Notornis, 2013, Vol. 60: 173-177
0029-4470

SHORT NOTE

A comparison of bird counting techniques in an urban environment

JAMES A. J. MORTIMER*
4A Avoca Valley Road, Heathcote Valley, Christchurch 8022, New Zealand

DIANA CLARK
153 Starkholmes Road, Starkholmes, Matlock, Derbyshire, DE4 5JA, England

Transect and point counts are 2 of the most commonly-used techniques for surveying and monitoring birds (Fuller & Langslow 1984; Gregory 2000; Rosenstock *et al.* 2002; Spurr 2005). These methods attempt to measure changes in populations using indices of abundance, and whilst the majority of survey and monitoring in New Zealand has focused on birds inhabiting indigenous forests, they can be applied to other habitats (*e.g.*, Deifenbach *et al.* 2003). Published examples of bird monitoring programmes in urban areas from within New Zealand have been few but include counts of bird populations in relation to habitat characteristics in Hamilton (Day 1995), Auckland (Gill 1989) and Dunedin (van Heezik *et al*. 2008). In this small-scale study, we compare 2 bird counting techniques and their application in urban and suburban habitats in New Zealand.

Christchurch, New Zealand is a green city with 'urban forest' habitat in the form of large residential gardens, parks, roadside trees and urban landscaping. These man-made environments form a mosaic, interspersed with remnants of indigenous habitat including the lowland swamps of Travis Wetland and Styx Mill Basin, alluvial floodplain forest at Riccarton Bush and the coastal systems of the Avon Heathcote Estuary (Christchurch City Council 2008).

Fieldwork was carried out between 30 Sep and 28 Oct 2011. The city (as defined by the limits of the built-up areas and green space, but not including adjacent farmland) was divided into 1 km squares, using the 1:50000 scale NZTM projection Topo50 maps (Land Information New Zealand 2011). From a total of 185, 1 km squares, 32 (approximately 17%) were randomly selected for sampling (Fig. 1).

Within each sampled grid square a single transect and point count were used to record species and numbers of birds observed. The transect methodology was based upon that described by O'Donnell & Dilks (1986). A route was walked through the square and all birds encountered (either heard or seen) were recorded, including those that could not be identified. Transect routes were dictated by available roads and footpaths. Length varied between 2.0 and 2.9 km, with a mean of 2.2 km. Point counts were completed on the same day,

Received 23 Jun 2012; accepted 2 Nov 2013
*Correspondence: *jamesmort@rocketmail.com*

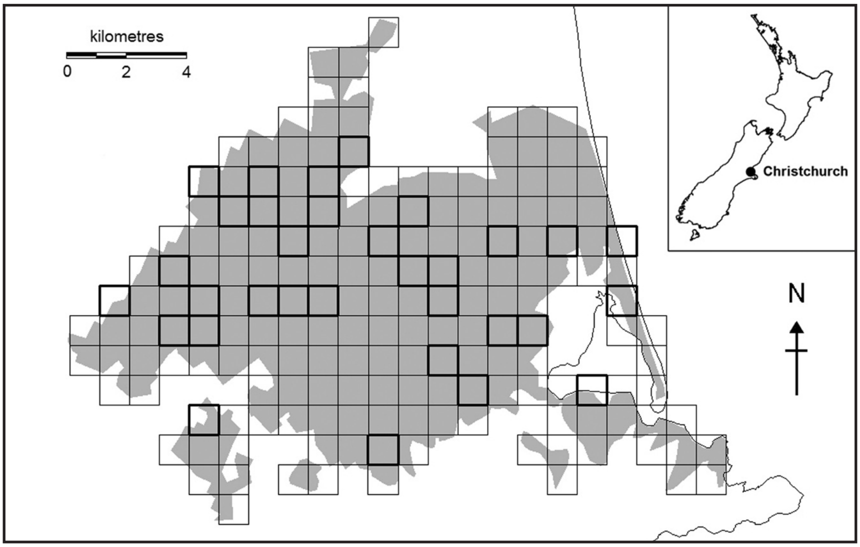

Fig 1. Survey area and 1 km squares selected for sampling in a comparison of bird counting techniques, Christchurch, New Zealand. The shaded area represents the urban extent. The 1 km squares highlighted in bold were selected for sampling.

usually near the centre of each 1 km square, using the 5-minute bird count methodology (Dawson & Bull 1975). All counts were completed by the same observer between 0745 and 1300 hrs, avoiding extreme weather conditions, and were unbounded (*i.e.*, birds were recorded regardless of distance from the observer).

The total number of species recorded during the survey was 36 (including 2 identified to genus only; Table 1). Transect counts recorded 34 species (20 native; 14 introduced) whilst point counts recorded 28 species (14 native; 14 introduced). Note that transect and point counts recorded the same number of introduced species, however transects recorded a higher number of natives. The number of species recorded per count was significantly higher for transects than for point counts (t = 8.69, d.f. = 31, P < 0.001). Likewise, for each species the total numbers recorded and frequency of occurrence were significantly higher for transects than for point counts (numbers recorded: t = 2.92, d.f. = 35, P = 0.006; frequency of occurrence: t = 6.44, d.f. = 35, P < 0.001). For both methods, introduced species occurred more frequently than native species, a trend recorded by other urban bird studies in New Zealand (Fig. 2; Day 1995; van Heezik *et al*. 2008).

There are a number of possible reasons to explain the higher numbers and frequencies recorded for transect counts. Firstly, there was a large difference in time spent on each count between the 2 methods. Point count time was standardised at 5 minutes, whereas transect count time varied from 25 to 42 minutes (mean 31 minutes). Secondly, a point count, being at a fixed location, could only sample a single habitat type (although birds may have been recorded from adjacent habitats), whereas a transect had the potential to sample multiple habitat types. Thirdly, transect counts required the observer to be continually walking. This could result in birds reacting to observer movement (*e.g.*, being flushed from cover), and thereby increasing the numbers counted.

Although transects recorded higher numbers and frequencies of birds, a similar pattern of relative abundance was recorded by point counts. There was a significant positive correlation between total numbers of each species recorded by the 2 methods (r = 0.89, d.f. = 35, P < 0.001). There was also a significant positive correlation between frequencies recorded (r = 0.94, d.f. = 35, P < 0.001). This suggests that transect and point count methods may be equally effective in determining patterns of relative abundance.

Fig. 3 compares the effectiveness of transect and point counts at recording the number of species, in terms of survey effort. This analysis indicates that for an equal number of counts, transects were more effective as the number of species recorded was consistently higher (Fig. 3). However, when time spent is compared, point counts were more effective, as a higher number of species was recorded than transects for the same amount of time spent observing (Fig. 3). Verner & Ritter (1985) also reported that when comparing counting time, point counts were more efficient than transects.

Transect and point counts both have their strengths and weaknesses, which have been summarised by Gregory (2000). In our study there were 2 limitations specifically related to counting birds in an urban environment and that applied to both methods. Firstly, high proportions of birds were recorded as 'unidentified' (10.7% for transect counts; 14.9% for point counts). The majority of these were birds that were sighted, with no calls heard. As habitats were generally open, birds

Table 1. Species recorded by transect and point counts, Christchurch, New Zealand, with indices of abundance and frequency of occurrence (percentage of counts in which each species was recorded).

Species name	Transect counts		Point counts	
	Birds per km	Frequency (%)	Mean count	Frequency (%)
Australian magpie (*Gymnorhina tibicen*)	0.13	25.0	0.06	6.3
Barbary dove (*Streptopelia roseogrisea*)	-	-	0.03	3.1
Bellbird (*Anthornis melanura*)	0.20	25.0	0.13	6.3
Black shag (*Phalacrocorax carbo*)	0.20	9.4	0.38	3.1
Black swan (*Cygnus atratus*)	0.16	12.5	0.13	3.1
Black-backed gull (*Larus dominicanus*)	3.38	87.5	2.03	53.1
Black-billed gull (*Larus bulleri*)	0.06	3.1	0.09	3.1
Blackbird (*Turdus merula*)	9.01	100.0	2.31	81.3
Chaffinch (*Fringilla coelebs*)	1.57	78.1	0.72	43.8
Dunnock (*Prunella modularis*)	2.81	100.0	0.56	50.0
Goldfinch (*Carduelis carduelis*)	1.37	65.6	0.41	21.9
Greenfinch (*Carduelis chloris*)	2.94	90.6	1.13	56.3
Grey teal (*Anas gracilis*)	0.03	3.1	-	-
Grey warbler (*Gerygone igata*)	0.10	15.6	0.03	3.1
House sparrow (*Passer domesticus*)	18.22	100.0	2.53	87.5
Mallard (*Anas platyrhynchos*)	1.78	56.3	0.78	25.0
New Zealand kingfisher (*Todiramphus sanctus*)	0.06	9.4	0.03	3.1
New Zealand scaup (*Aythya novaeseelandiae*)	0.17	9.4	0.09	6.3
Oystercatcher (*Haematopus* sp.)	0.42	3.1	-	-
Paradise shelduck (*Tadorna variegata*)	0.30	31.3	0.16	6.3
Pied shag (*Phalacrocorax varius*)	0.04	6.3	-	-
Pied stilt (*Himantopus himantopus*)	0.09	3.1	-	-
Pukeko (*Porphyrio porphyrio*)	-	-	0.03	3.1
Red-billed gull (*Larus novaehollandiae*)	0.79	34.4	0.03	3.1
Redpoll (*Carduelis flammea*)	4.14	84.4	1.75	75.0
Rock pigeon (*Columba livia*)	1.19	34.4	0.91	15.6
Silvereye (*Zosterops lateralis*)	8.39	100.0	2.59	90.6
Skylark (*Alauda arvensis*)	0.09	9.4	0.06	6.3
Song thrush (*Turdus philomelos*)	1.83	87.5	0.91	56.3
Spur-winged plover (*Vanellus miles*)	0.09	12.5	0.03	3.1
Starling (*Sturnus vulgaris*)	12.23	100.0	3.19	90.6
Tern (*Sterna* sp.)	0.01	3.1	-	-
Variable oystercatcher (*Haematopus unicolor*)	0.03	3.1	-	-
Welcome swallow (*Hirundo tahitica*)	0.55	37.5	0.16	15.6
White-faced heron (*Ardea novaehollandiae*)	0.04	3.1	-	-
Yellowhammer (*Emberiza citrinella*)	0.12	9.4	-	-
Unidentified	8.67	100.0	3.72	87.5

could be seen from relatively long distances. Those species with distinctive shapes or flight patterns (*e.g.*, black-backed gull; rock pigeon) were readily identified from a distance. However, this was more difficult for small species. It is likely that many of the unidentified birds were small passerines and that these species were consequently under-recorded by both survey methods.

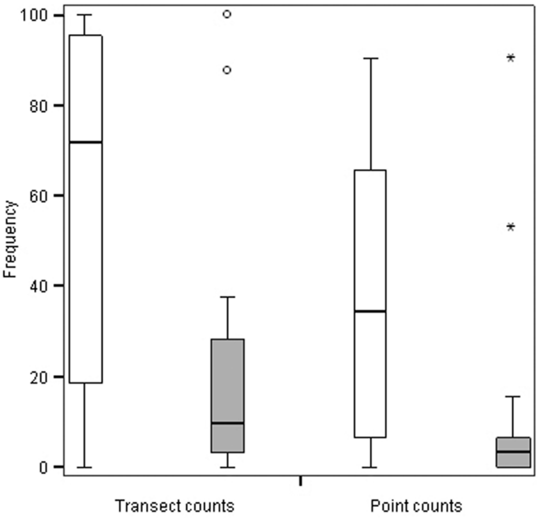

Fig 2. Frequency of occurrence for introduced and native birds using transect and point counts, Christchurch, New Zealand. Unshaded boxes represent introduced species whilst shaded boxes represent native species.

Secondly, noise levels (mainly from vehicles) were often sufficiently high to obscure bird calls from the observer. It is likely that this would apply in particular to distant birds and those species with relatively quiet calls. This could also result in under-recording of birds. In a study of point counts in the USA, Simons *et al.* (2007) found a decline in detection distances and an increase in identification errors with increasing levels of ambient noise.

There were a number of additional disadvantages identified specifically related to using transect counts: (1) it was difficult to maintain focus on birds because the observer was distracted by a number of factors, including traffic safety and map reading (to ensure the planned transect route was followed); (2) keeping track of individual birds during transect counts was problematic because the observer was moving and therefore the position of birds (even stationary ones) relative to the observer was continually changing; (3) transect count duration was considerably longer and as a result there was increased potential for double-counting individual birds (Fuller & Langslow 1984; Verner & Ritter 1985), especially those that were flying around within the 1 km square being sampled; and (4) transect counts required a greater degree of concentration due to the longer time required for each count and the high numbers of birds encountered. Any of these factors could potentially result in a higher degree of recording error in transect counts compared to point counts.

This study was limited by time constraints in several ways: (1) our study design did not include variation of point count time. Longer counts are

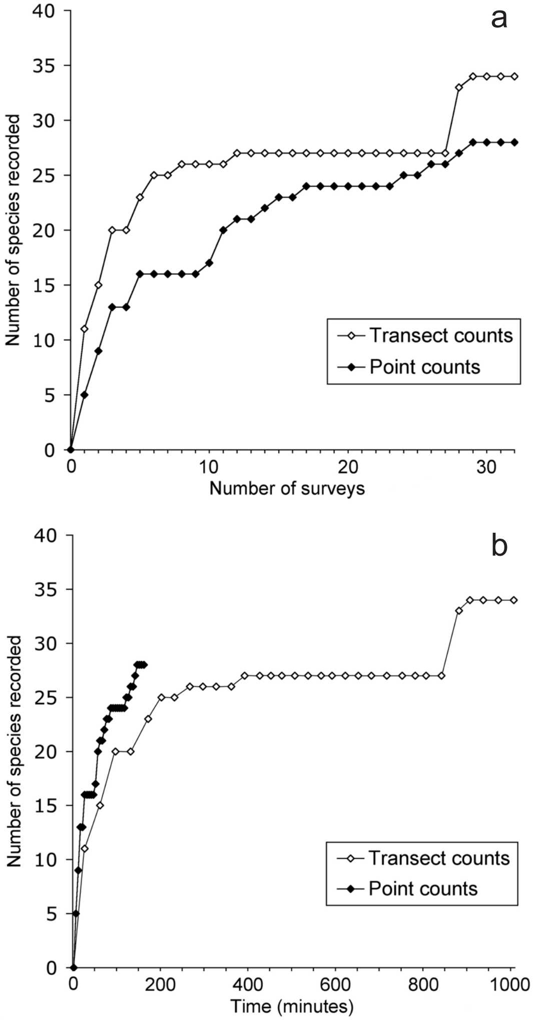

Fig 3. Cumulative number of species recorded for transect and point counts in Christchurch, New Zealand, for (a) number of counts completed, and (b) time spent on counts.

more likely to detect birds that are distant, call infrequently or are present in low densities (Fuller & Langslow 1984); (2) we did not experiment with comparing results obtained using different transect lengths; (3) we did not incorporate bounded counts in our study design, which with hindsight could potentially have helped reduce the number of birds recorded as 'unidentified'; and (4) time spent counting was recorded for both methods, however there was no attempt to record time spent travelling between transect/point counts. This time would affect efficiency but would be difficult to control.

In conclusion the effectiveness of count methods can be influenced by many factors. This study indicates that transects may be more effective at detecting species that are inconspicuous or present at low densities. However, the point count would appear to be a more efficient method, requiring less effort per count and having less potential for error than transect counts, yet still proving effective at identifying similar patterns in relative abundance and frequency. During study design, it is essential to keep in mind these strengths and weaknesses to ensure appropriate techniques are chosen to meet study objectives.

ACKNOWLEDGEMENTS
We are very grateful to the following people who reviewed draft versions of this short note and provided us with helpful comments: Terry Greene, Brenda Greene and 2 anonymous reviewers.

LITERATURE CITED

Christchurch City Council. 2008. *Christchurch City Council Biodiversity Strategy 2008-2035*. Christchurch: Christchurch City Council. 109p.

Dawson, D.G.; Bull, P.C. 1975. Counting birds in New Zealand forests. *Notornis 22:* 101-109.

Day, T.D. 1995. Bird species composition and abundance in relation to native plants in urban gardens, Hamilton, New Zealand. *Notornis 42:* 175-186.

Deifenbach, D.R.; Brauning, D.W.; Mattice, J.A. 2003. Variability in grassland bird counts related to observer differences and species detection rates. *Auk 120:* 1168-1179.

Fuller, R.J.; Langslow, D.R. 1984. Estimating numbers of birds by point counts: how long should counts last? *Bird Study 31:* 195-202.

Gill, B.J. 1989. Bird counts in regenerated urban forest at Auckland Domain. *Notornis 36:* 81-87.

Gregory, R.D. 2000. Development of breeding bird monitoring in the United Kingdom and adopting its principles elsewhere. *Ring 22:* 35-44.

Land Information New Zealand. 2011. *Topo50 Maps Christchurch & Lincoln.* Wellington: Land Information New Zealand.

O'Donnell, C.F.J. & Dilks, P.J. 1986. *Forest birds in South Westland: status, distribution and habitat use.* Wellington: New Zealand Wildlife Service. 179p.

Rosenstock, S.S.; Anderson, D.R.; Giesen, K.M.; Leukering, T.; Carter, M.F. 2002. Landbird counting techniques: current practices and an alternative. *Auk 119:* 46-53.

Simons, T.R.; Alldredge, M.W.; Pollock, K.H.; Wettroth, J.M. 2007. Experimental analysis of the auditory detection process on avian point counts. *Auk 124:* 986-999.

Spurr, E.B. 2005. *Monitoring bird populations in New Zealand: a workshop to assess the feasibility of a national bird population monitoring scheme*. Lincoln: Manaaki Whenua Press. 29p.

van Heezik, Y.; Smyth, A.; Mathieu, R. 2008. Diversity of native and exotic birds across an urban gradient in a New Zealand city. *Landscape and Urban Planning 87:* 223-232.

Verner, J.; Ritter, L.V. 1985. A comparison of transects and point counts in oak-pine woodlands of California. *Condor 87:* 47-68.

Keywords transect count; point count; bird surveys; urban environment