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COUNTING BIRDS IN NEW ZEALAND FORESTS

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ABSTRACT

Five-minute counts of birds at stations 200 m apart were easier to make and no less accurate as an index of numbers than were counts made while walking slowly through the same forest. The precision and errors of the technique are discussed.

INTRODUCTION

Conservation issues, raised by proposals for the commercial exploitation of South Island beech forests (Thomson 1971), require practical methods for determining the kinds and numbers of birds living in different parts of these forests. Skilled and energetic field workers can soon discover what kinds of birds are present but the question of how many is much more difficult.

Work on the numbers of birds in New Zealand forests began with Turbott's (1940) census on Taranga I. Since then three basic counting techniques have been used though the details of each have varied. Breeding pairs have been counted on plots of known size (Kikkawa 1966); transect counts have been made while walking (Stidolph 1948, Turbott & Bull 1954, Gibb 1961); and birds have been recorded in terms of their frequency of occurrence during some stated interval (Turbott & Bull 1954, Riney *et al.* 1959, Caughley 1962, McKenzie 1963, Dawson 1964, Choate & Gibbs 1964, Choate 1965 and Choate 1967). The diversity of techniques has limited the use of these counts in comparative studies such as that of McLay (1974). Emlen (1971) listed the principal overseas work.

An initial choice must be made between methods which, by mapping territories and nest sites, seek to establish the actual number of breeding birds, and methods which, by some sampling procedure, seek merely an index of numbers. Mapping is time-consuming and usually confined to the breeding season (International Bird Census Committee 1969); further, the results for some species do not relate closely to true density (Snow 1965, Haukioja 1968, Bell *et al.* 1973).

Emlen (1971) reviewed several transect methods which estimate absolute density from the distance at which a bird is first detected.

Such procedures suffer two disadvantages. In New Zealand forests far more birds are heard than seen and this often precludes accurate estimates of distance. For instance, estimates of distance made by six observers in rain forest near Wellington, varied about twofold and this degree of accuracy falls far short of " equivalent to a good 6-inch range finder " (Emlen 1971). Secondly some birds move towards or away from people while others remain undetected even when overhead, so that absolute density cannot be calculated. While not denying that information on the distance at which birds are encountered aids the interpretation of bird counts, we sought simply an efficient index of bird numbers, to measure bird populations accurately enough to detect major differences in abundance.

METHODS

The study area

Two forest areas were selected near Reefton (42°7′S, 171°52′E) on the West Coast of the South Island. The first, " Fletcher's Creek " is a remnant of the mixed podocarp and beech forest that formerly covered the valley floor; it is 230 m above sea level on a low damp terrace just north of Te Wharau creek at map reference S57-2942 NZMS 18. The second area, " Te Wharau," is a hillside of mixed podocarp and beech forest 370 m above sea level on the ridge between Te Wharau and Giles creeks at map reference S57-2739.

In 1972 a walking track was cut in each area, providing a circuit of 2 km at Fletcher's Creek and 1 km at Te Wharau.

The counts

After some preliminary counting by various methods in September, October and November 1972, four observers tested the three most promising methods in February 1973. The techniques listed below were used by each observer in both areas each day, so that a comparison of the methods could be made without error from differences between the days or between the observers.

(1) " Walking counts." An observer walked the track at about 0.8 km/hr counting every bird he saw or heard. No bird was knowingly counted twice. Subtotals were made every fifteen minutes (i.e. approximately every 200 m).

(2) " Five-minute counts." An observer walked about 200 m without counting and then stood still for five minutes, recording every bird seen or heard; he then walked another 200 m on, and counted again; and so on.

(3) " Ten-minute counts." The procedure was the same as in (2) except that each count occupied ten minutes.

COMPARISON OF THE METHODS

For each method, each circuit of the track gave a number of subtotals. The variability and magnitude of these determine the usefulness of their average as a measure for comparison with other counts. The mean count was highest for ten-minute counts, and lowest for five-minute counts (Table 1). However the average variance of the counts was least for five-minute counts and greatest for walking counts.

Also more five-minute than ten-minute counts were completed per unit time. The right-hand column of Table 1 gives an estimate of the 95% confidence of a mean count from two hours work by one observer; it shows that the three methods agree very closely, with practically no difference in accuracy.

TABLE 1. The magnitude, variability and precision of the mean count for five species[a] of bird

Counting method	Species	Mean of 64 counts	Mean of transformed counts[b]	Variance of transformed counts	100x95% conf. / mean[c]
Walking	Bellbird	2.066	1.286	0.369	40
	Tit	1.197	0.891	0.405	60
	Silvereye	1.672	1.000	0.466	57
	Fantail	0.902	0.380	0.320	124
	Warbler	2.344	1.312	0.243	31
	mean	1.636	0.974	0.361	62
Five-minute	Bellbird	1.736	1.242	0.304	32
	Tit	0.531	0.516	0.344	81
	Silvereye	1.030	0.744	0.388	60
	Fantail	0.545	0.479	0.308	83
	Warbler	1.169	1.019	0.217	33
	mean	1.002	0.800	0.312	58
Ten-minute	Bellbird	2.141	1.410	0.302	36
	Tit	0.797	0.715	0.290	70
	Silvereye	1.484	1.425	0.426	42
	Fantail	0.719	0.556	0.339	97
	Warbler	1.734	1.194	0.259	39
	mean	1.375	1.060	0.323	57

Notes:

a. The scientific names of the birds are listed in Table 2.

b. The individual counts were subjected to a square-root transformation (Snedecor and Cochran 1967, p.325) to facilitate statistical comparisons.

c. The 95% confidence value was calculated for the approximate number of counts that could be completed in two hours: eight sub-totals walking, ten five-minute counts and seven ten-minute counts. Easier walking conditions would favour the stationary counts, especially the five-minute ones.

The mean of transformed counts for five-minutes was significantly less than that for the other two techniques. The variances did not differ significantly between the methods.

The observers all preferred stationary counts because, in unfamiliar country, they allow undivided attention to the birds and are probably much less affected by variation in terrain. Such counts are also more suitable for a spot survey of the kind being used by the Wildlife Service on the West Coast (Crook & Best 1974). The five-minute count was preferred to the ten-minute one as it allows the observer to sample more forest in a given time, is no less accurate than the ten-minute count, and provides less opportunity for erroneously recording the same individual twice.

TABLE 2. Tests for a difference between the two areas, using the five-minute counts

		No. of counts	Mean of counts	Transformed Counts Mean	S.E.	Probability "T-test"	chi-sq.
Bellbird	Fletcher's	40	1.38	1.04	0.19	< 0.01	< 0.005
Anthornis melanura	Te Wharau	24	2.33	1.43	0.11		
Tit	Fletcher's	40	0.40	0.37	0.08	0.1-0.2	0.05-0.1
Petroica macrocephala	Te Wharau	24	0.75	0.60	0.13		
Silvereye	Fletcher's	40	1.12	0.81	0.11	0.3-0.4	0.25-0.5
Zosterops lateralis	Te Wharau	24	0.88	0.64	0.14		
Fantail	Fletcher's	40	0.62	0.54	0.09	0.2-0.3	0.25-0.5
Rhipidura fuliginosa	Te Wharau	24	0.42	0.37	0.11		
Warbler	Fletcher's	40	1.15	0.99	0.07	> 0.5	0.8-0.9
Gerygone igata	Te Wharau	24	1.20	0.90	0.13		

Notes:

The data are from February 1973, when each of four observers counted in each area.

The counts were subject to a square-root transformation to stabilise the variance, and the means and variances of these transformed data were used in the "t-tests".

The chi-squared tests were of the null hypothesis that the total count for each species would appear in the ratio of 40:24, i.e. that the mean count was identical in the two areas.

Bellbirds were statistically significantly different between the two areas, in both tests, but none of the other species was.

A COMPARISON OF BIRD NUMBERS IN THE TWO AREAS

In Table 2 the five-minute counts are examined to see if there are any differences between the two study areas in the abundance of each of the five commonest birds. Two statistical tests were employed. The " t-test " uses the means of the five-minute counts and their variability. Unfortunately, with such low counts, the values do not fall symmetrically round their mean, and to correct this a transformation was applied. A chi-squared test on the total counts* in each area is simpler, and a comparison of the two right hand columns of Table 2 shows that the two tests agree quite well.

While in Table 2 only the Bellbird differs significantly in its density between the two areas, these tests were based on about six man-hours work in each area and more recent work with sixteen hours of counting in each area has produced a large number of significant differences (P. R. Wilson pers. comm.). Table 3 shows the size of difference between two means that leads to statistical significance; figures are given for three variations in the number of counts and for three different average counts. The precision of the technique improves with both a larger average count and with a greater counting time. One hundred and twenty-five counts will give useful results for the more abundant species, but rarer ones require much more time.

TABLE 3. The percentage[a] difference between two mean counts required for statistical significance

		Average number of birds counted in five-minutes[b]		
		0.1	1.0	10
Number of counts in each area	25	175%	55%	18%
	125	78%	25%	8%
	1250	25%	8%	2½%

Notes:

a. The percentage difference was taken as $\frac{200\,|a-b|}{a+b}$ where 'a' and 'b' are the mean counts of the species in the two areas. The 5% probability level in a chi-squared test was used as the criterion of significance.

b. The "average number of birds" is the mean of the two areas being tested. The columns span a range of abundance. For example, ten bellbirds might be recorded per five minutes in an area where they were abundant and in full song, but only one parakeet in every ten counts (0.1).

For example if 25 counts were made in each of two areas and the mean count of a species was nine in one area and eleven in the other these two averages would be significantly different, as the difference between the two averages (two) as a percentage of their midpoint (ten) exceeds the critical value from the table (18%).

* Such a test assumes that each individual bird is identified independently of the others. This will not be so for flocking species, like Silvereyes, and the test may err towards significance for such species. Conversely, the average count of territorial species may be more accurate than this test would suggest.

Five - Minute Bird Counts	P.B.1 Fletchers Ck										
	Date: 20-4-74										
	Observer: P.D.G										
	Counts										
	1	2	3	4	5	6	7	8	9	10	
Temp °C	12·5	—	—	—	—	—	—	—	—	14·0	
Time	0952	1003	1015	1027	1038	1050	1101	1121	1132	1145	
Sun	0	0	0	3	3	2	1	0	1	0	
Wind	0	0	0	0	0	1	1	2	0	0	
Other Noise	0	0	0	0	0	0	0	0	1	0	
Precipitation	0	1	0	0	0	0	0	1	1	2	
Species	S/H	S/H	S/H	S/H	S/H	S/H	S/H	S/H	S/H	S/H	Total
Silvereye	/8			2/3	1/4	2/4	1/9	/4	4/2	2/1	47
Fantail	1/1	/1		1/1	2/		1/2			1/	11
Bellbird	/2	/2	1/2	1/1	/4	1/4	1/3	2/1	1/2	/3	31
Tit	1/	/2	3/		1/2	1/1	/2	/2		/1	15
Warbler	/1	/1			1/	/1	1/				5
N.Z. Pigeon	/2				/1	/1	1/		1/	/2	8
Robin		/1	/1	2/		/2		1/1	2/	1/2	13
Song Thrush				/1					/1		2
Redpoll					/1						1
Tui				/1			1/				2
Blackbird						/2	/1			/2	5
Parakeet sp.							/1				1
Chaffinch								/1		1/1	3
Weka									/1		1

Remarks:
2 Kakas seen in N. fusca between counts 3–4

FIGURE 1 — An example of the data recorded on a standard form.

FACTORS AFFECTING THE COUNT

The number of birds recorded will be affected by several factors apart from the number of birds present:

(1) Observers differ in their ability to see, hear and identify birds and in their judgement as to the number present, and these abilities may change with time.

(2) The birds' activity and calling change during the day and with season, and both the observers and the birds will be affected by weather and extraneous noises.

(3) The topography and density of the vegetation will influence the distance at which birds may be detected.

Current studies near Reefton seek to document these sources of variation so that they may be minimised. In the meantime we recommend that bird counts in forest be based on five-minute stationary counts as detailed in the appendix.

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APPENDIX

The five-minute bird count

The observer stops and stands quietly for five minutes every 200 m (approximately 250 paces). If possible the counting route should be through reasonably homogeneous vegetation, and further than 200 m from its edge. At each stop all the birds seen or heard are recorded. In regularly counted areas these stations are best marked so that the counts are made from the same point each time. Each count is treated as an entity so that, even if it is thought that an individual bird was included in a previous count, it is counted again. Within each count no bird is knowingly counted twice, nor are birds assumed to be present without some visual or auditory clue to their presence (e.g. a flock of Silvereyes is noted as the number heard calling rather than the number the observer guesses such a frequency of calling would represent; if a bird calls in one place and later one of the same species calls some distance away, they are taken as two individuals unless there is evidence that the first bird moved to the second place).

Each set of counts includes the following information:

Locality (including map reference, altitude, aspect, vegetation, etc. if not a regularly counted area);

Date (day, month, year);

Observer:

Temperature: in °C or:

1	freezing	<0°C
2	cold	0-5
3	cool	5-11
4	mild	11-16
5	warm	16-22
6	hot	>22;

Showers: a note of any rain in the hour before the counts.

And for each count:

Sun: (0-5) Record the approximate duration, in minutes, of bright sun on the canopy immediately overhead;

Wind: The average for each five-minute count on a modified Beaufort scale:

0 Leaves still or move without noise (Beaufort 0 and 1),
1 Leaves rustle (2),
2 Leaves and branchlets in constant motion (3 and 4),
3 Branches or trees sway (5, 6 and 7);

Other noise: (water, cicadas, traffic, chain saws, etc): the average for the five minutes on the following scale:

0 Not important,
1 Moderate,
2 Loud;

Precipitation: the average for each count

Mist — M, Rain — R, Hail — H, Snow — S, on scale as follows:

0 None,
1 Dripping foliage,
2 Drizzle,
3 Light,
4 Moderate,
5 Heavy;

Time: 24-hour clock time at the beginning of each count.*

Extremes of weather are best avoided.

Birds which were identified by sound only are noted as heard (h), the rest are seen (s).

Distance — if a bird is judged to be more than 200 m away then exclude it from the list (this is the distance between successive counts and can be checked whenever a bird is near one counting point and audible from the next). Birds flying overhead and judged not to belong to that vegetation type should be recorded, but the record may be circled to indicate this.

The counts should be presented as in the first four columns of Table 2, as this provides sufficient information for the chi-squared tests.

Figure 1 is the record sheet used in Westland with an example of the data.

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* Current work near Reefton by Ecology Division, D.S.I.R., involves counting 2 km (10 stop) loop tracks twice each day, between 0930 and 1530 hrs, and survey work by Wildlife Branch, Dept of Internal Affairs involves spot counts between 0900 and 1500 hrs, thus avoiding the rapid change in birds' conspicuousness near dusk and dawn. While not essential, the choice of a similar routine by other observers would facilitate comparison.