Bird Counts in Kennedy's Bush Scenic Reserve, Port Hills, Christchurch

By AMANDA N. D. FREEMAN

17 Magnolia St., Atherton, Queensland 4883, Australia

ABSTRACT

Between March 1992 and February 1993, 222 five-minute stationary bird counts were conducted at 12 sites in the Kennedy's Bush Scenic Reserve on Christchurch's Port Hills. Over the period of the survey, 22 species of bird were recorded in or flying over the reserve.The seven most frequently recorded species were Silvereye (*Zosterops lateralis*), Grey Warbler (*Gerygone igata*), Bellbird (*Anthornis m. melanura*), Fantail (*Rhipidura fuliginosa*), Chaffinch (*Fringilla coelebs*), Blackbird (*Turdus merula*) and Redpoll (*Acanthis flammea*). Kennedy's Bush does not contain a high diversity of native bush birds compared to some other mainland sites. Native species also appear less abundant in Kennedy's Bush than in continuous, climax forest sites near Reefton. Kennedy's Bush does, however, support high numbers of some species such as Silvereye, Grey Warbler, Fantail, Bellbird and Shining Cuckoo (*Chrysococcyx l. lucidus*) compared to sites at Kowhai Bush, Kaikoura.

The autumn peak in numbers of Silvereye recorded at Kennedy's Bush may result from flocks of migrating birds, some of which may move out of the reserve for the winter months. The numbers of Grey Warbler, Bellbird and Blackbird recorded probably reflect seasonal changes in conspicuousness rather than a change in actual numbers; adults are probably resident in the reserve year round. As in other parts of Canterbury, Fantail numbers were severely reduced by the heavy snow-falls of August 1992. Bellbird numbers were also reduced by the heavy snow-falls. Spring brought high numbers of Chaffinches to the reserve and summer brought high numbers of Redpolls, both of which were apparently absent or in very low numbers during winter. Small numbers of Goldfinches (*Carduelis carduelis*) and Greenfinches (*Carduelis chloris*) also appear to occur in Kennedy's Bush only during the summer months. Of particular interest were records of two rarer Port Hills birds, Tomtits (*Petroica m. macrocephala*) and New Zealand Pigeons (*Hemiphaga n. novaeseelandiae*). Tomtits were recorded on only two occasions over the survey period. By 1997, however, this species appeared to be resident in the reserve. New Zealand

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Pigeons were recorded in Kennedy's Bush in small numbers throughout the year and may breed there.

KEYWORDS: Seasonal occurrence, abundance, movements, passerines, native bush.

INTRODUCTION

Bush remnants on the Port Hills, Christchurch, are small and fragmented and degraded by grazing animals. Several native bird species have disappeared from these remnants including some, such as the Rifleman (*Acanthisitta c. chloris*) and Brown Creeper (*Mohoua novaeseelandiae*), that are still found on nearby Banks Peninsula. Despite the loss of habitat, however, some species (such as Silvereye, Bellbird, Grey Warbler and Fantail) appear to flourish.

A year-long series of bird counts was undertaken to assess the abundance of native and introduced bird species in Kennedy's Bush Scenic Reserve on Christchurch's Port Hills. Kennedy's Bush Scenic Reserve is an 86.5 ha area of second growth hardwood forest with dominant species of Mahoe (*Melicytus ramiflorus*), Kanuka (*Kunzea ericoides*) and Fushia (*Fushia excortica*). There are also a few surviving podocarps, and *Olearia paniculata* plantings of North Island provenance (Kelly 1972). The reserve has an altitudinal range of 200-440 metres above sea level.

The purpose of this study was to illustrate the importance of Kennedy's Bush for native birds in the Christchurch area where few remnants of native vegetation remain. The five-minute bird count technique that was used in this study (Dawson & Bull 1975) is a simple method for obtaining an index of bird numbers and detecting major differences in abundance. It has been widely applied in New Zealand. This allowed indices of abundance to be compared species by species between Kennedy's Bush and two other South Island mainland locations for which comparable studies had been undertaken; Beech forests near Reefton and Kowhai Bush near Kaikoura.

This study also provides a baseline for comparison in later years should habitat enhancement proposals for the Port Hills (e.g. Crossland 1996) be implemented.

METHODS

Twelve stations, 200m apart, were established at intervals along walking tracks within the reserve. The sites included examples of the range of native vegetation types occurring in the reserve. Insufficient counts were made to test for differences between sites so counts were lumped. Unfortunately this disregarded any variation that there may have been between sites; for example between sunny slopes and gullies or between the lower and higher altitude sites in the reserve.

Following the five-minute bird count procedure of Dawson & Bull (1975), all birds seen or heard over a five-minute period, to a radius of 200m, were recorded at all accessible stations between March 1992 and February 1993. Counts were undertaken one to three times per month at intervals of at least one week.

TABLE 1. Bird species at Kennedy's Bush Scenic Reserve, March 1992 to February 1993.

Residents	Seasonal Migrants	Occasional Visitors
Native		
Silvereye *Zosterops lateralis*	Shining Cuckoo *Chrysococcyx l. lucidus*	Tomtit *Petroica m. macrocephala*
Fantail *Rhipidura fuliginosa*		NZ Falcon *Falco novaeseelandiae*
Bellbird *Anthornis m. melanura*		Harrier *Circus approximans*
Grey Warbler *Gerygone igata*		
NZ Pigeon *Hemiphaga n. novaeseelandiae*		
Introduced		
Blackbird *Turdus merula*	Redpoll *Acanthis flammea*	Goldfinch *Carduelis carduelis*
Dunnock *Prunella modularis*	Chaffinch *Fringilla coelebs*	Greenfinch *Carduelis chloris*
		California Quail *Callipepla californica brunnescens*
		House Sparrow *Passer domesticus*
		Magpie *Gymnorhina tibicen hypoleuca*
		Rock Pigeon *Columba livia*
		Skylark *Alauda arvensis*
		Starling *Sturnus vulgaris*
		Black-backed Gull *Larus d. dominicanus*

On a few occasions, deep snow and/or fallen vegetation made some stations inaccessible. Of particular note were heavy snow-falls at the end of August 1992 that caused considerable damage to the vegetation. Due to the configuration of the tracks, two stations were located close to the edge of the reserve. At these sites, birds calling from outside of the reserve were included in the counts if they were judged to be within 200m of the station. Counts were conducted during fine weather between 0900h and 1500h.

I carried out all counts, alone or with one other observer, except for the September 1992 counts that were undertaken by Alastair Freeman. Alastair was familiar with the site and methods and I would not expect there to be a large difference in our observations, especially as the September counts were so affected by the heavy snow-falls.

I considered the mean annual bird counts recorded by Gill (1980) for three sites at Kowhai Bush and Dawson *et al.* (1978) for four sites in beech forests near Reefton to be comparable to these counts at Kennedy's Bush as they were for South Island sites relatively close to Christchurch and used the same methodology. The vegetation at Kowhai Bush is dominated by kanuka (one of the dominant species at Kennedy's Bush) and has a similar climate regime to Kennedy's Bush. The Reefton sites, however, are very different from Kennedy's Bush in climate and habitat composition. Mean annual counts recorded at Kennedy's Bush were compared with those documented for these other localities (Table 2). Where numbers permitted, counts were compared statistically by chi-squared tests on total numbers counted.

RESULTS

During the period of the survey 22 species of bird were recorded in, immediately adjacent to, or flying over, the reserve. Five native species; Silvereye (*Zosterops lateralis*), Fantail (*Rhipidura fuliginosa*), Bellbird (*Anthornis m. melanura*), Grey Warbler (*Gerygone igata*) and New Zealand Pigeon (*Hemiphaga n. novaeseelandiae*), and two introduced species; Blackbird (*Turdus merula*) and Dunnock (*Prunella modularis*) were resident in the reserve year round. The 13 other species were either seasonal migrants to the reserve or occasional visitors (Table 1). A monthly summary of birds recorded at Kennedy's Bush is given in Appendix 1. In addition to the species reported here, New Zealand Pipit (*Anthus n. novaeseelandiae*), Little Owl (*Athene noctua*), Song Thrush (*Turdus philomelos*) and Yellowhammer (*Emberiza citrinella*) have also been recorded in Kennedy's Bush Scenic Reserve, mainly on the scrubland or grass surrounding the bushland (A. Crossland pers. comm.).

The seven most frequently recorded species at Kennedy's Bush were Silvereye, Grey Warbler, Bellbird, Fantail, Chaffinch (*Fringilla coelebs*), Blackbird and Redpoll (*Acanthis flammea*). Differences in the numbers of these species recorded at Kennedy's Bush over the course of the year were analysed by Analyses of Variance (ANOVAs) and Bonferroni Multiple Comparison Tests on the raw data (Bellbird), the Log (X+1) transformed data (Silvereye and Grey Warbler) and Kruskal-Wallis ANOVAs followed by Bonferroni corrected Kruskal-Wallis Multiple Comparison Z-Value Tests on the raw data (Fantail, Chaffinch, Blackbird, Redpoll).

TABLE 2. Mean annual counts (number of birds per five-minute count averaged over entire year) recorded at Kennedy's Bush Scenic Reserve and comparative mean annual counts reported for sites in Kowhai Bush (240ha) and continuous beech forests near Reefton.

Locality	Kennedy's Bush Second growth hardwood/ Kanuka (200-440m asl)	Kowhai Bush 1 Stunted, open, low altitude Kanuka forest	Kowhai Bush 2 Tall, dense, low altitude Kanuka forest	Kowhai Bush 3 Very tall, dense, low altitude Kanuka forest	Fletcher Creek Silver/Red Beech forest (230m asl)	Reefton Saddle Hard/Red/Silver Beech forest (310-430 m asl)	Te Wharau Rimu and Hard Beech forest (300-420 m asl)	Rahu Saddle Red/Silver Beech forest (820-1070 m asl)
	Mar 92 - Feb 93	**Sep 76 - Aug 77**	**Sep 76 - Aug 77**	**Sep 76 - Aug 77**	**Apr 74 - Feb 75**	**Apr 74 - Feb 75**	**Apr 74 - Feb 75**	**Apr 74 - Feb 75**
n (counts)	**220**	**122**	**122**	**119**	**480**	**480**	**480**	**480**
Silvereye[1]	2.04	0.73*	0.53*	0.70*	3.08*	3.78*	2.81*	0.58*
Grey Warbler[1]	0.82	0.71	1.03	0.70	1.25*	1.16*	0.91	1.16*
Bellbird[1]	1.70	1.31*	1.35*	2.14*	2.72*	4.22*	3.92*	0.98*
Fantail[1]	0.29	0.40	0.29	0.16*	1.17*	0.75*	0.77*	0.43*
NZ Pigeon[1]	0.17	not stated	not stated	not stated	0.59*	0.27*	0.06*	0.01*
Tomtit	0.01	not stated	not stated	not stated	1.06	0.81	1.31	1.23
Harrier	0.01	not stated	not stated	not stated	0.00	0.004	0.00	0.002
NZ Falcon	0.01	not stated	not stated	not stated	0.00	0.00	0.00	0.01
Chaffinch[1]	0.42	0.66*	0.37	0.35	0.57*	0.33*	0.59*	0.39
Blackbird[1]	0.51	not stated	not stated	not stated	0.69*	0.51	0.34*	0.43
Redpoll[1]	0.58	1.84*	0.52	0.19*	0.09*	0.28*	0.03*	0.03*
Dunnock	0.06	not stated	not stated	not stated	0.004	0.01	0.02	0.00
Goldfinch	0.05	0.85	0.30	0.40	0.01	0.02	0.002	0.004
Greenfinch	0.01	not stated	not stated	not stated	0.06	0.08	0.03	0.002
	Oct 92 – Jan 93	**Oct 76 – Jan 77 (Kowhai Bush 1-3 pooled)**			**Oct & Dec 74**	**Oct & Dec 74**	**Oct & Dec 74**	**Oct & Dec 74**
n (counts)	**82**		**123**		**160**	**160**	**160**	**160**
Shining Cuckoo[1]	0.13		0.11		0.23	0.24	0.13	0.08

[1]Counts of these species were compared statistically by chi-squared tests on total numbers counted. Counts that differed significantly from Kennedy's Bush ($P < 0.05$) are indicated by an asterisk. The other species listed could not be compared statistically due to the small numbers counted.

Mean annual counts recorded at Kennedy's Bush, Kowhai Bush and sites near Reefton are shown in Table 2.

Silvereye

Silvereyes were recorded in all months and the numbers recorded fluctuated significantly over the course of the year's counts ($F = 3.87$, $df = 11$, $P < 0.05$). Bonferroni comparison of transformed means showed that there was considerable overlap between months with the only statistically significant difference being that the numbers of Silvereyes recorded in March and May 1992 were higher than the numbers recorded in July, August and December 1992 and in January 1993 (Fig. 1).

Silvereyes were recorded in significantly higher numbers at Kennedy's Bush than at the Kowhai Bush sites. Significantly lower numbers of Silvereyes were recorded at Kennedy's Bush than at the three lower-altitude Reefton sites (Table 2).

Grey Warbler

Grey Warblers were recorded in all months and the numbers recorded fluctuated significantly over the course of the year's counts ($F = 4.38$, $df = 11$, $P < 0.05$). Bonferroni comparison of transformed means showed that there was considerable overlap between months. The only statistically significant differences were that the numbers of Grey Warblers recorded in July – October 1992 were higher than the numbers recorded in January 1993, and numbers recorded in August and September 1992 were also higher than those recorded in May 1992 (Fig. 2).

Grey Warblers were recorded in similar numbers at Kennedy's Bush and the Kowhai Bush sites. Significantly lower numbers were recorded at Kennedy's Bush than at three of the Reefton sites (Table 2).

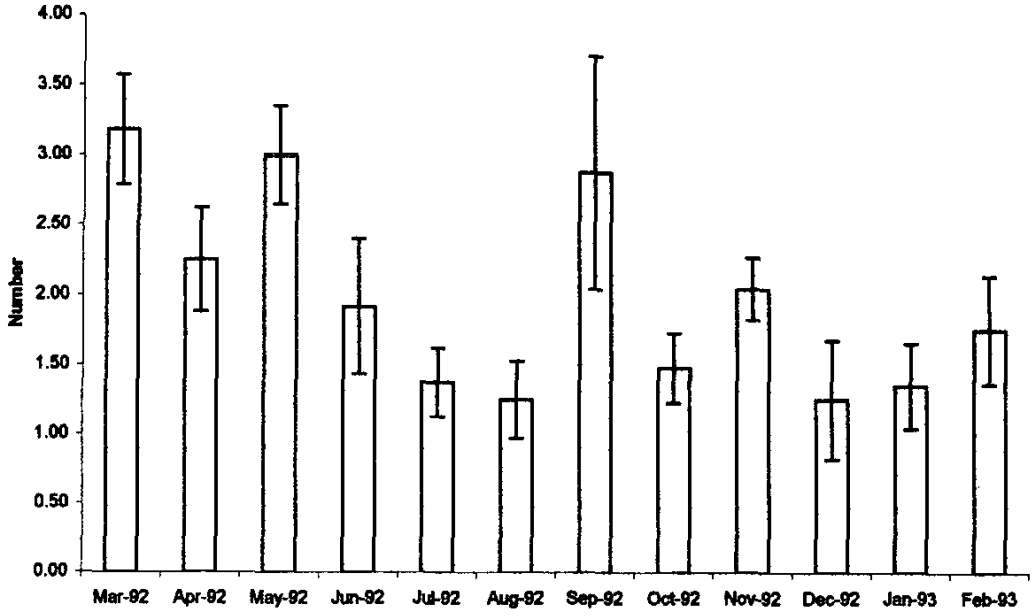
Bellbird

Bellbirds were recorded in all months and the numbers recorded fluctuated significantly over the course of the year's counts ($F = 14.5$, $df = 11$, $P < 0.05$). Bonferroni comparison of means showed that there was little overlap between counts conducted before and after August 1992. Numbers of bellbirds recorded were significantly reduced following heavy snow-falls in August 1992 (Fig. 3).

Bellbirds were recorded in significantly higher numbers at Kennedy's Bush than at two of the Kowhai Bush sites and at the Rahu Saddle site. Lower numbers of Bellbirds were recorded at Kennedy's Bush than at the three lower-altitude Reefton sites and the tallest forest at Kowhai Bush (Kowhai Bush 3) (Table 2).

Fantail

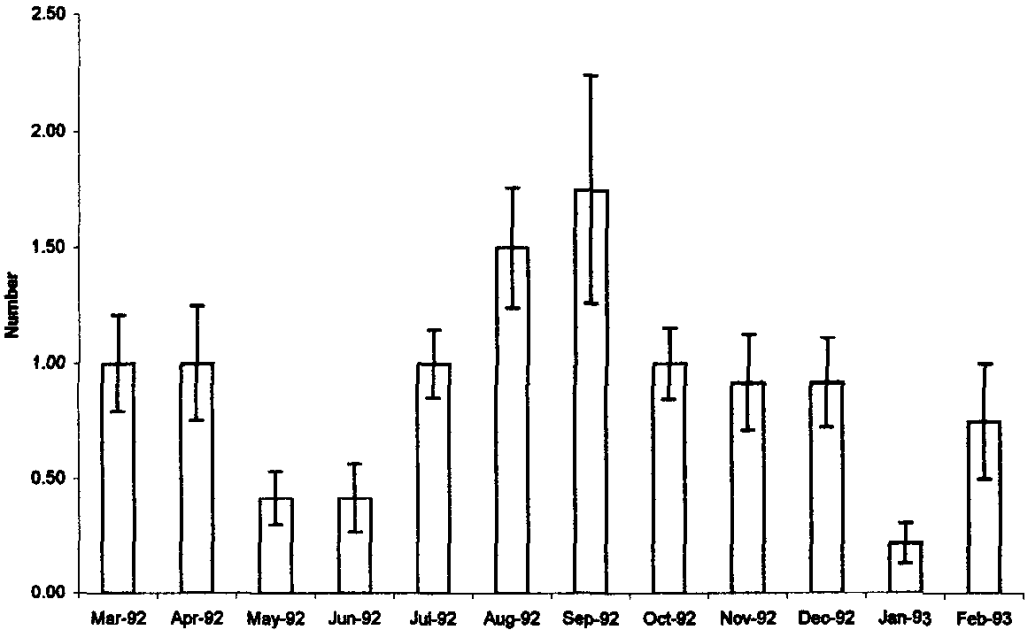
The numbers of Fantails recorded fluctuated significantly over the course of the year's counts ($H_c = 56.8$, $df = 11$, $P < 0.05$). Numbers were reduced in winter and none were recorded at the counting stations in the five months following heavy snow-falls in August 1992. Only two Fantails were seen in the reserve during this period. Kruskal-Wallis Multiple Comparison Z-Value Tests did not show any significant



Bonferroni Comparisons (transformed means)

Dec92	Jan93	Aug92	Jul92	Oct92	Jun92	Feb93	Nov92	Apr92	Sep92	May92	Mar92
0.27	0.30	0.31	0.32	0.35	0.39	0.39	0.46	0.46	0.50	0.54	0.58

FIGURE 1. The mean number of Silvereyes recorded per five-minute count at Kennedy's Bush (mean ± SE).



Bonferroni Comparisons (transformed means)

Jan93	May92	Jun92	Feb92	Nov92	Mar92	Dec92	Apr92	Oct92	Jul92	Aug92	Sep92
0.07	0.11	0.13	0.19	0.23	0.25	0.26	0.27	0.27	0.27	0.36	0.38

FIGURE 2. The mean number of Grey Warblers recorded per five-minute count at Kennedy's Bush (mean ± SE).

difference between the higher numbers recorded in March and the lower numbers recorded in April – August 1992 and February 1993 (Fig. 4).

Fantails were recorded in significantly higher numbers at Kennedy's Bush than at one of the Kowhai Bush sites. Significantly lower numbers of Fantails were recorded at Kennedy's Bush than at the Reefton sites (Table 2).

Chaffinch

The numbers of chaffinches recorded fluctuated significantly over the course of the year's counts ($H_c = 120.80, df = 11, P < 0.05$). Chaffinches were not recorded over the autumn and winter months. The numbers recorded increased over spring, peaked in November, and tailed off over the summer. Kruskal-Wallis Multiple Comparison Z-Value Tests showed that there was considerable overlap in numbers between months when Chaffinches were present but that the number of Chaffinches recorded in November 1992 was significantly higher than in September 1992 and in January and February 1993 (Fig. 5).

Chaffinches were recorded in significantly lower numbers at Kennedy's Bush than at one of the Kowhai Bush and two of the Reefton sites. Chaffinches were recorded in significantly higher numbers at Kennedy's Bush than at the Reefton Saddle site (Table 2).

Blackbird

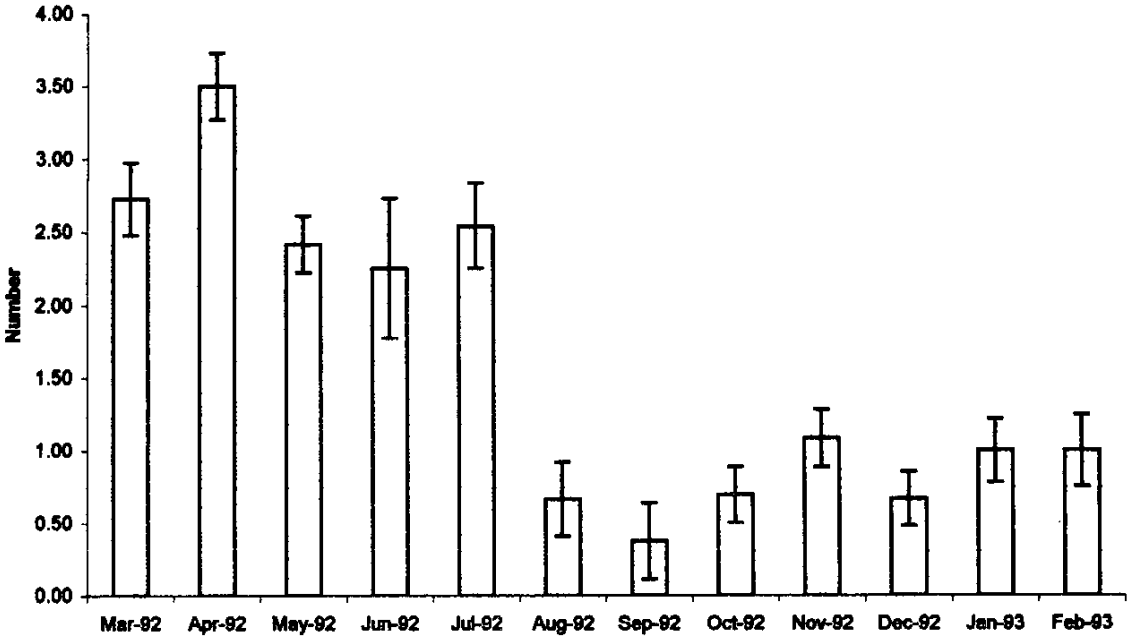
The numbers of Blackbirds recorded fluctuated significantly over the course of the year's counts ($H_c = 54.71$, $df = 11$, $P < 0.05$). The numbers of Blackbirds recorded were higher in spring and summer than in autumn and winter. Kruskal-Wallis Multiple Comparison Z-Value Tests showed that there was considerable overlap between months, but that numbers recorded in September – October 1992 were significantly higher than those recorded in March and July 1992 and that the number recorded in December 1992 was significantly higher than the numbers recorded for all the months March – July 1992 (Fig. 6).

Blackbirds at Kennedy's Bush were recorded in significantly lower numbers than at Fletcher Creek and significantly higher numbers than at Te Wharau (Table 2).

Redpoll

The numbers of Redpolls recorded fluctuated significantly over the course of the year's counts ($H_c = 178.24$, $df = 11$, $P < 0.05$) only being recorded in March 1992 and over the summer months December 1992 – February 1993. Kruskal-Wallis Multiple Comparison Z-Value Tests showed that the numbers recorded in December 1992 – February 1993 did not differ significantly from each other (Fig. 7).

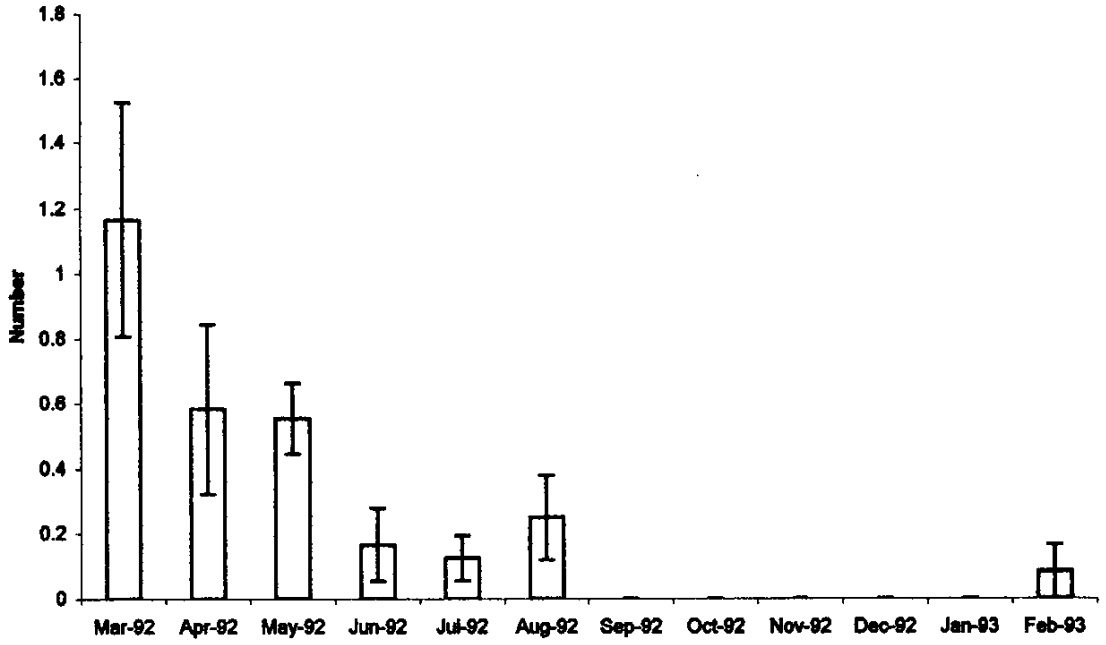
Redpolls were recorded in higher numbers at Kennedy's Bush than at the Reefton sites. The numbers of Redpolls recorded at Kowhai Bush varied considerably between sites. The number of Redpolls recorded at Kennedy's Bush was less than, equal to and greater than at Kowhai Bush Habitats 1, 2 and 3 respectively (Table 2).



Bonferroni Comparisons (means)

Sep92	Aug92	Dec92	Oct92	Feb93	Jan93	Nov92	Jun92	May92	Jul92	Mar92	Apr92
0.38	0.67	0.67	0.70	1.00	1.00	1.08	2.25	2.42	2.54	2.73	3.50

FIGURE 3. The mean number of Bellbirds recorded per five-minute count at Kennedy's Bush (mean ± SE).



Kruskal-Wallis Multiple Comparisons (mean ranks)

Jan93	Dec92	Nov92	Oct92	Sep92	Feb93	Jul92	Jun92	Aug92	Apr92	May92	Mar92
91.00	91.00	91.00	91.00	91.00	99.67	104.00	108.33	117.00	130.29	141.65	146.00

FIGURE 4. The mean number of Fantails recorded per five-minute count at Kennedy's Bush (mean ± SE).

Less Frequently Recorded Species

New Zealand Pigeons were recorded in significantly lower numbers at Kennedy's Bush than at the two lower-altitude Reefton sites but Kennedy's Bush appeared to support significantly higher numbers of New Zealand Pigeons than the higher-altitude Reefton sites.

Shining Cuckoos were first recorded at Kennedy's Bush during counts made on 31 October 1992 and were last recorded on 17 January 1993. The number of Shining Cuckoos recorded did not differ significantly between Kennedy's Bush and any of the Kowhai Bush or Reefton sites.

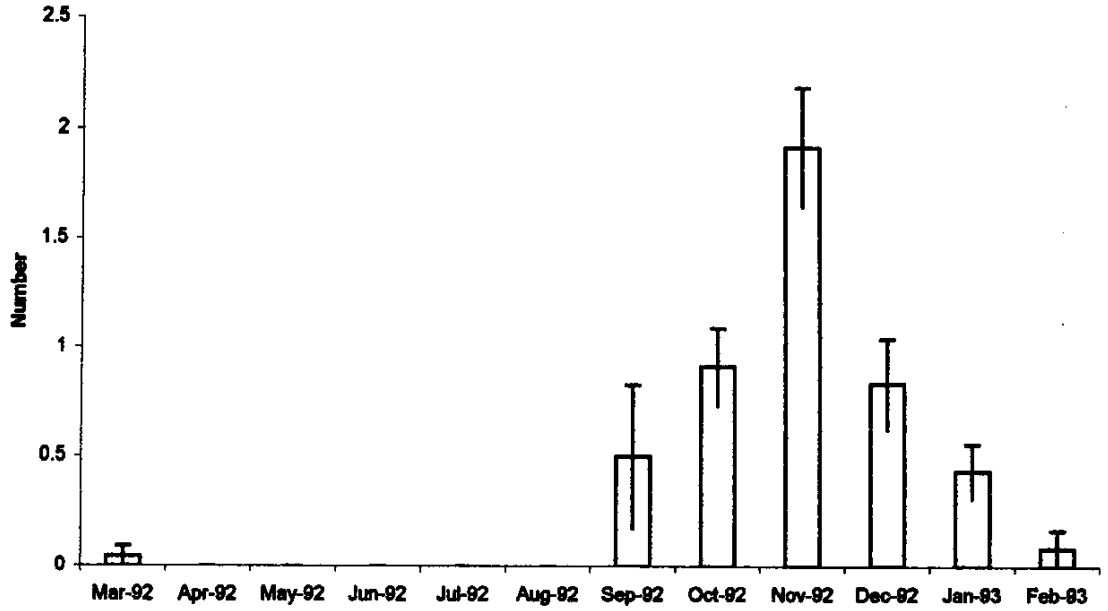
The other species that Kennedy's Bush and the Kowhai Bush and Reefton sites had in common were recorded in numbers too small to analyse statistically. Tomtits were common at the Reefton sites but were only recorded on two occasions at Kennedy's Bush. Harriers (*Circus approximans*) and New Zealand Falcons (*Falco novaeseelandiae*) were seldom recorded at both Kennedy's Bush and the Reefton sites. Dunnocks were recorded in low numbers at both Kennedy's Bush and the Reefton sites, as were Greenfinches. Goldfinches appeared to be in lower numbers at Kennedy's Bush than at the Kowhai Bush sites.

DISCUSSION

Making seasonal inferences from five-minute bird count data is problematic because the conspicuousness of birds can change with the season (Best 1981; Dawson 1981). This was certainly the case with Blackbirds that were resident in Kennedy's Bush year round, but were much more conspicuous in the breeding season. Similarly, Redpolls were apparently absent in winter, but the highly variable numbers recorded in summer as flocks passed over the reserve may have exaggerated this species' presence. Conspicuousness of a species should be broadly similar across sites however, making comparisons with other areas possible if the time of year is taken into account.

Compared to Kowhai Bush and the Reefton sites, Kennedy's Bush does not contain a high diversity of native bush birds. Rifleman, Brown Creeper and Robin (*Petroica a. australis*) are not found at Kennedy's Bush whereas they are recorded regularly at Kowhai Bush (Gill 1980). The Reefton sites also support Tui (*Prosthemadera n. novaeseelandiae*), Kaka (*Nestor m. meridionalis*), Parakeet (*Cyanoramphus* spp.) and Weka (*Gallirallus australis*) (Dawson *et al.* 1978). The Reefton sites generally support higher numbers of Silvereye, Grey Warbler, Bellbird, Fantail and New Zealand Pigeon than Kennedy's Bush. However, Kennedy's Bush appears to support equal or greater numbers of these species than the Kowhai Bush sites.

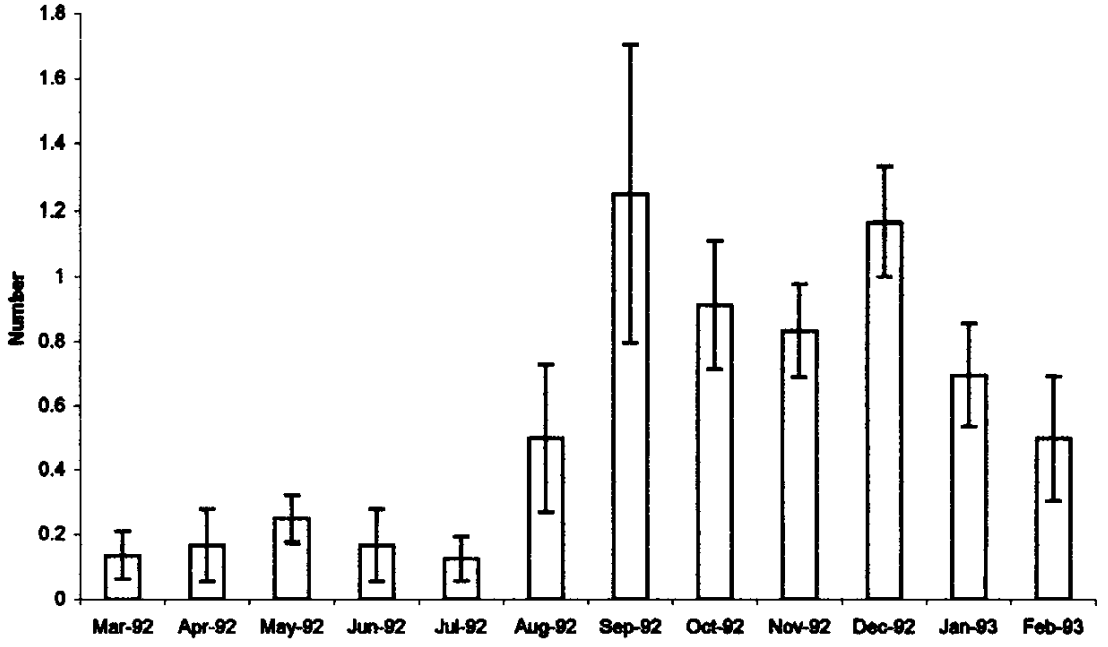
At Kennedy's Bush, the highest numbers of Silvereyes were recorded in March and May. At Kowhai Bush, there was also an autumn peak in Silvereye numbers from April to June with much flocking observed (Gill 1980). At the Reefton sites, Silvereye numbers were highest in autumn with numbers reduced over the winter months. It was postulated that Silvereyes move out of the forest or to forest types



Kruskal-Wallis Multiple Comparisons (mean ranks)

Apr92	May92	Jun92	Jul92	Aug92	Mar92	Feb92	Sep92	Jan93	Dec92	Oct92	Nov92
82.50	82.50	82.50	82.50	82.50	86.89	90.54	112.88	121.35	148.85	151.00	185.94

FIGURE 5. The mean number of Chaffinches recorded per five-minute count at Kennedy's Bush (mean ± SE).



Kruskal-Wallis Multiple Comparisons (mean ranks)

Jul92	Mar92	Apr92	Jun92	May92	Aug92	Feb93	Jan93	Oct92	Nov92	Sep92	Dec92
79.88	81.00	84.00	84.00	92.25	107.33	112.17	126.28	137.63	140.33	147.50	168.50

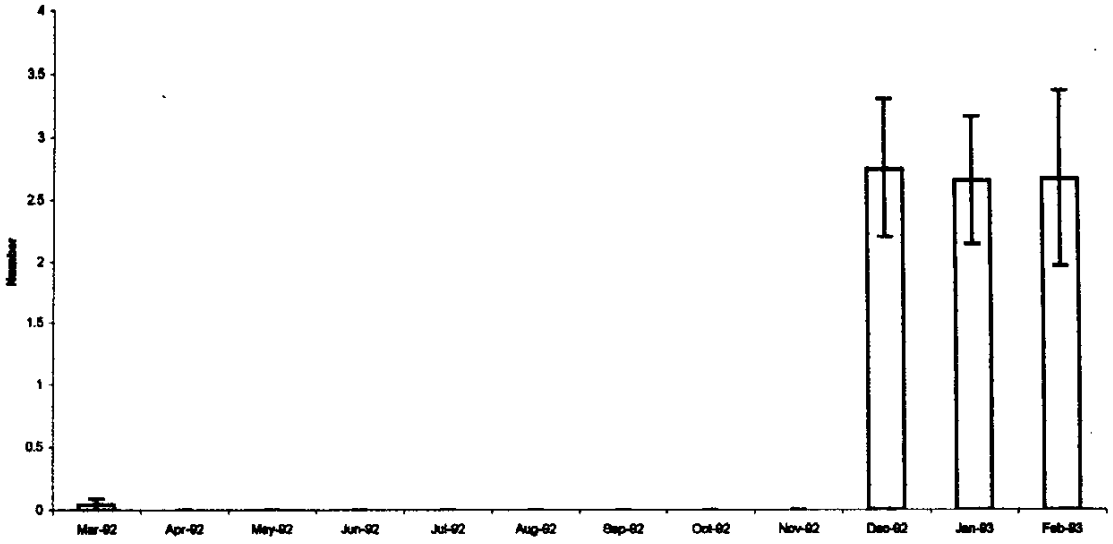
FIGURE 6. The mean number of Blackbirds recorded per five-minute count at Kennedy's Bush (mean ± SE).

not represented in the study over the winter months (Dawson *et al.* 1978). Results from an Ornithological Society of New Zealand (OSNZ) banding study of Silvereyes at Lansdowne Valley, a site at the foot of the Port Hills below Kennedy's Bush Scenic Reserve, suggest that each autumn and winter thousands of Silvereyes pass through the Port Hills area on migration (Crossland 1996). The higher numbers of Silvereyes recorded in Kennedy's Bush in autumn may, therefore, result from flocks of migrating birds, some moving out of the reserve for the winter months.

At the Reefton sites the timing of seasonally high numbers of Grey Warblers recorded differed between sites (Dawson *et al.* 1978). In the low-terrace and hill-country forests the peak in numbers recorded occurred between February and August whereas at Rahu Saddle the peak occurred in October to December. It was thought that this could be due to differences in the timing of breeding activity at the sites or to altitudinal movements. At Kowhai Bush, Gill (1980) found that adult Grey Warblers are sedentary year round and suffer little mortality. Juveniles disperse from their natal areas and few are recruited there. Gill argued that Grey Warblers are therefore most numerous when nestlings fledge (October to early January) and that their numbers probably fall in the interim. However monthly counts of Grey Warblers at Kowhai Bush did not reflect this and instead followed changes in song intensity with the highest numbers recorded from August to October. At Kennedy's Bush, the highest numbers of Grey Warblers were also recorded in spring and probably reflected changes in conspicuousness rather than a change in actual numbers.

Grey Warblers are more commonly recorded in Christchurch City in autumn and winter, and it has been suggested that this is because birds from the Port Hills move into the city in search of food at that time (Crossland 1996). If this is the case, it could be expected that, in Kennedy's Bush, Grey Warblers would be recorded less often in autumn and winter. However, although only low numbers of Grey Warblers were recorded at Kennedy's Bush in May and June numbers recorded in July and August were relatively high. An alternative explanation for the increase in Grey Warblers in Christchurch City in autumn and winter is that the birds seen are offspring moving away from the natal territory (P. Sagar pers. comm.). The pattern found at Kennedy's Bush better fits this later scenario, but this study was not designed to study bird movements between Christchurch City and the Port Hills, so only tentative inferences can be drawn.

At Kowhai Bush Gill (1980) recorded large numbers of Bellbirds throughout the year with numbers generally declining from April to October and then increasing. At the Reefton sites Dawson *et al.* (1978) recorded a similar pattern. At Kennedy's Bush there was a general decline from the peak in numbers recorded in April. The presence of juveniles following fledging in February/March and the onset of courtship singing in the winter months probably account for the higher counts recorded in March to July at these sites. Bellbirds are less conspicuous between September and January during nesting and hence counts are lower but increase over summer as breeding is completed. At Kennedy's Bush, however, the heavy snow-falls of August 1992 appeared to have a severe effect on the Bellbird population as the numbers of Bellbirds recorded did not increase over the following summer.



Kruskal-Wallis Multiple Comparisons (mean ranks)

Apr92	May92	Jun92	Jul92	Aug92	Sep92	Oct92	Nov92	Mar92	Feb93	Jan93	Dec92
89.50	89.50	89.50	89.50	89.50	89.50	89.50	89.50	93.86	181.88	184.93	191.21

FIGURE 7. The mean number of Redpolls recorded per five-minute count at Kennedy's Bush (mean ± SE).

At Kowhai Bush the number of Fantails recorded declined from May to July with a subsequent, gradual increase (Gill 1980). The higher numbers recorded from March to May were thought to reflect groups of juveniles that are noticeable in autumn. At the Reefton sites Dawson *et al.* (1978) also recorded a drop in Fantail numbers over the winter with numbers gradually increasing thereafter. At Kennedy's Bush the highest numbers of Fantails were also recorded in the autumn months when groups of up to five juveniles were seen together. The heavy snowfalls of August 1992 are presumed to have caused the dramatic decline in Fantail numbers recorded after that event. Fantail numbers also appeared low in other parts of Banks Peninsula over that summer. For example, no Fantails were recorded at Otepatoutou Scenic Reserve or at Hinewai on Banks Peninsula on 28 February 1993 (pers. obs.). Occasional sharp drops in the size of Fantail populations have previously been recorded as a result of high snow-storm mortality (Potts 1869; Stead 1927).

Spring brought high numbers of Chaffinches to Kennedy's Bush that were apparently absent over winter. At Kowhai Bush, Gill (1980) recorded Chaffinches in low numbers from February to September, increasing in October and November and peaking in December. This is in contrast to sites near Reefton where Chaffinches were also recorded in variable, but relatively high, numbers outside of the breeding season (Dawson *et al.* 1978). As male Chaffinches only sing fully between August and December counts may reflect seasonal changes in conspicuousness. Where so few Chaffinches are recorded outside of the breeding season, however, seasonal movement is probably also a factor. Gill (1980) considered that most Chaffinches may have vacated Kowhai Bush during the non-breeding period. This certainly

appears to be the case at Kennedy's Bush where no Chaffinches were positively identified outside of the breeding season. Occasional unidentified finch calls were heard outside of the breeding season that could have been Chaffinches. If so, they were in very low numbers.

The highest numbers of Blackbirds recorded at Kennedy's Bush were from September to December. At the Reefton sites, Dawson *et al.* (1978) also recorded the highest numbers of Blackbirds in October and December. This reflects the middle of the Blackbird song period (Falla *et al.* 1970) and presumably the differences in the numbers recorded are due primarily to changes in conspicuousness.

The numbers of Redpolls recorded is highly influenced by flocking and leads to large variability in counts of this species. At sites near Reefton, Dawson *et al.* (1978) recorded the highest numbers of Redpolls in August with low numbers in October. Redpolls were only present in small numbers at the Reefton sites, however, and the authors considered that the differences in the numbers recorded could have been due to chance. At Kowhai Bush, Redpolls were present in small numbers from February to September and high numbers were recorded from October to January, the period of greatest vocal conspicuousness (Gill 1980). At Kennedy's Bush, high numbers of Redpolls were recorded later in the summer from December to February. They were not positively identified in counts from April to November although occasional unidentified finch calls were heard that could have been Redpolls. As with Chaffinches, it appears that if Redpolls are present in Kennedy's Bush over the winter months they are only in small numbers compared to the summer.

New Zealand Pigeons were recorded in all months and were regularly encountered in the same locations throughout the study at Kennedy's Bush. This suggests that Kennedy's Bush contains a small resident population. The maximum number recorded was four birds. Twig breaking and flying with twigs by a pair of cooing birds observed on 11 October 1992, and display diving observed on 31 October 1992, indicate that nesting occurs in Kennedy's Bush Scenic Reserve.

In 12 years of visits up to 1996, only one Tomtit was recorded in Kennedy's Bush (Crossland 1996). During this study, Tomtits were seen on just two occasions; a female in April 1992 and a juvenile in February 1993. Tomtits were still present in Kennedy's Bush during autumn and winter 1997 and had, perhaps, re-established (A. Crossland pers. comm.). Tomtits are also rare at Kowhai Bush (Gill 1979), but are common at the Reefton sites.

Although not recorded in all months, records of Dunnocks were spread throughout the year at Kennedy's Bush and they were presumably resident in small numbers year round. Goldfinches and Greenfinches, although present in only small numbers at Kennedy's Bush, may have a similar pattern to Chaffinches, occurring in Kennedy's Bush only during the summer.

Native species appear to be less abundant at Kennedy's Bush than in continuous, climax forest sites near Reefton. Numbers of Silvereyes, Grey Warblers, Bellbirds and Fantails were significantly lower at Kennedy's Bush than at least three of the four Reefton sites. Only the high altitude Rahu Saddle site had less Silvereyes and

Bellbirds than Kennedy's Bush. New Zealand Pigeons were recorded in significantly lower numbers at Kennedy's Bush than at the two lower-altitude Reefton sites but Kennedy's Bush appeared to support significantly higher numbers of New Zealand Pigeons than the higher-altitude Reefton sites. Kennedy's Bush appeared to support similar numbers of Shining Cuckoos as the Reefton sites.

Kennedy's Bush had lower numbers of Chaffinches than two of the Reefton sites but equal to or greater numbers of Blackbirds than three of the four Reefton sites. Kennedy's Bush had higher numbers of Redpolls than the Reefton sites.

Compared to Kowhai Bush, however, Kennedy's Bush supports comparatively high numbers of some bird species. Silvereyes appear to be more abundant than at Kowhai Bush. Grey Warblers and Shining Cuckoos are in similar numbers. Fantails are in equal numbers to two of the Kowhai Bush sites but are more abundant than in the tallest forest (Habitat 3). Bellbirds are more common at Kennedy's Bush than at two of the three Kowhai Bush sites. Numbers of New Zealand Pigeons were not reported for Kowhai Bush but they are presumably rare as Gill (1979) reports only one breeding record and groups Pigeons with the rarer species. Kennedy's Bush had lower or equal numbers of Chaffinches as the Kowhai Bush sites.

For the native species still present on the Port Hills, Kennedy's Bush provides important habitat supporting Silvereyes, Grey Warblers, Fantails, Bellbirds and Shining Cuckoos in comparatively high numbers. These are all species that can utilise a variety of habitats and that are capable of crossing open country between pockets of bush. The self re-introduction of Tomtits to Kennedy's Bush illustrates the potential for the Port Hills to regain native species that still occur on Banks Peninsula if Port Hills habitat can be restored.

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APPENDIX 1. Monthly summary of birds recorded at Kennedy's Bush, March 1992 to February 1993.

	Mar 92	Apr 92	May 92	Jun 92	Jul 92	Aug 92	Sep 92	Oct 92	Nov 92	Dec 92	Jan 93	Feb 93	Total 220
n (counts)	**22**	**12**	**36**	**12**	**24**	**12**	**8**	**23**	**24**	**12**	**23**	**12**	
Silvereye	70	27	108	23	33	15	23	34	49	15	31	21	**449**
Grey Warbler	22	12	15	5	24	18	14	23	22	11	5	9	**180**
Bellbird	60	42	87	27	61	8	3	16	26	8	23	12	**373**
Fantail	28	7	20	2	3	3	0	0	0	0	0	1	**64**
NZ Pigeon	2	4	7	2	2	2	3	5	3	3	3	2	**38**
Shining Cuckoo	0	0	0	0	0	0	0	3	3	4	1	0	**11**
Tomtit	0	1	0	0	0	0	0	0	0	0	0	1	**2**
NZ Falcon	0	0	0	0	2	0	0	0	0	0	0	0	**2**
Harrier	1	0	0	1	0	0	1	0	0	0	0	0	**3**
Chaffinch	1	0	0	0	0	0	4	21	46	10	10	1	**93**
Blackbird	3	2	9	2	3	6	10	21	20	14	16	6	**112**
Redpoll	1	0	0	0	0	0	0	0	0	33	61	32	**127**
Dunnock	3	1	3	0	0	1	0	1	1	0	1	2	**13**
Goldfinch	0	0	0	0	0	0	0	0	0	8	2	1	**11**
Greenfinch	0	0	0	0	0	0	0	0	0	0	1	2	**3**
California Quail	0	0	0	0	0	0	0	1	2	1	0	0	**4**
House Sparrow	0	2	0	0	0	0	0	0	0	0	2	0	**4**
Magpie	1	0	1	1	0	2	1	0	0	0	0	0	**6**
Rock Pigeon	0	0	2	0	0	0	0	0	0	0	0	0	**2**
Skylark	0	0	0	0	0	0	1	0	0	0	0	0	**1**
Starling	0	0	0	0	0	0	0	0	0	0	2	0	**2**
Black-backed Gull	0	0	0	0	0	0	0	0	0	0	2	0	**2**