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SEASONAL DIFFERENCES IN BIRD COUNTS IN FORESTS NEAR REEFTON, SOUTH ISLAND, NEW ZEALAND

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ABSTRACT

Birds were counted in four forest areas every second month of a year to determine broad habitat preferences of the different species and the factors affecting the numbers counted. Most species showed marked seasonal changes in conspicuousness. The differences between the numbers of birds counted by different observers were generally small compared with the differences between areas and seasons. Many species were more abundant in the valley-bottom forest than in the two hill-country forests; only a few species preferred high-altitude forest. The preferred habitat of some species changed with season. The implications of these findings for bird conservation in Westland forests are discussed.

INTRODUCTION

Conservation issues, such as those raised by proposals to exploit South Island beech forests commercially (Thomson 1971), require information on the kinds and numbers of birds living in different forested areas. Dawson & Bull (1975) described what seemed a practical technique for counting birds in forests, and this paper reports the use of the technique to compare the bird populations of four forests near Reefton every second month for a year. The study had two main aims: to document broad habitat preferences and the seasonal distribution of each species of bird, and to examine the various factors influencing the numbers counted. This paper compares the areas and examines the effects of season and different observers on the numbers counted. A preliminary examination indicates that weather, noise (produced by running water, traffic, cicadas, etc.) and hour of day were not significant in the differences that occurred.

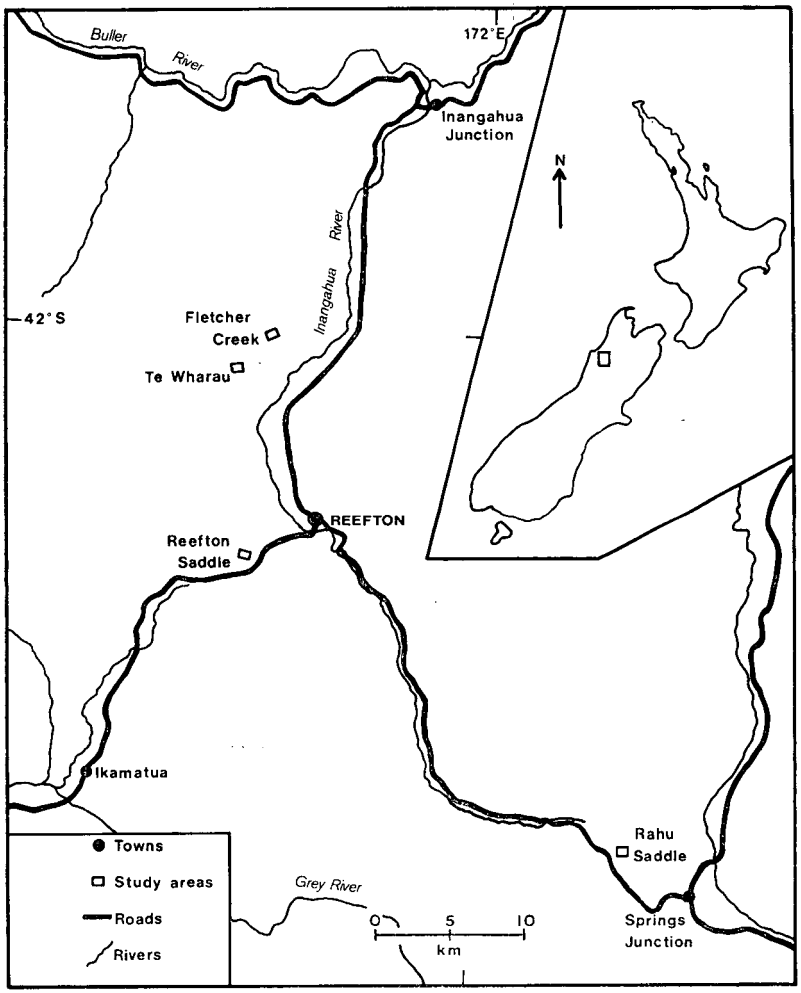

FIGURE 1 — The location of the four study areas.

STUDY AREAS AND METHODS

Four study areas were selected (Fig. 1). Two represent the main hill-country "types" (as mapped by the National Forest Survey, Masters *et al.* 1957) of the forests proposed for conversion to exotics or beech management in the West Coast Beech Utilisation Scheme (Thomson 1971; N.Z. Forest Service staff, Reefton, pers. comm.). These were at Reefton Saddle (type PB5: 310-430 m a.s.l.) and at Te Wharau (type PB15: 300-420 m a.s.l.). The third area, type PB1, sampled at Fletcher Creek (230 m a.s.l.), is a remnant of the type of

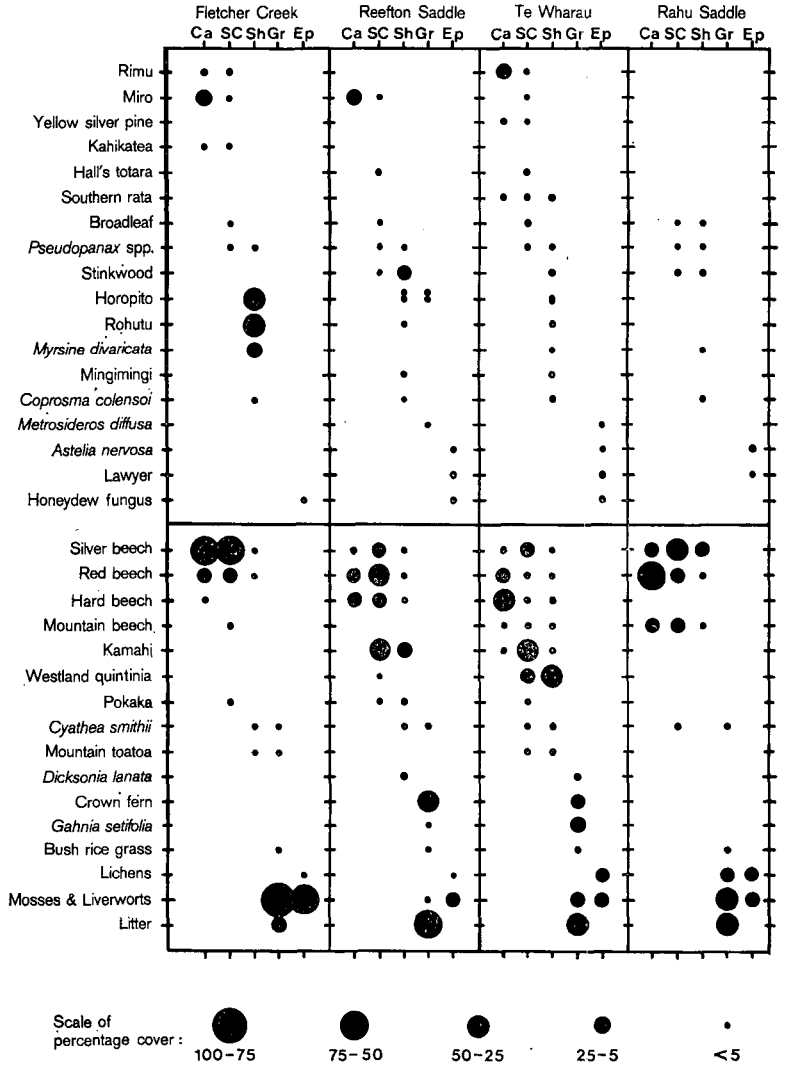

FIGURE 2 — The structure and composition of the vegetation in each study area. Species known to provide fruit or nectar for birds are grouped together at the top. The method used to estimate the ground cover provided by each species in each layer is given in Appendix III. (Ca = canopy & emergents; SC = subcanopy and tall understorey; Sh = shrubs; Gr = ground cover; and Ep = epiphytes). For scientific names see Appendix I.

TABLE 1 — The weather and noise recorded in the four study areas (average values).
Air temperature was recorded in each area at 0930, 1200 and 1500 hours each day; the other variables were recorded on an arbitrary scale (Dawson & Bull 1975) at every counting point.

	Fletcher	Reefton	Te Wharau	Rahu	Average
Air temperature (°C):	12.3	12.2	12.7	10.4	11.9
Sun (0-5):	2.0	2.5	2.1	1.8	2.1
Wind (0-3):	0.15	0.33	0.16	0.44	0.27
Rain (0-5):	0.22	0.20	0.33	0.24	0.25
Noise (0-2):	0.21	0.20	0.15	0.42	0.25

forest once common on alluvial flats and terraces; most of what is left could be logged under current New Zealand Forest Service proposals. The fourth study area is in " protection forest " at Rahu Saddle (820-1070 m a.s.l.) and represents the high-altitude areas that are to remain untouched.

Table 1 gives the average weather and noise levels recorded in the four study areas, and Figures 2 and 3 summarise the vegetation as described by G. N. Park and G. Y. Walls of Botany Division, DSIR. The major features of each area are described below; scientific plant names are given in Appendix I.

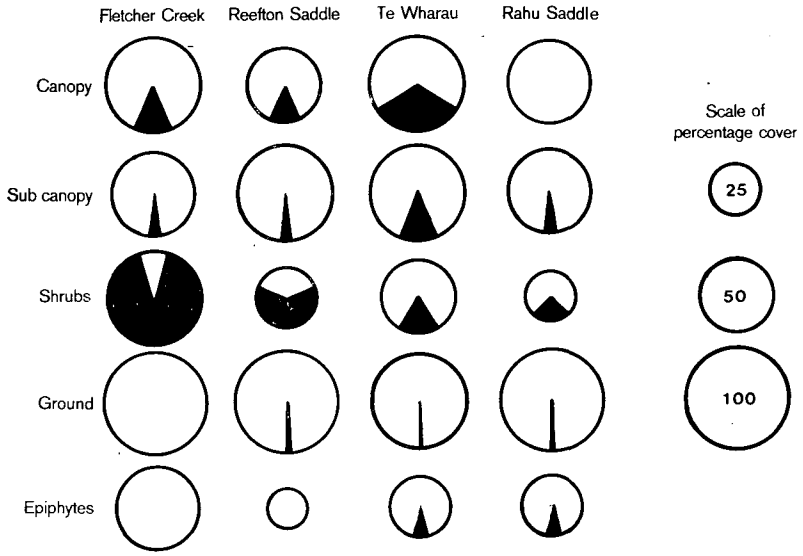

FIGURE 3 — The average cover provided by each of the layers of vegetation in Fig. 2. The areas of the circles indicate the ground cover provided by the layers. The proportion attributable to species known to provide fruit or nectar is shaded.

1. *Fletcher Creek (map ref. NZMS 18 S57 2942): silver beech, red beech forest, with emergent podocarps*

Despite its low altitude this area was no warmer (Table 1) than Te Wharau and Reefton Saddle, suggesting that cold air drained on to it from the surrounding hills. Silver beech predominated in the canopy and subcanopy, with few podocarps, but this was the only area with any kahikatea. The area was notable for a dense layer of the fruit-bearing shrubs horopito, rohutu, *Myrsine divaricata* and *Coprosma colensoi*. Mosses and liverworts covered the ground and tree trunks. Figure 3 shows that Fletcher Creek, in contrast to the other areas, had full representation of each layer.

2. *Reefton Saddle (map ref, S57 2826): hard beech forest and red beech, silver beech forest*

This area was appreciably windier than Fletcher Creek or Te Wharau. The ridges had hard beech forest over kamahi, quintinia and Hall's totara, but the slopes and gullies had red and silver beech, with some miro in the canopy, over kamahi. The shrubs were fewer than at Fletcher Creek, with stinkwood, rohutu and mingimingi the predominant fruiting species. Mosses and liverworts were scarce, and crown fern and litter predominated on the ground. The canopy and shrub layers were sparse and there were few epiphytes.

3. *Te Wharau (map ref. S57 2739): rimu, hard beech forest*

This area experienced a little more rain and slightly higher temperatures than the other three. Emergent rimu were prominent, but miro were practically absent. The canopy was mainly of hard beech, with some red beech in gullies, and poorly drained sites had yellow-silver pine and mountain beech. Kamahi, quintinia and silver beech were abundant below the canopy and there were few fruiting shrubs. The ground cover was varied, with much litter and *Gahnia setifolia* but with some mosses, liverworts and crown fern. Mosses, liverworts and lichens were the major epiphytes.

4. *Rahu Saddle (map ref. S57 5605): red beech, silver beech forest*

This area contrasted markedly with the three lower sites in many respects. It was colder, had less sun and more wind, and was noisier. There were no podocarps, the canopy being of red beech over silver beech. The shrub layer was very thin, though stinkwood and a few vines of lawyer provided some fruit. The ground was covered with litter, mosses, liverworts and lichens. The last three were also important as epiphytes.

The study areas were visited on 18-21 April, 19-22 June, 27-30 August, 21-24 October, 14-17 December 1974 and 17-20 February 1975; and 22-25 April 1976. On each visit, each of the four observers counted in all four areas, one per day; and on each of the four days, all four areas were counted simultaneously.

In each area a 2-km loop walking track was permanently marked at 200-m intervals, and 5-minute counts (Dawson & Bull 1975) were made from each of these 10 points twice each day: once between 0930 and 1200 hours N.Z. standard time and once between 1300 and 1530 hours. Thus 20 counts were made by each observer per day, 320 were made by the team in each four-day visit and 1920 in the year.

All differences were tested with chi-squared tests but, for two main reasons, the test results provide only a pointer to the real pattern. First, the chi-squared test assumes each observation to be statistically independent of the others, but we know that some species of birds flock, while others defend territories and are thus respectively more or less likely to be seen together than would be so by chance. The tests produce too many " significant " results for flocking species and too few for territorial ones. Second, though each observer counted in each area, some differences were found between the observers and between the four successive days. Thus the counts could be affected by a combination of particular observers and days.

The histograms and Appendix II give the numbers of each species counted. These are indices of abundance, not censuses; for example, Bellbirds are more conspicuous than Riflemen so that their numbers are not directly comparable, nor would Bellbird counts in summer be directly comparable with those in winter when they may be less conspicuous. Even when comparing areas at the same time of the year differences between counts can be caused by levels of song or activity rather than by real difference in numbers. With abundant species, fewer birds may be recorded than were actually seen or heard, because, when many birds are being seen or heard, it is difficult to discriminate new birds from ones already recorded; rarely were more then eight individuals of any species recorded in one count.

RESULTS

DIFFERENCES BETWEEN OBSERVERS

Figure 4 illustrates differences between the counts of the four observers. Most of the differences were statistically significant but only a few (Tit, Chaffinch, and Song Thrush especially) were large. These three species were the only ones for which a higher chi-squared value was obtained when testing observer differences than when testing area differences (both tests with three degrees of freedom). Most differences seemed to reflect differing judgement of a bird's distance or of whether a new call represented a new bird or one previously counted.

As the same four observers counted in each area on each visit, such differences were of minor importance, but they would be of more concern if counts made by observers who had never worked together were to be compared. However, our four observers rarely differed more than twofold (usually much less).

The possibility that our judgement or ability improved or deteriorated as time went on was investigated with a six (visits) by four (observers) chi-squared test for each species. Figure 5 illustrates this for the Blackbird. Though a quarter of the counts of all the species differed significantly from the mathematically expected value, for no species did any of the observers find a seasonal trend which differed appreciably from the average.

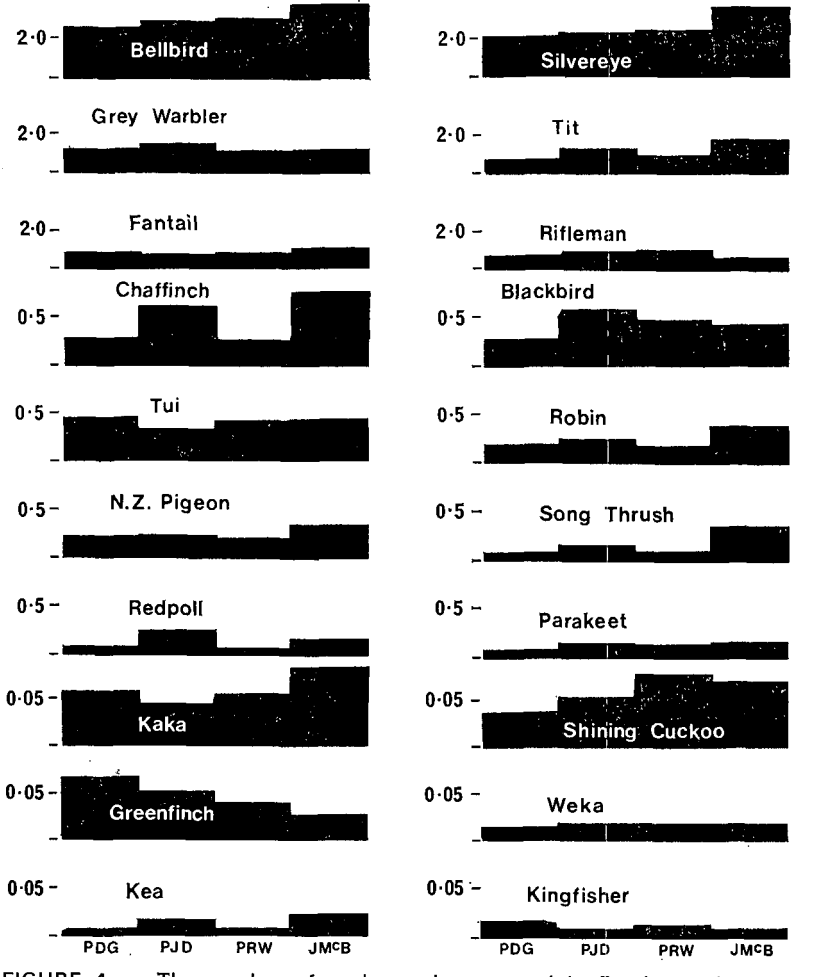

FIGURE 4 — The number of each species counted in 5 minutes by each of the four observers, averaged over the whole study. Note the different scales. The differences between observers were highly significant ($P<0.01$) for all species except Shining Cuckoo and Greenfinch, which were significant ($0.01<P<0.05$), and Weka and Kea, which were not significant.

DIFFERENCES BETWEEN AREAS

Figure 6 shows that many species had marked preferences for certain areas. Fantails, Tuis, New Zealand Pigeons and Song Thrushes were common in the low-terrace forest at Fletcher Creek, less so in the hill-country forests of Reefton Saddle and Te Wharau, and least common in the high-altitude forest at Rahu Saddle. Conversely, Riflemen and Keas were commonest at Rahu Saddle. Bellbirds, Kakas and Dunnocks preferred hill-country forests. Blackbirds and Robins favoured the low-terrace and high-altitude forest. Redpolls, Silvereyes, Shining Cuckoos, Greenfinches and Wekas were commonest at Reefton Saddle and were next most abundant at Fletcher Creek, and less abundant at Te Wharau, the other hill-country forest. Parakeets and Chaffinches were found mainly at Fletcher Creek and Te Wharau. No clear preference was shown by Grey Warblers or Tits.

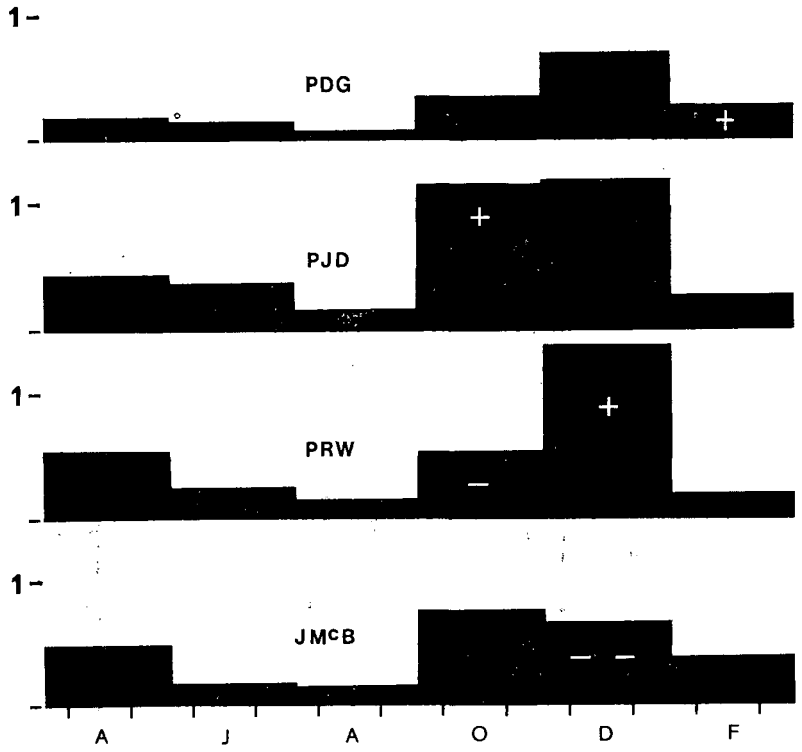

FIGURE 5 — The average number of Blackbirds counted in 5 minutes by each observer on each of the six visits. Statistically significant (+ or −) and highly significant (++ or −−) departures from expected are marked; the expected count was based on each observer's and each month's average.

Thus while all the areas were used by most of the common species, the high-altitude forest (Rahu Saddle) was favoured by fewest birds, with only Riflemen, Robins and Keas preferring it; by contrast, the now much diminished low-terrace forest (Fletcher Creek) held numerous Fantails, Blackbirds, Tuis, Robins, Pigeons and Song Thrushes. Seasonal changes in this generalised picture are described below.

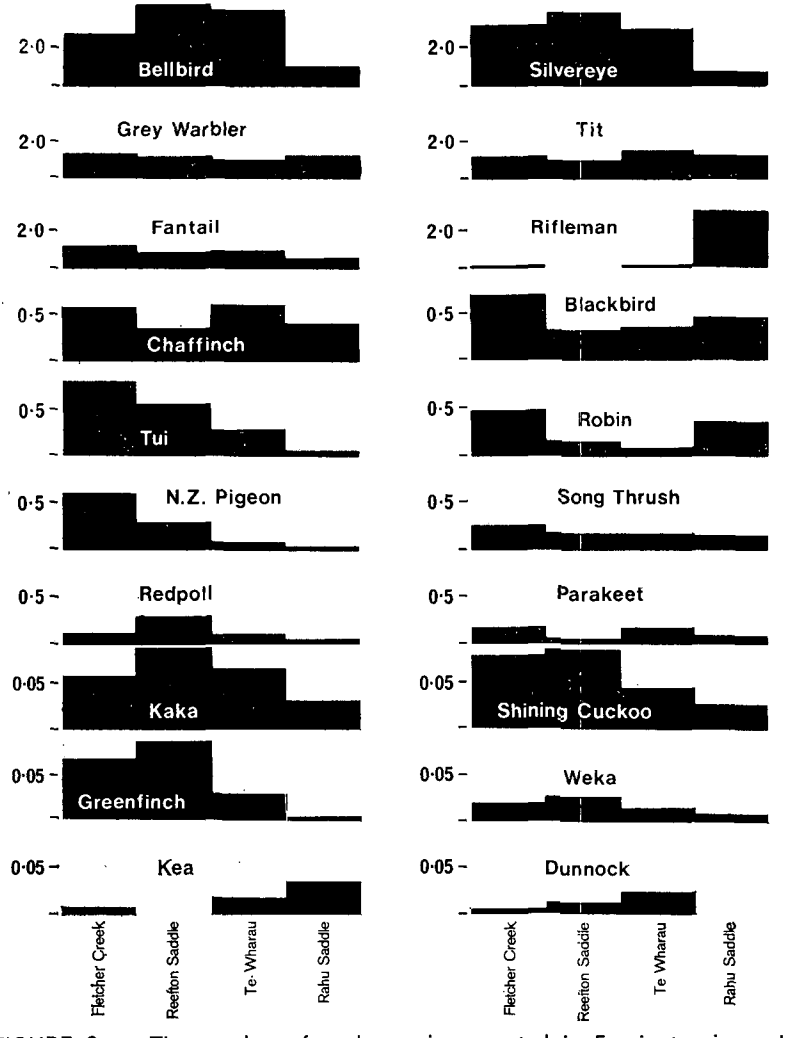

FIGURE 6 — The number of each species counted in 5 minutes in each of the four study areas, averaged over the whole year. The count was significantly different ($P<0.01$) between areas for all species except Weka. Other species are given in Appendix II.

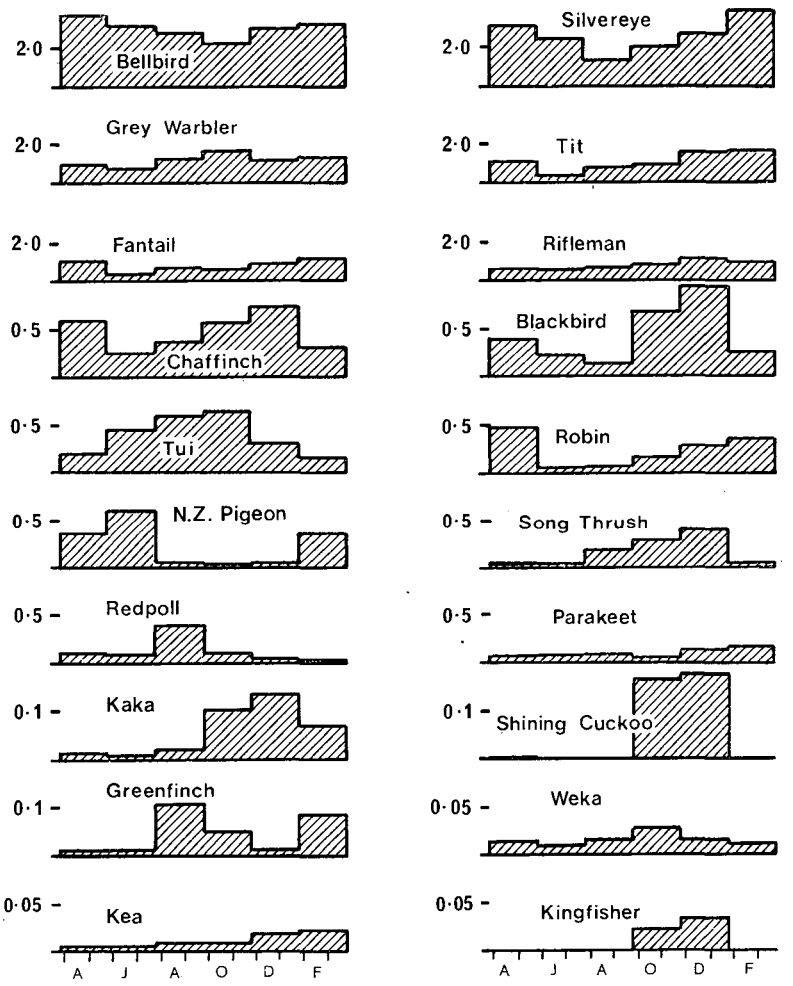

FIGURE 7 — Average 5-minute count of each species on each of the six visits; April 1974 to February 1975. Note the different scales. The count differed significantly ($P<0.01$) between months for all species except Weka, Kea and Kingfisher. Other species are given in Appendix II.

SEASONAL DIFFERENCES

Figure 7 shows that for many species the number counted rose from early winter till December, remained high till May, and then declined rapidly back to the winter minimum. This may reflect changes in numbers brought about by movement in and out, and by breeding and mortality, or in the conspicuousness of the birds through

changes in their behaviour (e.g. song) and through the direct influence of the weather on the observers' acuity.

If birds did not move from an area, the combined effect of the other processes could be allowed for when comparing counts made at different times of the year. Thus, with the Robin, a count made in late June would need to be multiplied by 121/15 = 8.07 (Appendix II) to be comparable with one made in February, if this factor sums up the net effects of mortality and changes in conspicuousness between February and June. Such reasoning obviously does not apply to species such as the Shining Cuckoo and Kingfisher which certainly leave the area for winter, and others (Silvereye, Pigeon) which may move out of the forests or to forest types not represented in our study. Nevertheless this is the best correction factor to use until further work in other habitats can improve it.

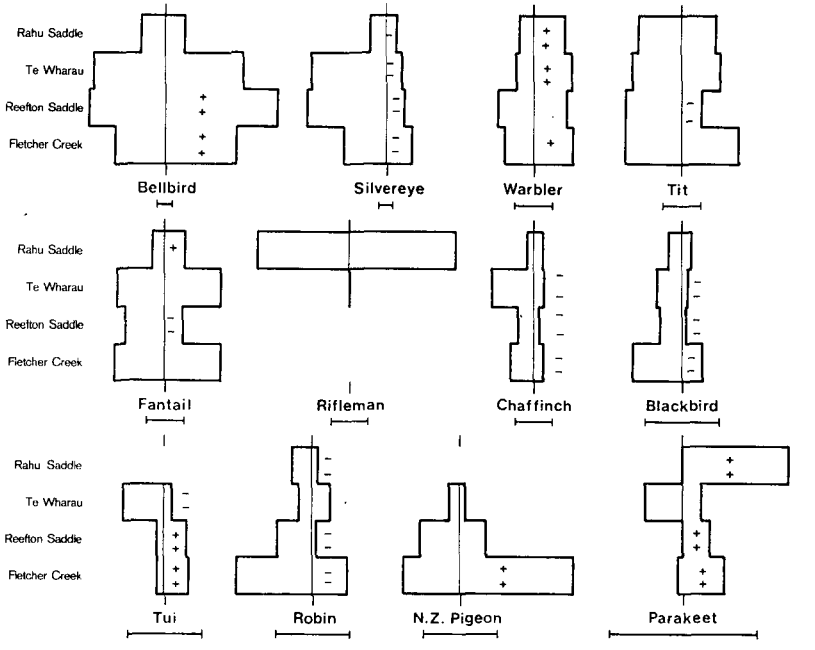

FIGURE 8 — A comparison of counts in April 1974 (left) and April 1976 (right), for 12 species. Significant differences between the two years are marked as in Fig. 5. One scale unit equals one bird.

COMPARISON OF APRIL COUNTS

The April counts were repeated in 1976 to measure the combined effect of learning by the observers, differences in conspicuousness, and real differences in bird abundance. For the 12 most abundant species the two years differed about twofold or less (Fig. 8). Chance probably

affects the counts not only of scarce species such as the Blackbird and Robin, but also of those that flock such as the Silvereye, Chaffinch and Parakeet.

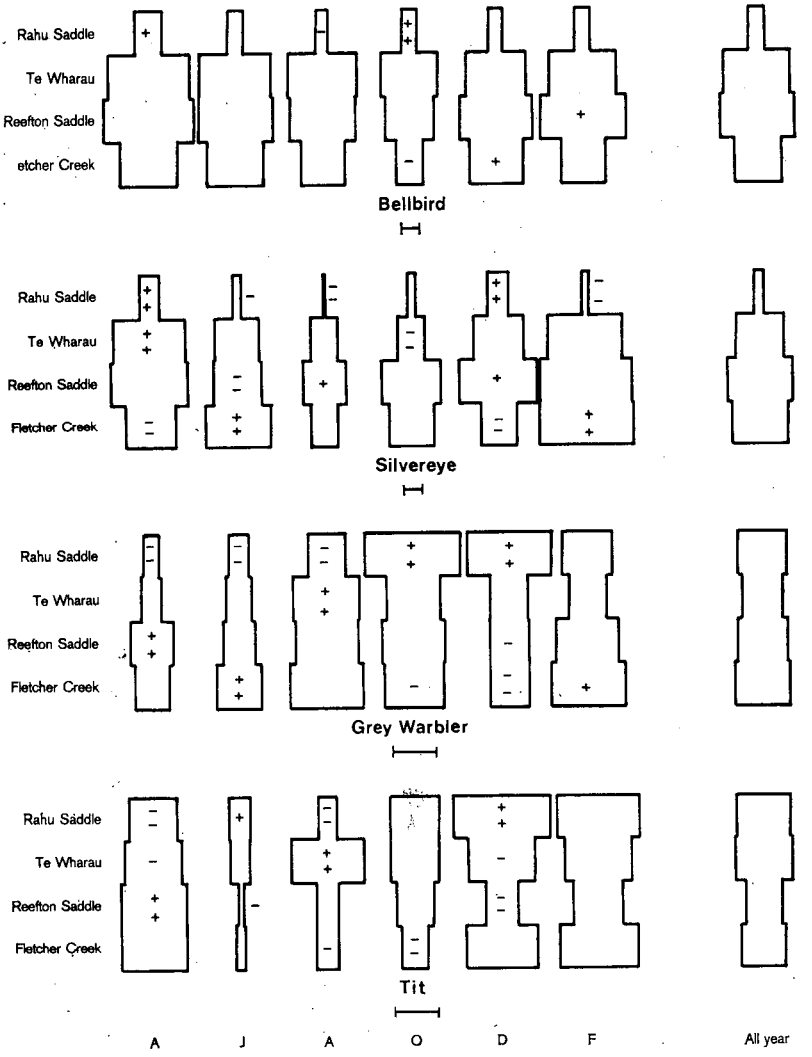

FIGURE 9A — Average 5-minute count of each species in each area on each of the six visits. Statistically significant differences from the proportion of each species counted in each area over the whole year (extreme right) are marked as in Fig. 5. The Rifleman and Pigeon showed no significant changes and so are not illustrated. One scale unit equals one bird.

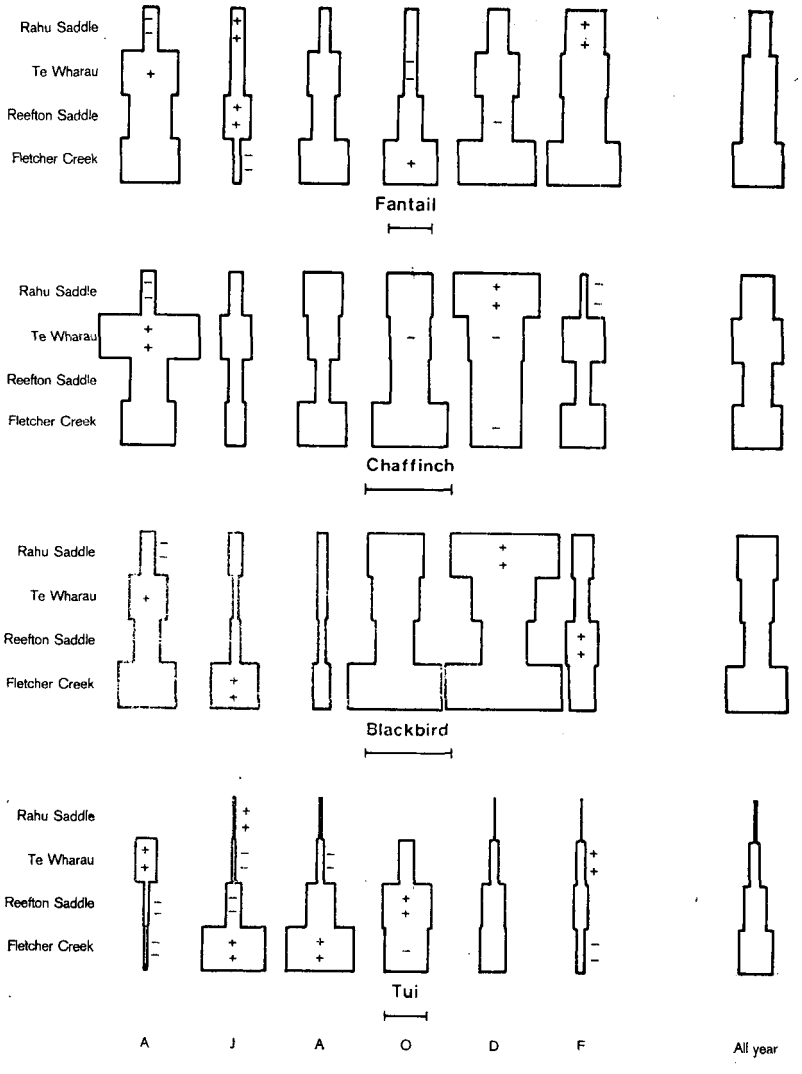

FIGURE 9B — Average count of each species in each area on each of six visits (continued).

SPECIES COUNTS

In this section we examine the seasonal changes in the apparent preferences of the 14 most commonly encountered species (Figs. 6 & 7) for each of the four study areas. This was done by comparing the proportion of each species counted in each area over the whole year,

with the proportion counted in each area, each month. For example, for Grey Warbler (Fig. 9A), though there was little difference between the annual average count for each area there were large differences between areas in some months: more than the expected numbers of

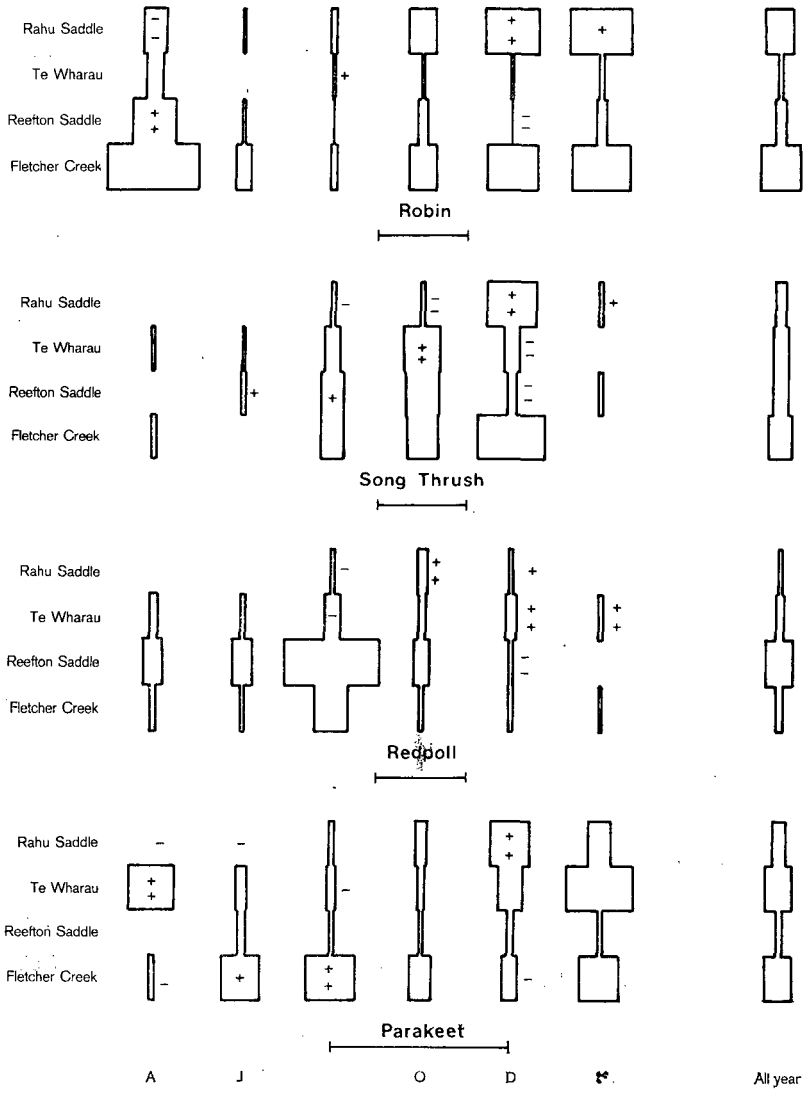

FIGURE 9C — Average count of each species in each area on each of six visits (continued).

warblers were found at Rahu Saddle in October and December, at Te Wharau in August, at Reefton Saddle in April and at Fletcher Creek in June and February. Conversely, fewer warblers than expected were counted at Rahu Saddle in April, June and August, at Reefton Saddle in December and at Fletcher Creek in October and December. Such departures from expected figures suggest either that birds moved between forest types or that they were more conspicuous in one place than another. For instance, the peak of song may be specially late at high altitude or on south-facing slopes, or birds may sing more vigorously after a nest failure as they revert to early stages of the breeding cycle.

In Figure 9, and below, the species are listed in descending order of the total number counted.

BELLBIRD *Anthornis melanura*

Unlike Tuis (see below), Bellbirds favoured hill-country forests throughout the year (Fig. 9A).

SILVEREYE *Zosterops lateralis*

We counted fewest Silvereyes in winter (Fig. 7), probably because some leave the forest then (Kikkawa 1962) rather than because they become less conspicuous. We do not know why so few Silvereyes were counted at high altitude in February. Fewer Silvereyes were counted in April 1976 than in April 1974 in all four areas, suggesting the difference was real.

GREY WARBLER *Gerygone igata*

Though, on average, warblers were distributed quite evenly through the forests (Fig. 6), comparatively many were recorded in the low-terrace and hill-country forests from February till August and at Rahu during October and December (Fig. 9A). Warblers are frequently double-brooded and breed from August to January at lower altitudes (Oliver 1955), but probably for a shorter period at higher altitudes. This may explain why we counted so many warblers at Rahu Saddle in summer. Alternatively, perhaps some warblers move to high altitude by October to avoid parasitism by Shining Cuckoos, which appear to move up later (see below).

PIED TIT *Petroica macrocephala*

Tits were found in similar numbers in all four study areas but they were inconspicuous in June and August except at Te Wharau, where singing may have begun early. Increasing numbers were counted in all areas through to February probably because there were more young about. Fleming (1950: 26) reviewed the evidence that tits are sedentary but our counts (Fig. 9A) suggest movements do occur although in no simple pattern.

FANTAIL *Rhipidura fuliginosa*

With only minor exceptions (Fig. 9B), Fantails seemed to prefer the lower-altitude forests, especially the low-terrace forest at Fletcher Creek (Fig. 6). The increasing numbers counted from June to February (Fig. 7) probably reflect the long breeding season (Blackburn 1965).

RIFLEMAN *Acanthisitta chloris*

Riflemen clearly always preferred the high-altitude protection forest (Fig. 6). Kikkawa (1966) considered that Riflemen preferred drier forests, as they become scarcer towards the West Coast. We have no reason to believe Rahu Saddle was drier than the other areas, but it is further east. Altitude *per se* seems not to explain their distribution as Riflemen are common near sea level near Dunedin (Gray 1969) and Kaikoura (pers. obs. D.G.D. & P.R.W.). The high numbers recorded in December and February (Fig. 7) were probably the result of breeding.

CHAFFINCH *Fringilla coelebs*

Chaffinches were more abundant at Fletcher Creek and Te Wharau than at the other two areas (Fig. 6), except that more were counted at Rahu Saddle in December (Fig. 9B). Increasing numbers were counted in all areas from August to October or December (Figs. 7 and 9B) probably because they increased during the breeding season. Flocks of Chaffinches outside the breeding season made counts of them very variable.

BLACKBIRD *Turdus merula*

Throughout the year, on average, the distribution of Blackbirds conformed to the pattern in Figure 6 except that unexpectedly many were recorded at Rahu Saddle in December (Fig. 9B). Either they had moved to high-altitude forest in summer or they had bred very successfully there. Some may also have moved into lower-altitude terrace forests for the winter. Blackbirds were counted most commonly in the middle of their song period, i.e. in October and December.

TUI *Prosthemadera novaeseelandiae*

Tuis favoured the low-terrace forest of Fletcher Creek, especially during winter, but were also quite common in the hill-country forests of Reefton Saddle and Te Wharau (Figs. 6 and 9B). By October, they had spread more into the hill-country forests, probably to breed there as well as in the low-terrace areas. This dispersion persisted until April, after which Tuis returned to their preferred over-wintering habitat. Most were counted in winter and spring, when noisy flocks fed at low altitude.

ROBIN *Petroica australis*

Robins favoured the protection forest at Rahu Saddle and the low-terrace forest at Fletcher Creek, and their increase and decrease through the year (Fig. 7) reflected the breeding cycle; first, singing adults became more conspicuous, then young birds swelled the population between October and April. The highly significant increase in numbers at Reefton Saddle during April 1974 (Fig. 9C) may have reflected a movement of young birds, but it did not recur in 1976.

NEW ZEALAND PIGEON *Hemiphaga novaeseelandiae*

Pigeons were distributed very similarly to Tuis (Fig. 6), specially preferring forests with kahikatea and/or miro as at Fletcher Creek, but

also the hill-country forest at Reefton Saddle which has some miro in the gullies. Pigeons were rarely seen in late winter and spring, probably because they were then in lowland habitats outside our study areas, e.g. feeding on kowhai foliage until September, then on new shoots of willows until October (pers. obs.). Oliver (1955) recorded that most eggs are laid in November and December and that the young fledge about 70 days later. Pigeons were virtually absent from Fletcher Creek in December but were present during the February counts, suggesting they may have bred early elsewhere.

SONG THRUSH *Turdus philomelos*

Though Song Thrushes were distributed throughout, they were usually commonest at Fletcher Creek. Few were counted except in the breeding season (August till December) when they were singing strongly. As with Blackbirds, the sudden reduction in numbers counted in both of the hill-country forest types and the marked increase in the protection forest between October and December (Fig. 9C) may indicate an upward movement, or they may begin to sing later at higher than at lower altitudes.

REDPOLL *Acanthis flammea*

Redpolls were most often encountered at Reefton Saddle, especially in winter. However, only few were seen and the differences in Figure 9C may well be due to chance.

PARAKEET *Cyanoramphus* spp.

Only a few parakeets were identified to species and all of these were Yellow-crowned *(Cyanoramphus auriceps)*. Parakeets were commonly found at Fletcher Creek and Te Wharau (Fig. 6). Figure 9C suggests that they move to higher altitudes for the summer and down for the winter, but the large difference between the two April counts (Fig. 8) throws some doubt on this.

KAKA *Nestor meridionalis*

Kakas were found mainly below the protection forest (Fig. 6) and were most often recorded from October to February (Fig. 7); noisy birds flying overhead at this time may be family parties (Jackson 1963a).

SHINING CUCKOO *Chrysococcyx lucidus*

Although Shining Cuckoos may arrive as early as August and leave as late as April (Oliver 1955), we recorded them only during their peak song period (Fig. 7). The shift of peak numbers from Fletcher Creek to higher forests between October and December (Appendix II) was highly significant ($P<0.005$ in a chi-squared test) and may reflect a movement in search of warblers' nests to parasitise.

GREENFINCH *Carduelis chloris*

Greenfinches were often heard at Fletcher Creek and Reefton Saddle and, like Redpolls, were common in late winter and again in February. These changes could reflect either movement or conspicuousness.

WEKA *Gallirallus australis*

A few Wekas were encountered at all seasons and in all four areas, but no significant differences were detected.

KEA *Nestor notabilis*

Like Kakas, Keas were normally noticed flying overhead and calling more frequently in December and February (Fig. 7), when possibly in family parties (Jackson 1963b), than at other seasons. They were most numerous at Rahu Saddle, whereas Kakas favoured low and mid-altitude forest (Fig. 6).

KINGFISHER *Halcyon sancta*

Kingfishers were found only in October and December (Fig. 7) the same seasonal pattern shown by Taylor (1966) for areas near Lake Rotoiti (Nelson) at around 600 m above sea level. We found none at Rahu Saddle, 800 m or more above sea level. Taylor found Kingfishers inconspicuous in January and February while moulting, and we agree that they move out of the forests for the winter, when they are most abundant at the coast (pers. obs. D.G.D., P.R.W.).

DUNNOCK *Prunella modularis*

Dunnocks were recorded only from those study areas with low second-growth vegetation within earshot of at least one counting point. No seasonal variation was shown by the statistical tests.

GOLDFINCH *Carduelis carduelis*

A few Goldfinches were recorded in all four study areas throughout the year (Appendix II).

BROWN CREEPER *Finschia novaeseelandiae*

Our records of Brown Creepers were confined to the protection forest at Rahu Saddle in December and February (Appendix II). This species occurs at coastal forest margins at Punakaiki, Westland, only in winter (D. J. Onley, pers. comm.), perhaps having then moved down from high altitudes on the Paparoa Range.

OTHER SPECIES

Too few Yellowhammers *(Emberiza citrinella)*, Harriers *(Circus approximans)*, New Zealand Falcons *(Falco novaeseelandiae)*, Long-tailed Cuckoos *(Eudynamis taitensis)*, Paradise Ducks *(Tadorna variegata)* and Moreporks *(Ninox novaeseelandiae)* were recorded for detailed analysis (Appendix II). The three Falcons, Long-tailed Cuckoo and Morepork were recorded at Rahu Saddle, and the other three species were flying over the forest at one or more localities.

Occasional observation at night revealed the presence of Moreporks and Great Spotted Kiwis (Appendix II). A Great Spotted Kiwi *(Apteryx haasti)* was captured at Fletcher Creek, and others were heard nearby and at Te Wharau.

DISCUSSION

The study was confined to diurnal birds in four forest types. Three were important inland, North Westland forest types included in the Beech Forest Utilisation Scheme (Thomson 1971) and classified by the New Zealand Forest Service as PB1, PB5 and PB15; the fourth was high-altitude 'protection' forest.

Some general patterns emerge from the details in Figures 6 and 9, summarised in Figure 10. The low-terrace forest (Fletcher Creek) was preferred by more species than were the other three areas (Fig. 10, average). Though many species were found in all four areas throughout the year, Figure 9 suggests that a varying proportion of the population of many species in all areas moved seasonally. Warblers and parakeets used the high-altitude forest (Rahu Saddle) principally in spring and summer.

The maintenance of complete populations of forest birds thus probably depends upon preserving a full, balanced range of forest types adjacent to one another, so that birds may move seasonally from one to another to avoid bad weather or food shortage — as suggested by Falla (1939). The need for large and representative reserves also follows from the general observation that small isolated areas support few species (Diamond 1975).

Of the forests studied, Fletcher Creek had the richest bird fauna, but is only a small remnant of a forest type once widespread, i.e. the podocarp-beech forests of the valley bottom. The present rarity of these low-lying forests may have reduced the numbers of birds and of species in the surrounding hill-country forests.

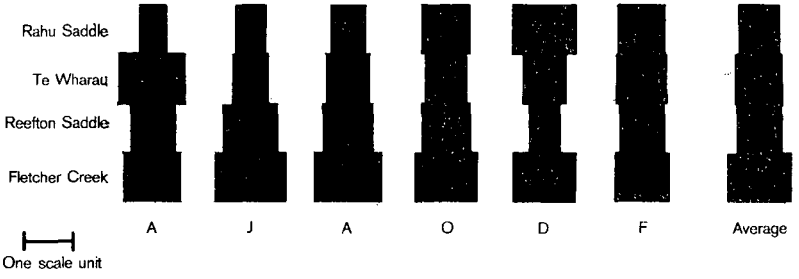

FIGURE 10 — The relative abundance of birds (pooling the 14 most numerous species) in each area during each of the six visits. The average 5-minute count of each species for each of the six visits was arbitrarily assigned a scale value of one and the counts in each area expressed on this scale. For example, the average count of Silvereyes in October in each area was 2.76, 3.32, 1.54 and 0.51 (Appendix II), averaging 2.03, so the scale values were 2.76/2.03 = 1.4, 3.32/2.03 = 1.6, 1.54/2.03 = 0.8, and 0.51/2.03 = 0.3. The values in the figure are the average of the 14 such scaled counts for each area each visit.

Birds are indicators of general habitat diversity: bird numbers (Fig. 10) and diversity of species correlate with the structural diversity of the vegetation (Fig. 3), with the abundance of flowers and fruits, and with the numbers of invertebrates (McColl 1974) in the forests studied. Thus the preservation of representative samples of the forest communities may preserve the birds and invertebrates as well, but very large areas of forests may be needed to preserve the full range of bird species.

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APPENDIX I

Glossary of plant names

Broadleaf	**Griselinia littoralis**	Mountain beech	**Nothofagus solandri** var. ***cliffortioides***
Bush rice grass	***Microlaena avenacea***	Mountain toatoa	**Phyllocladus alpinus**
Crown fern	**Blechnum discolor**	Pokaka	**Elaeocarpus hookerianus**
Cutty grass	**Gahnia setifolia**	Red beech	**Nothofagus fusca**
Hall's totara	**Podocarpus hallii**	Rimu	**Dacrydium cupressinum**
Hard beech	**Nothofagus truncata**	Rohutu	**Neomyrtus pendunculata**
Horopito	**Pseudowintera colorata**	Silver beech	**Nothofagus menziesii**
Kahikatea	**Dacrycarpus dacrydioides**	Southern rata	**Metrosideros umbellata**
Kamahi	**Weimannia racemosa**	Stinkwood	**Coprosma foetidissima**
Lancewood	**Pseudopanax crassifolium**	Westland quintinia	**Quintinia acutifolia**
Lawyer	**Rubus australis**	Yellow-silver pine	**Dacrydium intermedium**
Mingimingi	**Cyathodes fasciculata**		
Miro	**Podocarpus ferrugineus**		

	Fletcher Creek						Reefton Saddle						Te Wharau						Rahu Saddle					
	Apr	Jun	Aug	Oct	Dec	Feb	Apr	Jun	Aug	Oct	Dec	Feb	Apr	Jun	Aug	Oct	Dec	Feb	Apr	Jun	Aug	Oct	Dec	Feb
Bellbird	267	250	197	135	244	211	407	342	308	234	337	397	378	333	319	255	282	313	123	73	55	78	67	76
Silvereye	231	305	121	221	165	434	345	226	184	266	361	432	328	210	113	123	236	337	88	29	5	41	93	21
Grey warbler	62	82	129	111	75	139	77	58	115	116	76	116	34	47	118	101	70	69	31	33	68	178	157	92
Tit	121	16	38	48	135	149	121	10	40	65	63	92	107	35	130	92	125	141	91	39	32	91	180	157
Fantail	110	13	89	82	137	130	87	48	43	43	55	82	103	22	53	23	82	88	27	26	21	23	38	73
Rifleman	1	1											3	5	8	8	23	5	202	172	202	232	302	285
Chaffinch	49	20	45	71	48	40	34	15	15	34	47	14	93	30	27	39	54	39	14	12	34	43	80	6
Blackbird	53	43	16	89	108	22	24	9	7	34	41	129	34	7	8	44	58	12	15	11	8	53	101	20
Tui	8	107	125	80	43	13	8	29	51	95	41	26	44	4	12	27	13	15		7	4		2	1
Robin	82	12	6	23	44	54	38	2	1	7	1	8	14		3	2	2	4	21	1	6	23	48	55
New Zealand pigeon	61	137	2	4	5	75	41	46	5	1	1	36	11	8	1	3	1	4		1	2		2	1
Song thrush	4		19	27	60			4	21	27	9	4	4	2	15	32	14				3	3	45	5
Redpoll	6	2	28	5	3	1	17	20	85	13	1		8	4	13	6	9	4			1	8	3	
Parakeet	2	17	23	9	7	17		3	1	1	2	1	20	5	3	3	11	30			1	5	17	10
Kaka	3	1	3	7	7	5	1	1	1	16	20	2			1	7	10	11			1	2	7	4
Shining cuckoo				30	7					19	20					2	19					1	11	
Greenfinch		1	5	8		17	3	3	23	3	3	5	1		5	3		4				1		
Weka	1		1	5	2		2	2	4	1	2	1	1	1		1	1	2				2		1
Kea			1										2	1	2	2				1		1	6	7
Kingfisher				2	1				4	8						1	2							
Dunnock		1			1					5			1	7	1	2								
Goldfinch			3				3		3	1	2		1								1	1		
Brown creeper																				1		2	6	5
Yellowhammer			1							2						1								
Harrier										2												1		
New Zealand falcon																						3		
Paradise duck										2														
Morepork			+							+						+						1		
Long-tailed cuckoo																						1		
Great spotted kiwi			+													+								

APPENDIX II

The total of the 80 counts for each species in each area each visit. Because of their value for comparisons with other work, these figures (on which Figures 6 - 10 were based) are given in full. The visits are not distinguished for the last seven species.

+ = species not represented in count but presence confirmed.

APPENDIX III

Method of describing the vegetation

The vegetation was described using a method modified from Druce (1959). The technique is described here as it provided a quick semi-quantitative assessment and so may be useful to others with similar needs.

Up to seven structural layers were described from the area within about 30 metres of each counting point: upper canopy (usually emergent), lower canopy (usually semi-continuous), subcanopy, upper shrub understorey, lower shrub understorey, ground layer, and epiphytes. The percentage ground cover (for epiphytes the percentage cover of trunks and branches) provided by each layer, and the percentage of each layer's total cover provided by each species, were estimated and categorised into one of five classes. These categories were noted with a shorthand consisting of various line rulings, as follows:

over 75%; 50-75%; 25-50%; 5-25%; and less then 5%

The appropriate line symbolising each layer's percentage cover was placed vertically beside its species list, and each species name was also underlined to indicate its percentage contribution to the layer's total. For example:

Canopy	Red beech
	miro
	hard beech
	silver beech
Subcanopy	Silver beech
	hard beech
	kamahi

To summarise the data, we considered the average ground cover provided by each canopy layer and by each species in each layer. For example, if the canopy gave 50-75% (average 62.5%) ground cover and miro was estimated to comprise 25-50% (average 37.5%) of the canopy, we estimated the ground cover provided by canopy miro as 37.5% of 62.5%, which is 23%. The data for Figure 2 were obtained by averaging such percentages over the 10 counting points in each area and grouping two pairs of structural layers — the upper and lower canopy, and the subcanopy and upper understorey. The data for Figure 3 were the totals of those used for Figure 2.

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SHORT NOTE

LEACH'S FORK-TAILED STORM PETREL

A specimen of Leach's Fork-tailed Storm Petrel *(Oceanodroma leucorhoa)* was found in a farm paddock at Turangaomoana, near Waharoa, Waikato, after a storm on 19 April 1978, and is now in the collection of the Auckland War Memorial Museum (A.M. No. AV 1283.3).

The plumage is normal for this species but there are faded pale brown feathers on the forehead and secondaries. The rump is white, almost completely divided by dark feathering, the only white in the central area being supplied by a 4 mm fringe on two dark feathers. The only previous record for New Zealand was in 1922.

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