and Kaikōura 2000–2016. In total, 21,565 birds of 14 species were captured in mist-nets or traps and banded; 3,213 individuals were recovered or recaptured. The most common species banded was silvereeye (*Zosterops lateralis lateralis*) with 15,349, followed by house sparrow (*Passer domesticus domesticus*) with 4,497, and common starling (*Sturnus vulgaris vulgaris*) with 430; all other species were less than 300 birds banded which is less than five birds per year. Distance recoveries of note are: silvereeyes - Kaikōura to Wellington (153.0 km), Rangiora to Greymouth (146.0 km), Rangiora to Otira (99.0 km), with two more birds over 25.0 km; house sparrow - Christchurch to Homebush (43.5 km), with two more over 25.0 km; common starling - Rangiora to Christchurch (27.8 km); dunnoek (*Prunella modularis*) - local movement (5.1 km). The most significant recoveries from time of banding to recovery are: silvereeye - 8.8 years; house sparrow - 8.7 years; starling - 8.0 years; dunnoek - 5.3 years. Wing length and mass measurements of Kaikōura birds were generally within published ranges.

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### INTRODUCTION

From 1958 through the 1970s, the late Ken Rowe held a general bird banding permit that allowed him to band almost every species apart from game birds, providing he had suitable bands. Banding was carried out at home, rivers, coasts, offshore islands, in fact, wherever a bird could be caught,

often in the company of staff from the former Wildlife Branch of the Department of Internal Affairs. His aim was simple: band anything that could be caught, see what resulted, and make the data available to anyone who wished to use it. The best example was banding red-billed gulls (*Larus novaehollandiae scopulinus*) at Kaikōura from 1959 to 1963 which progressed into a study by Jim Mills continuing through to the present day (e.g. Mills 1970; Mills *et al.* 2018). The author took over his

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general permit until the days of “band and fling” ended and continued as more specific programmes were required.

Prior to 1950, homemade bands were used in many bird studies, and early work on the life history of silvereyes was reported by Fleming (1943). A study of silvereyes at 14 New Zealand sites was also compiled by Marples (1944). In 1950 the first bird, a silvereye (*Zosterops lateralis lateralis*), was banded under the Ornithological Society of New Zealand’s new banding scheme where unique numbered bands were issued (Cunningham 1951). The Department of Conservation (DOC) database holds records of birds banded under that scheme and those now issued under the New Zealand National Bird Banding Scheme. Silvereyes are the most banded of the passerines found in urban gardens with the database holding 113,991 records at 31 March 2013 (Jamieson *et al.* 2016). House sparrows (*Passer domesticus domesticus*) were next with 46,184 records and other species of interest to this study ranged from 19,885 for common starling (*Sturnus vulgaris vulgaris*) to 1,283 for the South Island New Zealand fantail (*Rhipidura fuliginosa fuliginosa*).

Despite there being much banding of passerines at urban sites for over 70 years there has been relatively little information published in the New Zealand literature. Banding has been used to determine: bird populations in the Botanic Gardens, Dunedin (Kikkawa 1959); the number of silvereyes visiting winter feeding stations in Dunedin (Kikkawa 1962); movements of blackbirds (*Turdus merula merula*) and song thrushes (*T. philomenos*) in the Hutt Valley (Bull 1953, 1959) and house sparrows, also in the Hutt Valley (Waddington & Cockrem 1987); and changes in mass of silvereyes with time (Bell & Bell 2010). More studies on banded birds have been carried out in forest and farmland situations: for example, breeding of bellbirds (*Anthornis melanura melanura*) (Sagar 1985, Anderson & Craig 2003), fantails (McLean & Jenkins 1980; Powlesland 1982), and grey warblers

(*Gerygone igata*) (Gill 1983); determining home ranges of bellbirds (Sagar 1985; Anderson & Craig 2003; Spurr *et al.* 2010); population composition of bellbirds (Sagar & Scofield 2006, 2014); feeding of fantails (Powlesland 1982); bird diets and seed dispersal (Williams & Karl 1996).

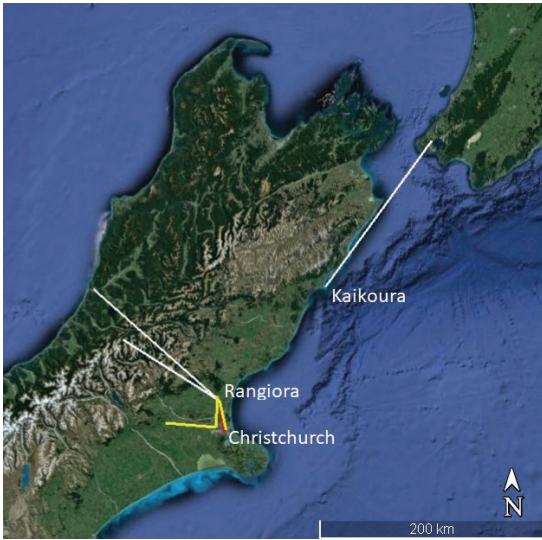
This paper follows others in which I present information from our banding efforts, mainly time since banding and dispersal for recoveries, recaptures, and sightings (e.g. Rowe 2013, 2014).

## METHODS

Banding sites were in suburban gardens at the residences of Ken Rowe in Rangiora, the author in Rangiora, Christchurch, and Kaikōura, and at several other sites (Table 1; Fig. 1). Banding took place at Rangiora during 1961–1977, at Christchurch 1977–2000, and at Kaikōura 2001–2016 using unique numbered metal bands supplied, initially, by the Banding Office of the Wildlife Branch of the Department of Internal Affairs and then the Department of Conservation (DOC). Birds were caught in a Potter trap, a sparrow trap, or mist-nets (Melville 2011) often using bread as bait. The time spent banding varied over the years as it took place after school or work, at weekends, and holidays with most banding taking place from autumn once silvereyes appeared until spring when the flocks disappeared, and if the weather was suitable, i.e. it was not raining or there was little wind to affect the net. There were a few years when little banding was carried out, e.g. 1994 and 1995 at a new property with few plants to attract birds. No record was kept of capture methods used on specific days which does influence species caught. For example, on windy days when the mistnet was not set, blackbirds were not caught as they would avoid the sparrow trap, but silvereyes could be. Nor was banding effort over time recorded but a surrogate is the number of days on which birds were handled. This will, however, be an underestimate as the number of days with nil captures is not known.

**Table 1.** Major bird banding locations. These are all gardens in residential suburbs with significant farmland nearby.

| Location                          | Latitude (°S) | Longitude (°E) | Distance to farmland (km) |
|-----------------------------------|---------------|----------------|---------------------------|
| Rangiora, 120 King Street         | 43.307        | 172.591        | 0.70                      |
| Rangiora, 4 Wallace Place         | 43.296        | 172.592        | 0.01                      |
| Rangiora, 4 other sites           | -             | -              | 0.01–0.66                 |
| Christchurch, 34 Radbrook Street  | 43.514        | 172.559        | 0.90                      |
| Christchurch, 22a Highfield Place | 43.518        | 172.561        | 1.40                      |
| Christchurch, 8 Kintyre Drive     | 43.522        | 172.532        | 0.09                      |
| Kaikōura, 11 Margate Street       | 42.415        | 173.691        | 0.17                      |



**Figure 1.** Upper South Island, New Zealand, showing the banding locations and the long-distance (>25 km) recoveries of silvereyes (white lines), house sparrows (yellow lines), and the starling (red line). Hidden are two silvereye recoveries of Rangiora banded birds at Christchurch (Picture: Google Earth 6 November 2019).

Data used here have been sourced from the author's files or from DOC Banding Office records. A recovery is defined as a banded bird that is later found dead, and a recapture is a bird that is subsequently caught again and released alive at the banding site (Melville 2011); the few birds found and released alive away from the banding site are referred to here as sightings. Generally, banded birds were classified as adults of unknown age (1+ years) unless there were definite reasons to classify them as pullus (p) or juvenile (j). Thus, the time between banding and subsequent recapture/recovery will usually be a minimum age. Where the sex is confidently known it may be abbreviated to m for male, f for female, otherwise nd for not determined. The DOC records have a potential inherent distance error as many birds recovered/recaptured at the banding sites were shown as movements of 8 km or 19 km. Hence, those records have been reset to 0 km, and for birds found away from the banding sites distances have been recalculated as point-to-point distances using Google Earth.

From 2007, some birds had wing lengths measured to 1 mm using a stop end rule (Melville 2011), and mass recorded to 0.1 g using an electronic scale, the calibration of which was checked with scientific quality standard weights. Where a week of the year is specified, week 1 starts on 1 January, and so on, and the season after that of banding is given as year 1, and so on. Unless specified, a

season referred to herein is loosely defined as April through September.

Averages are given with 95% confidence limits; statistical tests used are those found in the Microsoft Excel™ package, Freese (1967), or Sokal & Rolfe (1981), and significance is determined at the 95% confidence level.

Species nomenclature follows Gill *et al.* (2010).

## RESULTS

In total, 21,565 birds of 14 passerine species were banded and 3,213 individuals subsequently seen dead or alive (Table 2). By town, the number of birds banded and individuals seen later were, respectively: Rangiora 7,262 and 1,343; Christchurch 6,344 and 779; Kaikōura 7,959 and 1,133.

### Yellowhammer *Emberiza citrinella*

Sixteen yellowhammers ( $j = 1$ ,  $1+ m = 9$ ,  $1+ f = 3$ ,  $1+ nd = 3$ ) were caught in mistnets and banded at Rangiora, 12 at a site adjacent to farmland and four further in the township; none were seen again after banding. No yellowhammers were banded at Christchurch nor at Kaikōura although one study site at Christchurch and the Kaikōura site were within 200 m of farmland.

### Bellbird *Anthornis melanura melanura*

No bellbirds were banded at Rangiora or Christchurch although they were seen occasionally (LKR *pers. obs.*). There were 25 bellbirds caught in mistnets and banded at Kaikōura and of those with recorded sex, 11 were 1+ males and 12 were 1+ females. An adult male was recaptured at the banding site after 88 days and another after 2.0 years.

At Kaikōura, wing length and mass were recorded for six female and five male bellbirds. An unpaired sample t-test indicated wing lengths were significantly different between the sexes: male average 92.0 mm (sd = 2.9 mm, 95% CI =  $\pm 2.6$  mm, range 88–95 mm,  $n = 5$ ); female average 85.2 mm (sd = 4.7 mm; 95% CI =  $\pm 3.8$  mm, range 79–90 mm,  $n = 6$ ); unpaired sample t-test  $t = 2.81 > t_{p=0.05} = 2.26$ ,  $df = 9$ . Similarly, mass was significantly different between the sexes: male average 35.3 g (sd = 1.1 g, 95% CI =  $\pm 1.0$  g, range 34.0–36.8 g,  $n = 5$ ); female average 30.0 g (sd = 2.4 g, 95% CI =  $\pm 1.9$  g, range 26.9–32.7 g,  $n = 6$ ); unpaired sample t-test  $t = 4.48 > t_{p=0.05} = 2.26$ ,  $df = 9$ .

### South Island New Zealand fantail *Rhipidura fuliginosa fuliginosa*

None of the 40 fantails caught in mist nets at the three towns (Rangiora 14;  $p = 4$ ,  $1+ = 10$ ; Christchurch 7;  $1+ = 7$ ; Kaikōura 19;  $j = 1$ ,  $1+ = 18$ ) were seen again.

**Table 2.** Numbers of birds banded at Rangiora, Christchurch and Kaikōura between 1961 and 2016 and individuals recovered, or recaptured/sighted and released alive.

|                                  | Rangiora     |           |              | Christchurch |            |            | Kaikōura     |           |              | Total         |            |              |
|----------------------------------|--------------|-----------|--------------|--------------|------------|------------|--------------|-----------|--------------|---------------|------------|--------------|
|                                  | Banded       | Recovered | Alive        | Banded       | Recovered  | Alive      | Banded       | Recovered | Alive        | Banded        | Recovered  | Alive        |
| Yellowhammer                     | 16           | 0         | 0            | 0            | 0          | 0          | 0            | 0         | 0            | 16            | 0          | 0            |
| Bellbird                         | 0            | 0         | 0            | 0            | 0          | 0          | 0            | 0         | 2            | 25            | 0          | 2            |
| South Island New Zealand fantail | 14           | 0         | 0            | 7            | 0          | 0          | 19           | 0         | 0            | 40            | 0          | 0            |
| Song thrush                      | 20           | 1         | 1            | 13           | 1          | 0          | 18           | 0         | 0            | 51            | 2          | 1            |
| Common redpoll                   | 16           | 1         | 0            | 60           | 0          | 1          | 21           | 0         | 0            | 97            | 1          | 1            |
| Grey warbler                     | 20           | 0         | 0            | 10           | 0          | 0          | 75           | 0         | 7            | 105           | 0          | 7            |
| European greenfinch              | 32           | 0         | 0            | 34           | 1          | 1          | 53           | 0         | 2            | 119           | 1          | 3            |
| European goldfinch               | 8            | 0         | 0            | 27           | 0          | 0          | 91           | 0         | 3            | 126           | 0          | 3            |
| Chaffinch                        | 28           | 0         | 0            | 37           | 0          | 1          | 149          | 0         | 5            | 214           | 0          | 6            |
| Dunnock                          | 25           | 1         | 2            | 58           | 1          | 3          | 142          | 1         | 25           | 225           | 3          | 30           |
| Eurasian blackbird               | 70           | 1         | 6            | 75           | 13         | 18         | 126          | 3         | 25           | 271           | 17         | 49           |
| Common starling                  | 150          | 12        | 13           | 260          | 15         | 6          | 20           | 0         | 0            | 430           | 27         | 19           |
| House sparrow                    | 1,255        | 22        | 116          | 2,200        | 48         | 83         | 1,042        | 8         | 103          | 4,497         | 78         | 302          |
| Silvereye                        | 5,608        | 54        | 1,113        | 3,563        | 44         | 501        | 6,178        | 9         | 940          | 15,349        | 107        | 2,554        |
| <b>Total</b>                     | <b>7,262</b> | <b>92</b> | <b>1,251</b> | <b>6,344</b> | <b>123</b> | <b>614</b> | <b>7,959</b> | <b>21</b> | <b>1,112</b> | <b>21,565</b> | <b>236</b> | <b>2,977</b> |

Three fantails caught and banded at Kaikōura were black-morph.

Eleven adult fantails of undetermined sex at Kaikōura were measured: wing length average 73.8 mm (sd = 2.1 mm, 95% CI = ± 1.3 mm, range = 70–77 mm, n = 11); mass average 7.8 g (sd = 0.4 g, 95% CI = ± 0.2 g, range = 7.3–8.5 g, n = 11).

**Song thrush *Turdus philomelos***

There were 20 song thrushes (j = 9, 1+ nd = 11) banded at Rangiora, 13 at Christchurch (j = 4, 1+ nd = 9) and 18 (j = 1, 1+ nd = 17) at Kaikōura, all caught in mistnets. The number of birds sighted after banding was low; one adult bird was killed by a cat 110 m from the banding site in Rangiora, another Rangiora bird was recaptured after 2.1 years, and one Christchurch bird was found dead at an undefined location after 12 days.

Seven unknown sex adult song thrushes at Kaikōura were measured: wing length average 118.0 mm (sd = 3.2 mm, 95% CI = ± 2.4 mm, range = 114–122 mm, n = 7); mass average 73.9 g (sd = 8.3 g, 95% CI = ± 6.7 g, range = 62.9–83.6 g, n = 6).

**Common redpoll *Carduelis flammea***

Banding redpolls at Rangiora (n = 16: p = 5, j = 1, 1+ m = 3, 1+ f = 3, 1+ nd = 4), Christchurch (n = 60: 1+ m = 5, 1+ f = 13, 1+ nd = 42) and Kaikōura (n = 21: 1+ m = 3, 1+ f = 3, 1+ nd = 15) resulted in one adult male being found dead at the Rangiora banding site after 1.8 years, and one live recapture at Christchurch 7 days after it was banded. All redpolls were caught in mistnets.

Measurements of redpolls at Kaikōura were taken for three females, three males and nine with undetermined sex. Overall, the average wing length was 39.0 mm (sd = 1.5 mm, 95% CI = ± 0.8 mm, range = 66–71 mm, n = 15) and the average mass was 11.3 g (sd = 0.7 g, 95% CI = ± 0.4 g, range = 9.8–12.5 g, n = 15); unpaired sample t-tests indicated there were no significant differences between the small samples of each sex (wing length  $t = 0.14 < t_{P=0.05} = 2.78$ , df = 4; mass  $t = 0.04 < t_{P=0.05} = 2.78$ , df = 4).

**Grey warbler *Gerygone igata***

All grey warblers banded (Rangiora 20; Christchurch 10; Kaikōura 75) were caught in mistnets and, except for 1 juvenile at Kaikōura, were aged 1+ years. The seven recaptures were all Kaikōura birds: 4 within 2 months of banding, 2 more within 12 months, and 1 at 1.9 years.

Thirteen Kaikōura grey warblers were measured: wing length averaged 53.3 mm (sd = 1.5 mm, 95% CI = ± 0.8 mm, range = 51–56 mm, n = 13); mass averaged 6.4 g (sd = 0.3 g, 95% CI = ± 0.2 g, range = 5.9–7.0 g, n = 13).

**European greenfinch *Carduelis chloris***

In total 119 greenfinches were banded: Rangiora 32 all 1+; Christchurch 34 (1+ m = 8, 1+ f = 1, 1+ nd = 25); Kaikōura 53 (j = 1, 1+ m = 29; 1+ f = 16; 1+ nd = 7) (Table 2). Where there are available data, no birds were caught in the sparrow trap, only mistnets. There were no recoveries/recaptures of Rangiora birds. One Christchurch bird was recaptured after three years and one was found dead at an undisclosed site after 1.2 years. Two live recaptures, one male and one female, at Kaikōura were within two weeks of banding.

The wing lengths of Kaikōura 1+ birds averaged 87.0 mm (sd = 3.0 mm, 95% CI = ± 1.2 mm, range = 79–92 mm, n = 26) with no significant differences between males and females: males average 87.7 mm (sd = 3.3 mm, 95% CI = ± 1.7 mm, range = 79–92 mm, n = 15); females average 85.0 mm (sd = 2.2 mm, 95% CI = ± 1.6 mm, range = 82–89 mm, n = 7); unpaired sample t-test:  $t = 1.95 < t_{p=0.05} = 2.09$ , df = 20. Mass of 1+ birds averaged 27.3 g (sd = 2.1 g, 95% CI = ± 0.8 g, range = 22.9–30.4 g, n = 27) and there was no significant difference between sexes: male average 27.4 g (sd = 1.8 g, 95% CI = ± 0.9 g, range = 24.6–30.1 g, n = 15); females average 27.8 g (sd = 2.5 g, 95% CI = ± 1.7 g, range = 22.9–30.4 g, n = 8); unpaired sample t-test:  $t = 0.45 < t_{p=0.05} = 2.08$ , df = 21.

**European goldfinch *Carduelis carduelis britannica***

There were no recoveries/recaptures of the eight goldfinches ( $p = 5$ , 1+ nd = 3) banded at Rangiora and 27 1+ nd birds banded at Christchurch. At Kaikōura 91 goldfinches were banded (j = 6, 1+ m = 22, 1+ f = 19, 1+ nd = 46) and there were three recaptures of females at the banding site 6, 23 and 84 days after banding. Goldfinches were only caught in mistnets.

The wing lengths of Kaikōura 1+ males were significantly larger than females: males average 79.5 mm (sd = 2.6 mm, 95% CI = ± 1.2 mm, range = 74–83 mm, n = 17), females average 77.1 mm (sd = 2.5 mm, 95% CI = ± 1.1 mm, range 72–81 mm, n = 19); unpaired sample t-test:  $t = 2.78 > t_{p=0.05} = 2.03$ , df = 32. Males were also significantly heavier: males average 15.7 g (sd = 1.2 g, 95% CI = ± 0.6 g, range = 12.0–17.7 g, n = 18), females average 14.9 g (sd = 1.2 g, 95% CI = ± 0.5 g, range = 12.7–16.6 g, n = 19); unpaired sample t-test:  $t = 2.18 > t_{p=0.05} = 2.03$ , df = 35.

**Chaffinch *Fringilla coelebs***

Since August 2008 at Kaikōura when the capture method was first noted, only two chaffinches of 60 caught were in the sparrow trap, the others being in a mistnet. No chaffinches were recovered and recaptures at the banding sites were few. None of

28 chaffinches banded (j = 1, 1+ m = 5, 1+ f = 16, 1+ nd = 6) at Rangiora was seen again. One female of 37 chaffinches banded (1+ m = 10, 1+ f = 23, 1+ nd = 4) at Christchurch and three (two female and one male) of 149 birds banded (1+ m = 63, 1+ f = 84, 1+ nd = 2) at Kaikōura were recaptured within 14 days of banding. Another Kaikōura male was recaptured at 0.9 years and again at 1.2 years, and a third male at 4.1 years after banding.

Measurements of chaffinches at Kaikōura showed females had significantly shorter wing lengths than males: male average 87.1 mm (sd = 3.2 mm, 95% CI = ± 1.2 mm, range = 80–93 mm, n = 26); female average 81.6 mm (sd = 2.4 mm, 95% CI = ± 0.8 mm, range = 78–88 mm, n = 38); unpaired sample t-test:  $t = 7.89 > t_{p=0.05} = 2.00$ , df = 62. Females were also lighter: male average 22.8 g (sd = 1.6 g, 95% CI = ± 0.6 g, range = 19.7–27.5 g, n = 27); female average 21.1 g (sd = 1.4 g, 95% CI = ± 0.5 g, range = 18.4–25.1 g, n = 37); unpaired sample t-test:  $t = 4.37 > t_{p=0.05} = 2.00$ , df = 62. One female chaffinch recaptured eight days after banding was 1.0 g (4.5%) lighter whereas a male caught at 0.9 years and at 1.2 years after banding had smaller changes; +0.4 g and +0.1 g, respectively.

**Dunnock *Prunella modularis***

Twenty-five dunnock were banded at Rangiora, 58 at Christchurch and 142 at Kaikōura (Table 2). All birds were aged 1+ except for two juveniles banded at Christchurch; there was the occasional bird caught in the sparrow trap when set but most were captured in mistnets. One dunnock was recovered at the banding site in Rangiora where it had been killed by a cat nine days after banding; two others were recaptured after 83 and 128 days. Three Christchurch birds were seen at the banding site after 62 days, 0.9 years, and 1.9 years; a fourth bird was found dead 126 days after banding 5.1 km away. One dunnock banded at Kaikōura was found dead 100 m from the banding site after 84 days. Another 25 Kaikōura birds (18% of the dunnocks banded) were recaptured a total of 42 times at the banding site; 18 birds were only seen in their first year after banding, three more birds were last seen up to two years after banding, and another four between 2.0 and 5.3 years after banding. The dunnock last seen after 5.3 years had been recaptured five times previously.

The average wing length of dunnocks measured at Kaikōura was 69.5 mm (sd = 2.1 mm, 95% CI = ± 0.4 mm, range = 64–73 mm, n = 85) and their mass averaged 21.0 g (sd = 15 g, 95% CI = ± 0.3 g, range = 17.6–26.8 g, n = 87). Birds that were subsequently recaptured weighed in the range -1.2 (-5.7%) and +2.9 g (+14.5%) of their mass at banding.

**Table 3.** Numbers of individual blackbirds recovered or recaptured/resighted and released alive that were banded at Rangiora, Christchurch and Kaikōura between 1961 and 2016.

| Town         | Banded    |            |           |          | Recaptured/sighted alive |          |           |           |          |                       | Recovered dead           |          |          |          |          |                       |                          |
|--------------|-----------|------------|-----------|----------|--------------------------|----------|-----------|-----------|----------|-----------------------|--------------------------|----------|----------|----------|----------|-----------------------|--------------------------|
|              | j&p       | m 1+       | f 1+      | nd 1+    | Total                    | j        | m 1+      | f 1+      | nd 1+    | Maximum distance (km) | Maximum duration (years) | j        | m 1+     | f 1+     | nd 1+    | Maximum distance (km) | Maximum duration (years) |
| Rangiora     | 36        | 19         | 12        | 3        | 70                       | 2        | 4         | 0         | 0        | 0.28                  | 2.6                      | 0        | 1        | 0        | 0        | 0.14                  | 1.9                      |
| Christchurch | 12        | 39         | 19        | 5        | 75                       | 2        | 10        | 6         | 0        | 2.8                   | 2.4                      | 3        | 6        | 3        | 1        | 3.2                   | 5.7                      |
| Kaikōura     | 16        | 72         | 38        | 0        | 126                      | 3        | 16        | 6         | 0        | 0.0                   | 4.2                      | 1        | 2        | 0        | 0        | 1.3                   | 2.4                      |
| <b>Total</b> | <b>64</b> | <b>130</b> | <b>69</b> | <b>8</b> | <b>271</b>               | <b>7</b> | <b>30</b> | <b>12</b> | <b>0</b> | <b>2.8</b>            | <b>4.2</b>               | <b>4</b> | <b>9</b> | <b>3</b> | <b>1</b> | <b>3.2</b>            | <b>5.7</b>               |

**Eurasian blackbird *Turdus merula merula***

The blackbird was the species with the fourth highest number banded with a total of 271 banded after being caught in mistnets (Table 2): Rangiora 70, Christchurch 75, and Kaikōura 126; the ages and sexes are listed in Table 3. Seven Rangiora blackbirds, 10% of those banded, were seen later: one killed by a car 140 m from the banding site and six recaptured. One recapture was 2.6 years after banding and the rest were up to four times in the year after banding; the furthest distance a bird was resighted away from the banding site was 280 m (Table 3). At Christchurch, 31 birds (41% of blackbirds banded) were subsequently recovered or recaptured. There were 13 recoveries of which six were birds killed by cats and seven others were found dead; these were found up to 3.2 km away from the banding sites and within 5.7 years of banding. One live recapture was a bird found 2.8 km distant at 0.9 years after banding; 17 birds were recaptured a total of 32 times at the banding sites, all within 2.4 years of banding. A total of 28 Kaikōura blackbirds (22% of those banded) were seen after banding: three recoveries and 25 birds recaptured a total of 45 times all within 4.2 years of banding. Of the 66 individual blackbirds from all sites that were recovered or recaptured (24% of birds banded), 23 were recaptured between two and six times, 30 were at least one year after banding, and only six were identified more than three years after banding.

The wing lengths of male blackbirds measured at Kaikōura averaged 129.1 mm (sd = 4.0 mm, 95% CI = ± 1.1 mm, range = 118–136 mm, n = 48) which was significantly larger than the female average of 124.6 mm (sd = 3.3 mm, 95% CI = ± 1.4 mm, range = 119–134 mm, n = 22), unpaired sample t-test:  $t = 4.63 > t_{p=0.05} = 2.00$ , df = 68. Mass was not significantly different: males averaged 99.5 g (sd = 7.4 g, 95% CI = ± 2.1 g, range = 73.5–120.0 g, n = 47), females 94.4 g (sd = 6.0 g, 95% CI = ± 2.5 g, range = 82.2–104.4 g, n = 22), unpaired sample t-test:  $t = 0.56 < t_{p=0.05} = 2.00$ , df = 65. Repeat weighings on recaptures had males in the range -3.5 to +5.0 g and females -4.9 to +6.3 g from the original mass.

**Common starling *Sturnus vulgaris vulgaris***

The third most common species banded was starling (Table 2): Rangiora 150, Christchurch 260, Kaikōura 20. At Rangiora, three of 42 (7%) juvenile starlings were killed by cats within 870 m of the banding site, and six (15%) were recaptured at the banding site, five within 17 days and one at 1.6 years after banding. One of 108 (1%) 1+ starlings was killed by a cat at the banding site, and eight (7%) more were recovered (five killed by cats) away from the banding sites. Seven (6%) 1+ starlings were resighted, one away from the banding site and six at

**Table 4.** Numbers of individual starlings recovered or recaptured/sighted and released alive that were banded at Rangiora, Christchurch and Kaikōura between 1961 and 2016.

| Town         | Banded    |            |            | Recaptured/sighted alive |           |                             |                                | Recovered dead |           |                             |                                |
|--------------|-----------|------------|------------|--------------------------|-----------|-----------------------------|--------------------------------|----------------|-----------|-----------------------------|--------------------------------|
|              | j         | nd<br>1+   | Total      | j                        | nd<br>1+  | Maximum<br>distance<br>(km) | Maximum<br>duration<br>(years) | j              | nd<br>1+  | Maximum<br>distance<br>(km) | Maximum<br>duration<br>(years) |
| Rangiora     | 42        | 108        | 150        | 6                        | 7         | 0.44                        | 2.7                            | 3              | 9         | 27.8                        | 3.7                            |
| Christchurch | 35        | 225        | 260        | 0                        | 6         | 0.42                        | 3.9                            | 3              | 12        | 1.0                         | 8.0                            |
| Kaikōura     | 0         | 20         | 20         | 0                        | 0         | –                           | –                              | 0              | 0         | –                           | –                              |
| <b>Total</b> | <b>77</b> | <b>353</b> | <b>430</b> | <b>6</b>                 | <b>13</b> | <b>0.42</b>                 | <b>3.9</b>                     | <b>6</b>       | <b>21</b> | <b>27.8</b>                 | <b>8.0</b>                     |

the site. Ten of the 25 birds recorded after banding were last seen >1 year after banding (maximum 3.7 years) and only one was sighted away, in Christchurch 27.8 km distant (Fig. 1; Table 4).

Of the 260 starlings banded at Christchurch, 35 were juveniles and three (9% of juveniles) were subsequently recovered, all killed by cats. There were 225 1+ nd starlings banded and 12 (5%) were recovered (8 killed by cats) and 6 (3%) were recaptured. Thirteen of the Christchurch birds were recovered/recaptured/sighted >1 year after banding with two found dead 7.0 and 8.0 years after banding; no birds were found >1.0 km from the banding sites (Table 4).

None of the 20 starlings, all 1+ nd, banded at Kaikōura was recaptured or found dead. Over the three towns, 4% of starlings were recaptured, 3 twice, and 6% were recovered.

Measured Kaikōura starlings had an average wing length of 130.5 mm (sd = 3.2 mm, 95% CI = ± 1.7 mm, range = 124–136 mm, n = 13) and on average weighed 83.8 g (sd = 7.1 g, 95% CI = ± 3.9 g, range = 72.4–101.4 g, n = 13).

#### House sparrow *Passer domesticus domesticus*

The house sparrow was the species with the second highest numbers of birds banded, 4,497: Rangiora 1,255, Christchurch 2,200, Kaikōura 1,042 (Table 2). The ages and sexes are listed in Table 5. There were 22 (1.8%) recoveries of Rangiora birds, the longest distance being 25.4 km to Christchurch and the longest interval between banding and recovery was 6.3 years. The 116 (9.2%) live sightings were all within 0.5 km of the banding sites and up to 5.3 years after banding. Forty-eight (2.2%) Christchurch birds were recovered up to 6.3 years after banding, the most notable being 43.5 km west and 26.7 km north. Another 83 (4.0%) birds were sighted up to 8.7 years after banding and all were within 0.6 km of the banding site. At Kaikōura all 8 (0.8%) birds recovered and 103 (9.9%) resighted were within 0.6 km of the banding site and up to 5 years after banding.

In total, there were 482 recoveries/recaptures of 380 (8.5%) individual birds. Of the 78 birds recovered dead, 41 (53%) were reported killed by cats, and all but two recoveries were away from the banding sites. The majority of the 404 birds sighted alive were at the banding sites with birds caught up to six times; only six birds at Rangiora and eight at Christchurch were found alive away from the banding site and all were within 1 km. Overall, 81% of birds recovered/recaptured were found only once and 49% only in the first year after banding; eight recoveries and 20 recaptures were between 4 and 8.7 years after banding. Only 11 sparrows were recovered >1 km from the banding sites with three >20 km away (Fig. 1; Table 5).

Adult house sparrows were only measured at Kaikōura: 202 female and 255 males. There was a highly significant difference between the sexes with the wing lengths of males averaging 78.4 mm (sd = 2.0 mm, 95% CI = ± 0.2 mm, range = 72–84 mm, n = 246) compared to the females at 75.9 mm (sd = 2.2 mm, 95% CI = ± 0.3 mm, range = 70–83 mm, n = 183); unpaired sample t-test:  $t = 12.33 > t_{P=0.05} = 1.96$ , df = 427. Similarly, there were significant differences in mass: male average 29.3 g (sd = 2.0 mm, 95% CI = ± 0.2 g, range = 23.6–34.9 g, n = 246); female average 28.8 g (sd = 2.1 mm, 95% CI = ± 0.3 g, range = 24.0–34.4 g, n = 197); unpaired sample t-test:  $t = 2.64 > t_{P=0.05} = 1.96$ , df = 441.

#### Silvereye *Zosterops lateralis lateralis*

Silvereye was the species with most birds banded – nearly all were unsexed 1+ birds: Rangiora 5,608 (including two juveniles); Christchurch 3,563 (including 4 juveniles); Kaikōura 6,178; total 15,349 (Tables 2 & 6). A few silvereyes were seen at all sites throughout the year (LKR *pers. obs.*), especially Kaikōura (Rowe & Rowe 2018). Numbers of silvereyes banded each year were highly variable with 1,372 the highest number banded at Rangiora in 1968. At Kaikōura, peak numbers were 1,282 in 2004, 1,127 in 2006, and 1,276 in 2010; it is possible

**Table 5.** Numbers of individual house sparrows recovered or recaptured/resighted and released alive that were banded at Rangiora, Christchurch and Kaikōura between 1961 and 2016.

| Town                 | Banded     |              |              | Recaptured/sighted alive |              |           |            |            |          | Recovered dead        |                          |          |           |           |          |                       |                          |
|----------------------|------------|--------------|--------------|--------------------------|--------------|-----------|------------|------------|----------|-----------------------|--------------------------|----------|-----------|-----------|----------|-----------------------|--------------------------|
|                      | j&p        | m            | f            | nd                       | Total        | j&p       | m          | f          | nd       | Maximum distance (km) | Maximum duration (years) | j&p      | m         | f         | nd       | Maximum distance (km) | Maximum duration (years) |
| Rangiora             | 187        | 583          | 457          | 28                       | 1,255        | 23        | 53         | 37         | 3        | 0.5                   | 5.3                      | 5        | 11        | 6         | 0        | 25.4                  | 6.3                      |
| Christchurch         | 227        | 1,232        | 718          | 23                       | 2,200        | 8         | 48         | 27         | 0        | 0.6                   | 8.7                      | 3        | 28        | 17        | 0        | 43.5                  | 6.3                      |
| Kaikōura             | 22         | 556          | 449          | 15                       | 1,042        | 3         | 50         | 50         | 0        | 0.0                   | 5.0                      | 0        | 4         | 2         | 2        | 0.6                   | 2.0                      |
| <b>Total/maximum</b> | <b>436</b> | <b>2,371</b> | <b>1,624</b> | <b>66</b>                | <b>4,497</b> | <b>34</b> | <b>151</b> | <b>114</b> | <b>3</b> | <b>0.6</b>            | <b>8.7</b>               | <b>8</b> | <b>43</b> | <b>25</b> | <b>2</b> | <b>43.5</b>           | <b>6.3</b>               |

2007 would have been over 1,000 as banding did not start until 20 July when the author returned from overseas and banded over 450 in the first 3 days back. The variability of numbers present at Kaikōura is demonstrated in Fig. 2, where, using the days in which birds of any species were handled at the sites as an index of banding effort, it can be seen that in 2008, 20 silvereyes were banded on 10 days of 67 (0.30 silvereyes/day of effort) and in 2004, 1,282 silvereyes were banded on 23 days of 43 (29.8 silvereyes/day of effort). Variation throughout the year is further demonstrated for a selection of 5 years (Fig. 3). In 2008 there were only 95 banded despite frequent banding effort throughout most of the season. Silvereyes were present for about 2 months from about mid-June to early August in 2001 and 2010, and they were mostly present for about 2–3 weeks about 1 July in 2006 and late August in 2004 (Fig. 3).

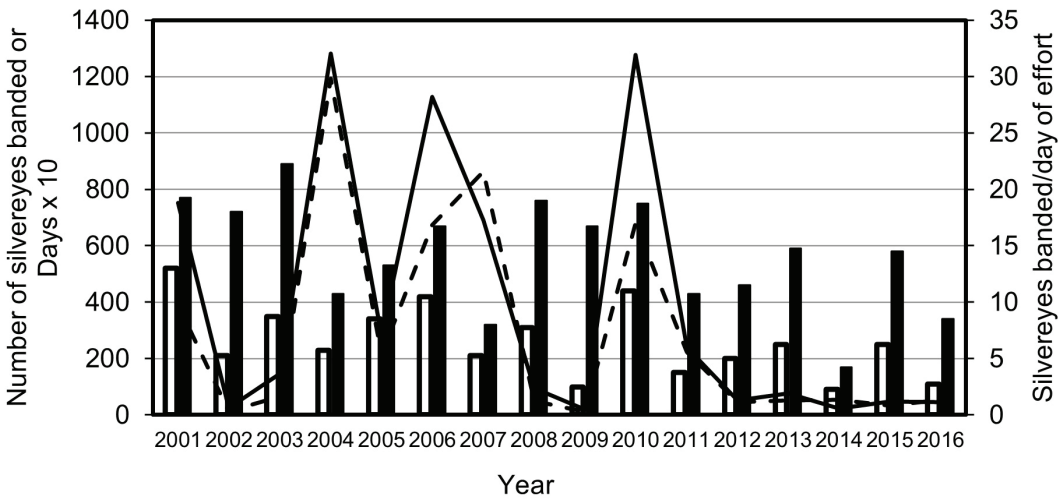
Of the Rangiora birds, 1,167 birds (20.8%) were subsequently seen a total of 2,466 times at least 1 day after banding (Table 6); 1,106 (94.8% of recaptured birds) were seen again in the season of banding. One bird was recaptured 32 times in the 66 days after banding. The 54 (1.0%) birds recovered dead were found as far away as Otira (99 km, 17 months after banding); two of these were in Christchurch (25.5 km and 26.4 km) (Fig.1). The longest duration between a bird being banded and found dead was 4.0 years. Being killed by cats was given as the cause of death for 17 birds. Seventeen birds (0.3%) were recaptured away from the banding site. Most of these were less than 3 months after banding and less than 1 km away, the exception being a bird caught and released at Coal Creek near Greymouth (Fig. 1), 146.0 km away and 5.1 years after banding. A total of 85 Rangiora birds (1.5% of those banded) were found in a year after banding. Fifty-seven birds were seen in year 1 and seven of these were also seen once more up to year 5. A further 28 birds were seen once only between year 2 and year 6; the longest period from banding was 6.1 years.

Banding at Christchurch resulted in 545 birds (15.3%) subsequently being seen (Table 6) a total of 973 times at least 1 day after banding with 498 seen again in the year of banding; one bird was seen 20 times in the 57 days after banding and 4 more times the next year. The 44 (1.2%) birds recovered dead were all within 7.3 km of the banding sites, and the longest duration after banding a bird was found dead was 4.1 years. Cats were reported to have killed at least 17 birds. Only six birds were recaptured away from the banding site. Four of these were less than 2 months after banding, two were after 2.1 years, and all were less than 1.4 km away. A total of 89 birds (2.5% of those banded) were found in later years. Sixty-five were seen in year 1 after banding and of those, eight were also



**Table 6.** Numbers of individual silvereyes recovered or recaptured/resighted and released alive that were banded at Rangiora, Christchurch and Kaikōura between 1961 and 2016.

| Town                 | Banded   |               | Total         | Recaptured/sighted alive |                       |                          | Recovered dead |                       |                          |
|----------------------|----------|---------------|---------------|--------------------------|-----------------------|--------------------------|----------------|-----------------------|--------------------------|
|                      | j&p      | nd 1+         |               | nd 1+                    | Maximum distance (km) | Maximum duration (years) | nd 1+          | Maximum distance (km) | Maximum duration (years) |
| Rangiora             | 2        | 5,606         | 5,608         | 1,113                    | 146.0                 | 6.1                      | 54             | 99.0                  | 4.0                      |
| Christchurch         | 4        | 3,559         | 3,563         | 501                      | 1.4                   | 8.0                      | 44             | 7.3                   | 4.1                      |
| Kaikōura             | 0        | 6,178         | 6,178         | 940                      | 153.0                 | 8.8                      | 9              | 2.0                   | 1.3                      |
| <b>Total/maximum</b> | <b>6</b> | <b>15,343</b> | <b>15,349</b> | <b>2,554</b>             | <b>153.0</b>          | <b>8.7</b>               | <b>107</b>     | <b>99.0</b>           | <b>4.1</b>               |



**Figure 2.** The variability of silvereyes banded each year at Kaikōura as reflected in the numbers of silvereyes banded per year (solid black line), the banding effort each year using the number of days when birds of any species were handled as the index (solid bar), the number of days each year in which silvereyes were banded (open bar), and the variability of silvereyes/ caught per day of effort (dashed line).

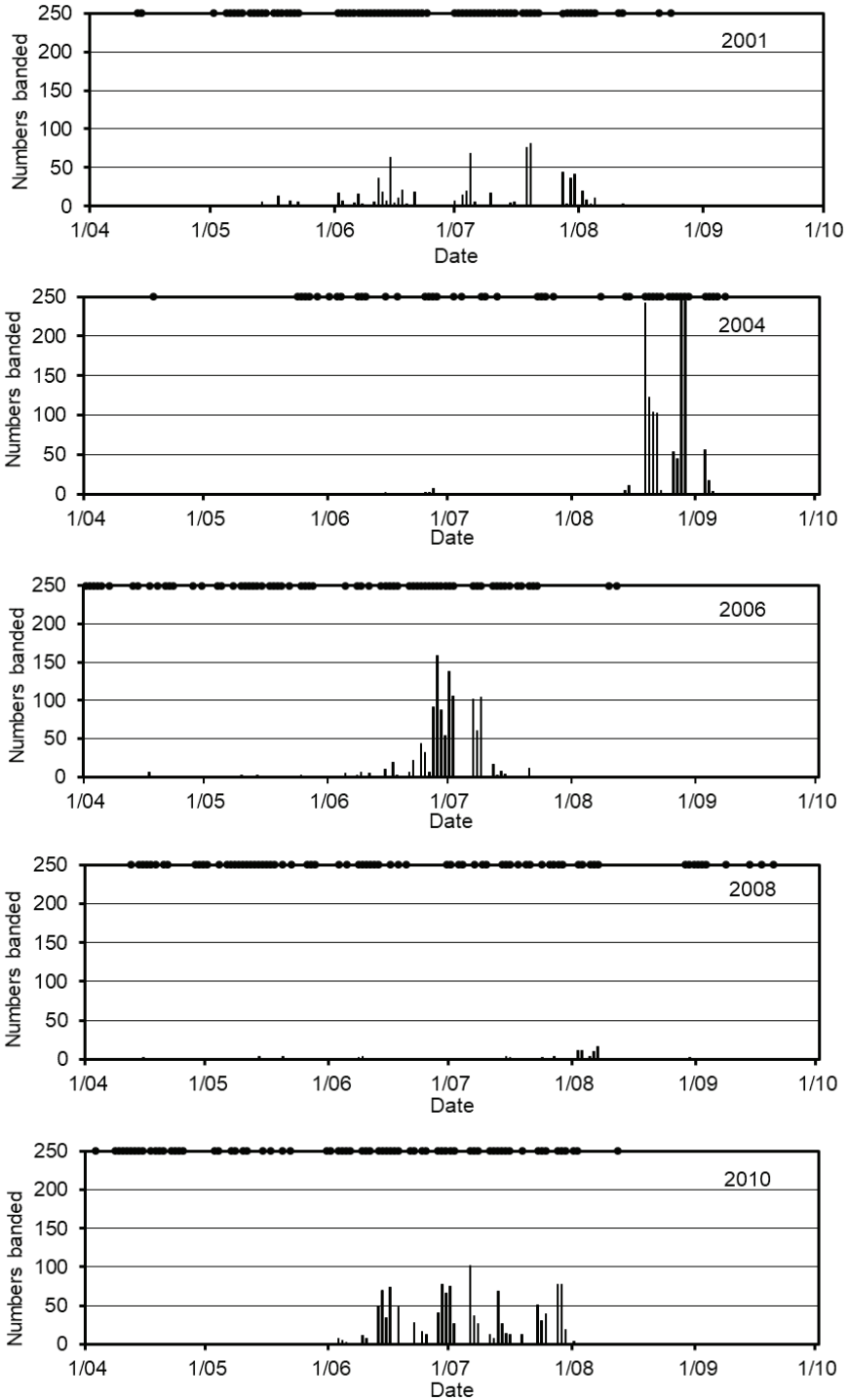
seen in year 2, and four more up to year 4. A further eight birds were seen in year 2 only, seven in year 3 only, seven in year 4 only, and one in each of year 5 and year eight; the longest period from banding was 8.0 years.

The greatest number of silvereyes banded was at Kaikōura (Table 6). A total of 949 birds (15.4% of those banded) were subsequently seen again for a total of 1,605 sightings; 904 birds were seen again in the season of banding. The most sightings for any one bird was 14 in the 47 days after banding. There was a very small number of recoveries with nine (0.1%) found dead (four killed by cats) within 2 km of the banding site; only one of these was more than 4 months after banding at 1.3 years. The only reported sighting of a live bird away from the banding site was a bird found in Wellington, 153 km north of Kaikōura, 8.8 years after banding. A total of

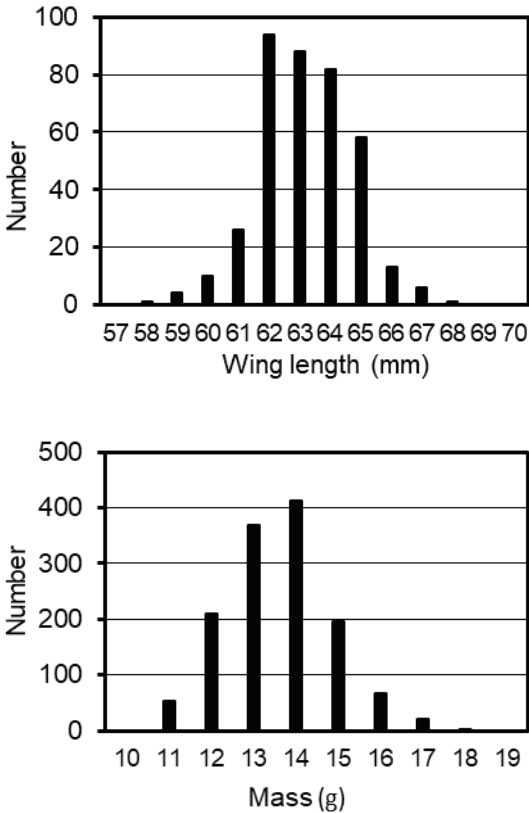
58 (0.9%) birds were seen in a season later than the banding year at Kaikōura: 33 in year 1, 11 in year 2 only, and 13 once only in years 3 to 6; only one bird was seen in more than one season post-banding.

Overall, our records have 2,661 (17.3%) individuals found at a date after banding, 107 dead and 2,554 alive, with a total of 5,044 records (excluding repeats on any given day) (Table 6). Cats were the largest identified cause of death, being responsible for at least 38 of the 107 recoveries. Very few birds were noted away from the banding sites (Rangiora 18 alive, 43 dead; Christchurch two alive, 11 dead; Kaikōura one alive, six dead).

Individual silvereyes were recaptured on up to 32 different days after banding and up to six times on any given day (LKR *unpub. data*). About 16.3% (2,495) of the birds were seen again in the season of banding and 1.5% (232) of silvereyes banded



**Figure 3.** The number of silvereyes banded daily for a selection of years at Kaikōura showing the variability during and between years. The row of dots at the top of the graphs is an index of banding effort being days when birds of any species were handled. There would have been days when no birds were caught but there is no record of that except for when no banding took place between 9–24 August 2008.



**Figure 4.** Frequency distributions for silvereyes measured at Kaikōura during 2010. a) Mass; b) Wing length.

were caught in a season later than when banded. Only ten birds, four Rangiora, two Christchurch, and four Kaikōura, were sighted in the 5<sup>th</sup> season or later after banding, and these included the two birds found at Wellington and Greymouth.

Since 2008 silvereyes have been weighed each year; 2010 was the year with most birds weighed (1,037) and these have been used for this analysis (Fig. 4a). Eight hundred and eighty-six birds were weighed once, 95 twice and the balance, 56 birds, up to 14 times for a total of 1,329 weighings. There was no significant difference between the full set of weighings (average mass 13.1 g,  $sd = 1.2$  g, 95% CI =  $\pm 0.07$  g, range = 10.1–17.2 g,  $n = 1,329$ ) compared to the set of first values for all birds (average mass 13.1 g,  $sd = 1.3$  g, 95% CI =  $\pm 0.08$  g, range = 10.1–16.9 g,  $n = 1,037$ ); unpaired sample  $t$ -test  $t = 0.52 < t_{p=0.05} = 1.96$ ,  $df = 2,366$ . Sixteen birds had  $\geq 5$  measurements taken and the variation for individual birds ranged between 1.0 and 3.4 g with an average of 2.1 g ( $sd = 0.07$  g, 95% CI = 0.6 g). For the 58 birds that had two or more measurements in a single day, the variation

was between -1.8 and 1.5 g ( $sd = 0.74$  g; 95% CI = 0.19 g). There was a significant trend in mass change with time of day, mass =  $12.5 + 0.0485 \times \text{time}$  ( $F = 14.52 > F_{p=0.05} = 3.85$ ,  $df = 1265$ ) but the relationship explained only 1% of the variance in the data.

The distribution of wing lengths from 383 non-sexed, 1+ year old silvereyes captured at Kaikōura between 2008 and 2016 is shown in Fig. 4b. The majority of the birds (85%) had winglengths from 62 to 65 mm with the full set averaging 63.2 mm ( $sd = 1.6$  mm, 95% CI = 0.02 mm, range = 58–68 mm,  $n = 383$ ).

## DISCUSSION

Trapping and mist netting 14 species of passerines in gardens in three towns in Canterbury over 56 years has resulted in the banding of mostly house sparrows and silvereyes. The other 12 species each had fewer than 430 birds banded and, consequently, for these species few birds were recovered or resighted, and most were unremarkable with respect to time since banding or distance from the banding sites compared to those reported elsewhere (e.g. Higgins *et al.* 2001, 2006a, 2006b; Higgins & Peters 2002; Heather & Robertson 2005; Miskelly 2013a). For example, there were no recoveries/sightings of the 16 yellowhammers banded at Rangiora, and none was banded at Christchurch, or at Kaikōura where they were seen the least of all species observed more than once at that site (Rowe & Rowe 2018). Nor were any of the 40 fantails banded at the three sites found later.

Other species were only recovered/recaptured at the banding sites but they are known to travel some distance: bellbird seasonal movements seeking food (Higgins *et al.* 2001; Sagar 2013), banding record distance 10 km (Sagar 2013); chaffinch seasonal movements (Higgins *et al.* 2006b; Angus 2013a); redpoll localised seasonal movements (Higgins *et al.* 2006b; Angus 2013b), goldfinch possible local movements (Higgins *et al.* 2006b), and grey warbler probably has some local movement (Higgins & Peter 2002). Most of the sightings for these five species were in the year of banding, the exceptions being a bellbird seen two years after banding, two chaffinches seen 1.2 and 4.1 years after banding, one redpoll killed by a cat after 1.8 years, two grey warblers seen in the season after and another at 1.9 years. None of these records approached reported maximum longevity: bellbird 8+ years (Heather & Robertson 2005; Spurr *et al.* 2008; Sagar 2013); chaffinch over 9 years in New Zealand (Heather & Robertson 2005; Angus 2013a); redpoll about 8 years (Robertson 1972; Heather & Robertson 2005; Angus 2013b); goldfinch nearly 8 years (Heather & Robertson 2005; Miskelly 2013b);

grey warbler adult male 5.4 years after banding at Kōwhai Bush (Higgins & Peter 2002), but up to 10 years (Heather & Robertson 2005).

Seven species were recovered/resighted at the banding sites and elsewhere: blackbird, dunnock, greenfinch, house sparrow, song thrush, starling, and silvereeye. The movement of one Christchurch dunnock recovered 5.1 km away 126 days after banding is similar to the maximum reported dispersal in New Zealand of 5 km (Santos 2013). A Kaikōura dunnock last recaptured 5.3 years after banding was approaching the age of the oldest New Zealand bird, 6.3 years (Niethammer 1970; Robertson 1972). A song thrush killed by a cat had not moved far from a Rangiora banding site, 110 m, compared to 6.4 km for a bird in a Hutt Valley study (Bull 1959). The song thrush recaptured after 2.1 years is well short of the New Zealand record, 10+ years (Robertson 1972; Heather & Robertson 2005). Similarly, the longest period between banding and recapture for a Christchurch greenfinch, 3.0 years, was short compared to the oldest recorded in New Zealand of 7.5 years (Robertson 1972; Heather & Robertson 2005).

Blackbird was the species with the highest percentage of birds (24%) recovered; this rate was over twice that reported by Bull (1959) in a study at Hutt Valley. Of the 66 birds recovered, 23 were recaptured two to six times suggesting the banding sites may have been part of, or close to, their home range. The longest time between banding and recovery was 5.7 years which is much shorter than the reported 15 years for a New Zealand bird (Heather & Robertson 2005). Maximum dispersal here was a Christchurch bird found 3.2 km away which was similar to the Hutt Valley study (Bull 1959), but is insignificant compared to a movement of another banded bird from Orongorongo Valley to Levin, 90 km (Heather & Robertson 2005).

10.7% of starlings were found after banding with 92% of recoveries and one sighting away from the banding site. The oldest recovery was a bird found dead 8 years after banding as an adult at Christchurch. This was well short of the oldest New Zealand bird reported, 14+ years (Heather & Robertson 2005; Flux 2013). The maximum reported dispersal of starlings is 30 km (Flux 2013) and one bird banded in Rangiora found 27.8 km away in Christchurch 161 days after banding almost reached that distance.

House sparrow was the species with the second highest numbers banded. Over the three towns in this study, there was a total of 453 recoveries/sightings from 380 of the 4,497 individuals banded. The number of records of birds found back at the banding sites, 375, was 82.8% of all records which is smaller than that reported by Waddington & Cockrem (1987), 97% of 2,237 New Zealand

recoveries. The majority (53%) of the house sparrows recovered dead in this study were reported killed by cats; this may be a considerable underestimate as another 25% of recoveries were simply reported as "dead". Of the sparrows recovered/recaptured, 51% were in the next or later years after banding. The longest time between banding and recapture of house sparrows in this study, 8.7 years, was about half that of the oldest bird reported, 15 years (Heather & Robertson 2005, Dawson 2013). The longest distance recovery here, 43.5 km, was also short in comparison to other reports; e.g. 317 km from Upper Hutt to Reporoa, and six >100 km (Waddington & Cockrem 1982; Heather & Robertson 2005).

Silvereeye was the most common species banded at all sites with about four times as many banded as house sparrows. Most birds in this study (92%) were banded during June to August. The mistnets/traps were generally set from autumn once silvereeye numbers increased through to spring. At all our sites there were occasional silvereeyes seen in other months, but our banding coincided with the tendency for them to flock in winter and undertake local movements which sees them move from summer breeding areas into cities and towns seeking food (e.g. Marples 1944; Kikkawa 1962; Heather & Robertson 2005; Higgins *et al.* 2006b; Armitage 2013; Rowe & Rowe 2018). These movements were variable from year to year, both in numbers and timing which may reflect differing winter conditions that force them to move. In Australia, silvereeyes can undertake movements over 3,000 km (Higgins *et al.* 2006b), but the maximum dispersal in New Zealand is unknown and may be in the range of 10s to 100s of kilometres (Armitage 2013). In this study, we show movement across the Southern Alps with the recovery of a Rangiora bird at Otira (99 km) and the live capture of another near Greymouth (146 km). Another significant movement was a bird that travelled north from Kaikōura, across Cook Strait, to be captured at Wellington, 153 km distant. This is the second confirmed report of a banded silvereeye crossing Cook Strait, the first being an 81 km crossing from Ward to Wellington (Bell & Reese 2010). These movements of banded silvereeyes support previous reports of flocks possibly crossing Cook Strait (e.g. Dennison *et al.* 1982). Movements of 150 km may, therefore, not be uncommon.

Silvereeyes seen later in the season in which they were banded totalled 2,510 (16.3% of those banded), and 232 silvereeyes (1.5% of those banded) were seen in seasons after that of banding; these are lower than observed by Marple (1944), 20–25% and 3.5–4.0% respectively. Of these 232 birds, 21 were recaptured 2 or 3 times over the next 5 seasons. This may not be an uncommon occurrence as banded individuals have been recorded at the same sites

year after year (Marples 1944; Heather & Robertson 2005) suggesting there may be some regional or movement fidelity. The greatest time between banding a bird and its last recovery was 8.8 years, a similar time to that in Armitage (2013) but shorter than reports of over 11 years (Cossee 1967; Heather & Robertson 2005).

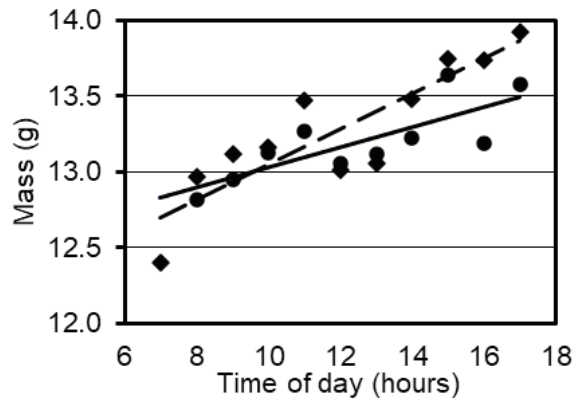
Despite banding large numbers of birds, there were no recoveries that exceeded published dispersal or longevity records; the most significant are listed in Table 7. A dunnock that was recovered 5.1 km away and another caught 5.3 years after banding were the closest to published data. Starling (8 years; 28.8 km), house sparrow (8.7 years; 43.5 km), and silvereye (8.8 years; 153 km) were the species with the most significant recoveries.

Higgins & Peters (2002) and Higgins *et al.* (2001, 2006a, 2006b) tabulated bird wing lengths and mass from a number of New Zealand studies, both for live birds and skins, and the following comparisons are made with those and from Heather & Robertson (2005) that has additional data for some species. Species that did not have comparable data for live New Zealand birds were chaffinch, dunnock, and greenfinch. Generally, the data collected at Kaikōura fitted within the ranges presented for live birds (starling, blackbird, goldfinch, greenfinch, grey warbler, house sparrow, silvereye, song thrush, and fantail) in those volumes. There were exceptions for a few birds with wing lengths just outside the upper limits reported. The main exception was bellbirds. Male bellbirds wing length and mass was within the ranges reported but on average the Kaikōura birds were larger, wings about 7% longer and weighed about 12% more. There were more pronounced differences with females with wing lengths 11% longer and weighing 17% more. If there were nondescript males misidentified as females, that could perhaps explain some of the difference in Kaikōura female bellbirds being proportionately larger than males compared to the reported studies.

Bell & Bell (2010) weighed 330 silvereyes at Blenheim in the period 1–15 July 2007: average mass = 13.22 g (SE = 1.08, n = 330). The Kaikōura average mass for the whole 2010 banding season was 13.10 g (CL =  $\pm 0.07$ , n = 1329), slightly lighter than for their birds. From Bell & Bell's data, calculating CLs =  $\pm t \times SE$  (Freese 1967) we get CLs =  $\pm 1.98 \times 1.08 = 1.78$ , and find the average mass  $\pm$  CLs for the Blenheim and Kaikōura samples overlap, i.e. the averages are not significantly different from each other. There is a difference between the samples in that the Blenheim average mass each clock hour have a larger spread throughout the day than at Kaikōura (Fig. 5), about 1.5 g compared to 0.8 g; the data for Blenheim were measured off Fig. 2 in Bell & Bell (2010). They applied a non-stated polynomial line to their data but I have applied simple linear

regressions to both samples to get comparable relationship between mass and time of day. These relationships explain over 63% of the variance in the data: Blenheim mass =  $0.12 \times \text{time of day} + 11.90$  ( $r^2 = 0.76$ ,  $r = 0.87 > r_{P=0.05} = 0.602$ ,  $df = 9$ ); Kaikōura mass =  $0.07 \times \text{time of day} + 12.34$  ( $r^2 = 0.63$ ,  $r = 0.79 > r_{P=0.05} = 0.632$ ,  $df = 8$ ). A comparison of linear regressions test (Freese 1967) indicated that these two lines were not different (common slope  $F = 2.95 < F_{P=0.05} = 4.45$ ,  $df = 1/18$ ; levels  $F = 2.00 < F_{P=0.05} = 4.41$ ,  $df = 1/19$ ). The overlapping mean mass  $\pm$  CLs and no differences between the mass v time of day relationships suggests both samples could have come from the same population of silvereyes.

In this study, cats were recorded having killed birds of six species in mainly urban environments. Of 236 recoveries (1.1% of all banded birds), cats were given as the cause of death in 107 (45%) cases, and this could be an underestimate as "found dead" could have included many more.



**Figure 5.** Diurnal mass of silvereyes at Kaikōura (dots and solid line) and Blenheim (diamonds and dashed line). Blenheim data extracted from Fig. 2 in Bell & Bell (2010).

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Table 7. List of the most significant recoveries and live resightings of birds banded at Rangiora, Christchurch and Kaikōura 1961–2016.

| Species            | Where banded | Where found  | Status | Time since banding (years) | Distance (km) | Reported longevity (years) | Reported distance (km) | Citation                    |               |
|--------------------|--------------|--------------|--------|----------------------------|---------------|----------------------------|------------------------|-----------------------------|---------------|
| Chaffinch          | Kaikōura     | Kaikōura     | Alive  | 4.1                        | 0             | 9+                         | -                      | Heather & Robertson (2005)  |               |
| Duncock            | Christchurch | Christchurch | Dead   | 0.3                        | 5.1           | 6.3 (NZ)                   | 5                      | Santos (2013)               |               |
|                    | Kaikōura     | Kaikōura     | Alive  | 5.3                        | 0             |                            | -                      | Niethammer (1970)           |               |
| Eurasian blackbird | Christchurch | Christchurch | Dead   | 5.7                        | -             | 15                         | 90                     | Heather & Robertson (2005)  |               |
|                    | Christchurch | Christchurch | Dead   | -                          | 3.2           |                            | -                      | -                           | -             |
| Common starling    | Rangiora     | Christchurch | Dead   | -                          | 27.8          | 14+                        | 30                     | Flux (2013)                 |               |
|                    | Christchurch | Christchurch | Dead   | 8.0                        | -             |                            | -                      | -                           | -             |
| House sparrow      | Rangiora     | Christchurch | Dead   | -                          | 25.4          | 15+                        | 317                    | Waddington & Cockrem (1982) |               |
|                    | Christchurch | Homebush     | Dead   | -                          | 43.5          |                            | -                      | -                           | Dawson (2013) |
|                    | Christchurch | Loburn       | Dead   | -                          | 26.7          |                            | -                      | -                           | -             |
|                    | Christchurch | Christchurch | Alive  | 8.7                        | 0             |                            | -                      | -                           | -             |
| Silvereye          | Rangiora     | Greymouth    | Alive  | 5.1                        | 146.0         | 11+                        | 10s to 100s            | Armitage (2013)             |               |
|                    | Rangiora     | Otira        | Dead   | -                          | 99.0          |                            | -                      | -                           | Cossee (1967) |
|                    | Rangiora     | Christchurch | Dead   | -                          | 26.4          |                            | -                      | -                           | -             |
|                    | Rangiora     | Christchurch | Dead   | -                          | 25.5          |                            | -                      | -                           | -             |
|                    | Kaikōura     | Wellington   | Alive  | 8.8                        | 153.0         |                            | -                      | -                           | -             |

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