

Evaluating Point Count Efficiency Relative to Territory Mapping in Cropland Birds¹

André Cyr, Denis Lepage and Kathryn Freemark²

Abstract: Species richness, composition, and abundance of farmland birds were compared between point counts (50-m, 100-m, and 150-m radius half circles) and territory mapping on three 40-ha plots in Québec, Canada. Point counts of smaller radii tended to have larger density estimates than counts of larger radii. Territory mapping detected 10 species more than 150-m radius point counts. Territory mapping at 150-m radius detected more birds per species than point counts; relative abundances, however, were similar. Bird density is probably optimally estimated with a 100-m radius point count. After four visits, more than 80 percent of species and birds from 7 visits had been detected by 150-m radius point counts. Our modified point count method appears to be accurate enough to reflect the farmland avifauna characterized by more labor-intensive methods such as territory mapping.

Several methods have been widely tested to estimate the number of birds in terrestrial habitats. Papers in Ralph and Scott (1981) give a broad overview of such methods and compare many of them. Territory mapping has usually been considered the standard technique against which most bird census methods have been compared (Anonymous 1970). Territory mapping is extensively used in Britain to monitor farmland avifauna (O'Connor and Shrubbs 1986). In North America, territory mapping is used in the breeding bird census program to collect habitat specific information. The point count, or "Indice Ponctuel d'Abondance, IPA" method (Blondel and others 1970, 1977), has been widely used in Europe and North America. However, few attempts have been made to use it extensively in open landscapes. Within the larger framework of a Canadian Wildlife Service project to evaluate the impacts of agricultural practices on the avifauna (Rogers and Freemark 1991), a modified point count method was used to enable a larger number of plots to be surveyed (Freemark and Rogers, in this volume, Verner 1981).

This paper compares species composition, richness, and abundance estimates of cropland point counts at varying survey distances. Territory mapping is used to provide complete census data for comparison.

Methods

Three 40-ha plots were chosen in the agricultural landscape of the Municipality of Wotton (lat. 45°45'N., long. 71°45'W.) in the province of Quebec, Canada. The surveys

were conducted between 0500 and 1000 (e.s.t.), between June 1 and July 13, 1990. One observer performed all surveys. The surveys were conducted in good weather with wind equal or lower than Beaufort 3, no heavy or lasting rain.

Visits to plots were scheduled so that surveys on each began at different times in the morning on consecutive visits to reduce biases related to time of day or season. For the territory mapping, each plot was visited for about 1.5 hours, eight or nine times each plot, for a total of 38.25 person-hours. Observations were accurately reported on plot maps. The number of territories was calculated at the end of the season by studying the composite maps of all visits for each species. A territory was counted as one when its boundaries were within the plot; it was counted as 0.5 when about one-half was within the plot, and 0.25 when found only along the edge of the plot. Bird abundance was equal to the total number of territories delineated.

Three half-circle point counts were located in each of the three plots (Freemark and Rogers, in this volume). The three point count locations per plot were selected to represent the crops and edge habitat of each plot and were at least 250 m apart on each plot (*table 1*). Point counts were conducted from the edges of fields (Freemark and Rogers, in this volume). All birds seen or heard within a 150-m radius semicircle were counted during 10 minutes, with data subdivided into radii of 50 m, 100 m and 150 m from the observer. Three to five point counts were surveyed each day during mapping surveys, the data of which were also included to generate the maps. Each point was visited five to seven times for a total of 50 point counts, or 8.33 person-hours.

The number of territories at each point-count location (hereafter referred to as mapped points) was determined from the composite maps of each plot using the same conventions as above. Since the points covered 31.77 ha of the 120 ha, the amount of time spent for territory mapping on the points can be estimated as 10.13 person-hours.

For accumulation curves, the data included all points within the three plots as well as those from eight comparable extra point counts from another study on a different farm located in hay (six points) and oat (two points) fields in Coaticook (*fig. 1*). The extra points were added to increase sample size. The points were counted during the same season as above without territory mapping. The calculations were as follows: the number of new species or individuals on subsequent visits were calculated then averaged for all points. For any visit, the number of individuals is the summation of individuals of each species above the previous number of individuals on any previous visit. Thus, the cumulative summation for each point corresponds to the summation of the maximum number of individual birds per species throughout all surveys for that point.

¹ An abbreviated version of this paper was presented at the Symposium on Monitoring Bird Population Trends by Point Counts, November 6-7, 1991, Beltsville, Maryland

² Professor of Biology, University of Sherbrooke, Sherbrooke, Quebec, Canada; Doctorate Student, Laval University, Quebec, Canada; and Research Ecologist, Canadian Wildlife Service, Environment Canada, Ottawa, Ontario, Canada, present address: Environmental Protection Agency, Corvallis, Oregon

Table 1--Number of species detected with territory mapping and point count methods on half circles of different radii.

Points	Crop	Radius: Method:	Number of Species					
			0-50 m		0-100 m		0-150 m	
			Map	Point Counts	Map	Point Counts	Map	Point Counts
A1	Hay		10	8	15	13	20	19
A2	Hay		7	7	10	8	14	13
A3	Barley		10	8	15	14	17	15
B1	Hay and barley (50-50)		8	6	12	11	19	14
B2	Hay and pasture (50-50)		10	9	17	14	27	21
B3	Hay		7	5	15	12	23	20
C1	Hay		11	9	16	11	17	14
C2	Hay and barley (50-50)		3	2	8	6	18	17
C3	Hay and mixed cereals (50:50)		6	5	16	10	26	16
Paired t-test (n=9)			5.9648*		4.8564*		3.550*	
Mean			8.0	6.6	13.8	11.0	20.1	16.6
Total			27	23	35	31	49	39
Ha surveyed/point			0.39		1.57		3.53	
Mean difference/ha			3.6		1.78		0.99	
Total difference/ha			10.2		2.5		2.8	

* indicates $P < 0.05$

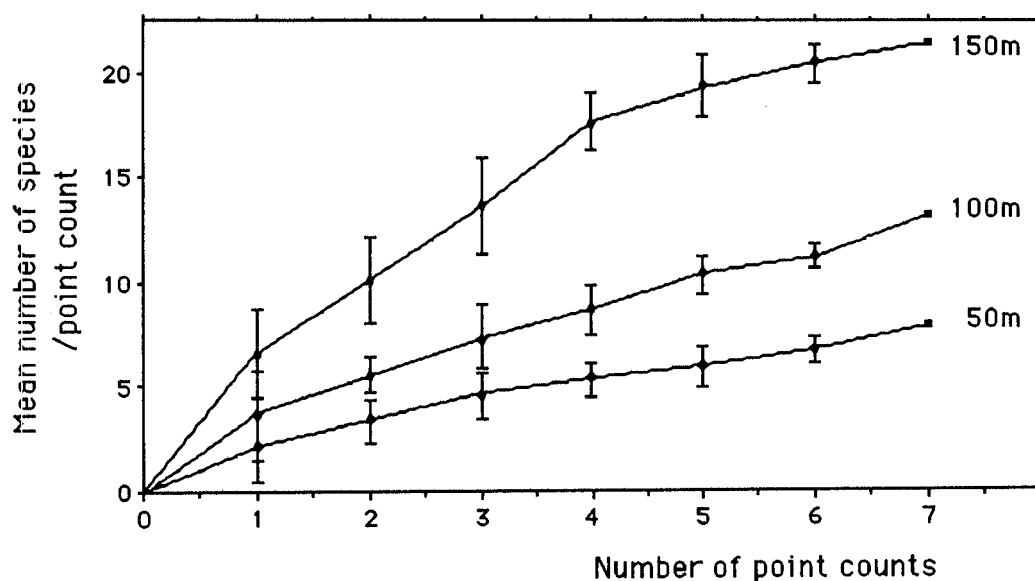


Figure 1--Species accumulation curves for point count include 8 point counts on an additional farm. See text for details.

We compared species richness, composition, and abundance between point counts and mapped points of different radii. We also compared absolute and relative abundance per hectare (proportion in percent of the total number of individuals of all points counted or territories mapped belonging to each species of a point or of a plot) between point counts and mapped points or between mapped points and the plots.

We used paired t -tests ($p < 0.05$) to compare the densities at different radii. Statistical comparisons are

confounded to some degree because the same data are used in point counts of different radii.

Results

Species Richness

Territory mapping at point count locations detected more species than point counts on 50-m, 100-m and 150-m radius semicircles (table 1). The number of species detected increased with greater distance from the observer for the

point counts or larger area for territory mapping. More species were detected by territory mapping compared to point counts at different radii (*table 1*). Comparing the species number between methods per hectare surveyed by each radius, the methods were most similar on a point-by-point basis for the 150-m radius (mean difference/ha = 0.99) and in total for the 100-m radius.

After seven point counts, the number of species per point was approaching an asymptote for only the 150-m radius (*fig. 1*). At seven counts, the numbers of species for the 50-m and 100-m radii were only 40 percent and 68 percent of that for the 150-m radius. During the first four counts, species number increased most rapidly for the 150-m radius. After four counts, more than 80 percent of its total number of species had been detected for the 150-m radius, 66 percent of its total number of species had been detected for the 100-m radius, and 68 percent of its total number of species had been detected for the 50-m radius.

Species Composition

At the 150-m radius, 10 species detected by territory mapping were not detected by point count (*table 2*). These species tended to have large territories (e.g., Turkey Vulture (*Cathartes aura*)), to breed in adjacent edge habitats (e.g., Gray Catbird (*Dumetella carolinensis*)) or off-site habitats (e.g., Black-capped Chickadee (*Parus atricapillus*) and Ring-billed Gull (*Larus delawarensis*)), and to have low abundance (<<1 territory per point).

Abundance

Although more birds per species were observed with territory mapping at the 150-m radius than with point counts, the differences were not large in most cases (*table 2*). Relative abundances of species were even less different between methods (*table 2*). For most species, the number of territories on the points is larger than the mean number of birds counted per point. For eight species, the reverse is true, the four most abundant ones being Song Sparrow (*Melospiza melodia*), Common Yellowthroat (*Geothlypis trichas*), Common Snipe (*Gallinago gallinago*), and Cedar Waxwing (*Bombycilla cedrorum*). During any count, groups of birds might be seen that increase the mean number of counts without providing useful data for mapping territories.

After seven point counts, the number of birds per point was approaching an asymptote for all radii. At seven counts, the number of birds for the 50-m and 100-m radii were only 35 percent and 68 percent of that for the 150-m radius. During the first four counts, the number of birds increased most rapidly for the 150-m radius. After four counts, more than 80 percent of all birds had been detected for the 150-m radius, 71 percent for 100-m, and 57 percent for 50-m.

Ten species for which territories could be clearly defined were selected for comparison of point count bird density between radii, because mapping on semicircle locations included only parts of many territories and provided only a rough approximation of abundance for most species. For these 10 species, point count bird density (mean number of birds per 10 ha) differed significantly between 50-m and 100-m,

Table 2--Species composition and abundance surveyed by point counts or territory mapping within a 150-m radius of the observer.

Species (n=49)	Point counts		Mapped points	
	Mean number birds/point ¹	Percent of total	Total number of territories	Percent of total
Bobolink	41.39	24.59	52.50	24.65
Savannah Sparrow	30.54	18.14	43.75	20.54
Red-winged Blackbird	12.47	7.41	16	7.51
Horned Lark	6.66	3.96	13	6.10
Song Sparrow	14.7	8.73	12.25	5.75
American Crow	7.57	4.5	11.25	5.28
European Starling	7.83	4.65	8	3.76
Common Grackle	7.34	4.36	7.50	3.52
Common Yellowthroat	8.27	4.92	7	3.29
Common Snipe	4.33	2.57	3.50	1.64
Killdeer	3.43	2.04	3.50	1.64
Rock Dove	2.70	1.60	3.50	1.64
Alder Flycatcher	2.19	1.30	3.25	1.53
American Goldfinch	1.31	0.78	2.25	1.06
American Robin	1.2	0.71	2.25	1.06
Upland Sandpiper	1.77	1.05	2.25	1.06
Yellow Warbler	1.33	0.79	2	0.94
Le Conte's Sparrow	1.17	0.70	1.50	0.70
Cedar Waxwing	2.97	1.76	1.25	0.59
Barn Sparrow	0.85	0.50	1	0.47
Brown-headed Cowbird	0.77	0.46	1	0.47
Cliff Sparrow	0.4	0.24	1	0.47
Mourning Dove	0.8	0.48	1	0.47
Tree Swallow	0.73	0.43	1	0.47
Black-capped Chickadee	0	0	1	0.47
Northern Goshawk	0.20	0.12	1	0.47
Eastern Kingbird	1.14	0.68	0.75	0.35
Bank Swallow	0.82	0.49	0.75	0.35
Northern Harrier	0.57	0.34	0.50	0.23
American Kestrel	0.40	0.24	0.50	0.23
Chipping Sparrow	0.37	0.22	0.50	0.23
Pine Siskin	0	0	0.50	0.23
Red-eyed Vireo	0.57	0.34	0.50	0.23
Blue Jay	0.20	0.12	0.25	0.12
Brown-capped Chickadee	0.17	0.10	0.25	0.12
Brown Thrasher	0.20	0.12	0.25	0.12
Black and white Warbler	0.2	0.12	0.25	0.12
Evening Grosbeak	0	0	0.25	0.12
Gray Catbird	0	0	0.25	0.12
Greater Yellowlegs	0.2	0.12	0.25	0.12
Lincoln Sparrow	0.2	0.12	0.25	0.12
Mourning Warbler	0.2	0.12	0.25	0.12
Northern Flicker	0	0	0.25	0.12
Purple Finch	0	0	0.25	0.12
Rose-breasted Grosbeak	0	0	0.25	0.12
Ring-billed Gull	0	0	0.25	0.12
Turkey Vulture	0	0	0.25	0.12
Yellow-bellied Sapsucker	0	0	0.25	0.12
Yellow-rumped Warbler	0.17	0.10	0.25	0.12
Total	168.33	100	213	100

¹ totaled for all points

Table 3--Mean bird density per 10 hectares on point counts for species for which territory could clearly be established. See table 1 for area of each radius.

Species	Radius (m)		
	50	100	150
Alder Flycatcher	1.41	0.71	0.69
Bobolink	24.11	17.43	13.01
Common Snipe	1.04	0.58	1.36
Common Yellowthroat	5.29	2.34	2.60
Eastern Kingbird	1.13	0.38	0.36
Horned Lark	6.37	3.58	2.09
Red-winged Blackbird	5.66	4.97	3.92
Savannah Sparrow	27.42	15.49	9.60
Song Sparrow	11.60	5.06	4.62
Upland Sandpiper	1.41	0.71	0.56
Total	85.44	51.24	38.81
Paired t-test (n=10)			
0-50-0-100 m	2.828	$P < 0.05$	
0-50-0-150 m	2.543	$P < 0.05$	
0-100-0-150 m	1.800	$P > 0.05$	

50-m and 150-m, but not 100-m and 150-m radii (table 3). Density decreased by 40 percent from 50 m to 100 m, 55 percent from 50 m to 150 m, and by 24 percent from 100 m to 150 m. Bird density is probably best estimated within a 100-m radius, being overestimated at 50 m and underestimated at 150 m because of lower detectability at greater distances for many species. Nine species had their highest density at the 50-m radius. The density of eight species declined continuously between radii of 50 m to 150 m. Only the Common Snipe, a species with a relatively large territory, had the highest density at 150 m.

On most 150-m radius points, point counts detected fewer birds than territory mapping for each of the 10 species with clearly defined territories. Common Snipe, Common Yellowthroat, and Song Sparrow showed respectively five, four, and three of nine points with more birds on point counts than on territory mapping. Relative abundances were not very different between methods, but was larger in two plots for Common Snipe and three for Song Sparrow (table 4). Point count locations were representative of each plot for at least these 10 species, since relative abundances from territory mapping on plots and points were not significantly different (table 4, paired t-test $t = 0.0052$, $n = 27$, $P > 0.05$).

Discussion

Both point counts and territory mapping at point count locations led to comparable results in terms of species composition and number of individuals per species. Since the data collected during point counts were also transcribed on the maps, this might be one reason for such links in the results. This also resulted in more time spent for mapping on the points, and it might explain the slightly higher densities on mapped points. This result is not in agreement with Edwards and others (1981) who detected more species with the variable circular-plot method, a modified point count method, than with mapping on plots. Point counts in open

landscape are also known to yield larger counts of rare species if distance of the plot is unlimited (Edwards and others 1981); thus 150 m should yield better results in such cases than shorter distances. Some species had low abundance on all points or did not use the site, such as ducks, some hawks, swifts, raven, orioles, and some warblers; others used it only for feeding and not for breeding, such as vultures, hawks, ducks, gulls, and many swallows. Many others used mainly the edges and thus required the presence of a different habitat or an ecotone which will be more or less important for nesting, or will be used as a perch for singing and territory maintenance.

The number of counts from four upward did not affect significantly the number of species detected per habitat in a study by Morrison and others (1981). Four counts per point seemed adequate since about 80 percent of all individuals per species have been accounted for in our study.

Absolute densities of territorial birds on the points compare well to the mean number of birds per point count. The mean number of individuals per species for any one point is about equal to the number of territories a point may support for most species, as long as they represent the actual number of birds the habitat could support. Relative densities of territorial birds obtained on mapped points match very well the relative mean number of individuals per point count and could be more useful than actual counts.

Our results suggest that point counts spanning at least 100 m are best suited for counting birds in agricultural landscapes. Four visits allow the detection of at least 80 percent of all species and birds. More visits would add more information, but the amount of work effort might impair the attainment of a good sample size on enough different points. Anderson and Ohmart (1981) also showed that more than three visits detected few additional birds.

Thus far, it appears that the point count method seems accurate enough to reflect "mapping based" true densities for comparison purposes between farm types in agricultural habitats. Blondel and others (1981) consider that the species

Table 4-Number of territories on the plots and on 150-m radius points, and mean number of birds on 150-m radius point counts. See table 1 for crop types in each point.

Species	Total territories on plots	Mapped points			Total	Point counts			Total	
		Number of territories				Mean number of birds				
		A1	A2	A3		A1	A2	A3		
Bobolink	34.5	6	9	1.5	16.5	4.8	9	0.67	14.47	
Common Snipe	4.5	0.25	0.5	0.75	1.5	0.6	0.8	0.5	1.9	
Common Yellowthroat	2.5	0	0.25	0	0.25	0	0.8	0	0.8	
Eastern Kingbird	1.5	0.25	0.25	0	0.5	0.6	0.4	0	1	
Horned Lark	11.5	2	0.25	6	8.25	1	0.2	3.83	5.03	
Red-winged Blackbird	23.5	2.25	8	2.5	12.75	1.6	6.6	1.83	10.03	
Savannah Sparrow	36.0	5	2	5	12	2.8	1	4	7.8	
Song Sparrow	11.0	1	2.25	0.25	3.5	0.8	2.4	0.67	3.87	
Upland Sandpiper	3.0	0.5	0	1.5	2	0.2	0.4	1.17	1.77	
		B1	B2	B3		B1	B2	B3		
	Alder Flycatcher	2	0.25	0	0.25	0.5	0.29	0	0.4	0.69
	Bobolink	36.5	6	6	5	17	6.29	4.8	2.8	13.89
	Common Snipe	2	0.25	0.5	0.5	1.25	0.29	0.8	0.8	1.89
	Common Yellowthroat	7	1	1	1	3	0.71	1.6	0.4	2.71
	Eastern Kingbird	1	0.25	0	0	0.25	0.14	0	0	0.14
	Horned Lark	6	2	2.25	0	4.25	0.86	0.4	0.2	1.46
	Red-winged Blackbird	3	0.25	1	1	2.25	0.14	0.8	0.8	1.74
	Savannah Sparrow	39.5	6	5.75	3.5	15.25	5.57	5	1.6	12.17
	Song Sparrow	18	1.25	2	1.5	4.75	1.43	2.2	1.2	4.83
	Upland Sandpiper	0.5	0.25	0	0	0.25	0	0	0	0
			C1	C2	C3		C1	C2	C3	
	Alder Flycatcher	5.5	1.5	0.5	0.75	2.75	1.17	0.33	0	1.5
	Bobolink	55	14.5	2.5	2	19	6.83	3	3.2	13.03
Common Snipe	0.75	0.25	0.25	0.25	0.75	0.17	0.17	0.2	0.54	
Common Yellowthroat	12	2	0.25	1.5	3.75	1.83	1.33	1.6	4.76	
Horned lark	1	0	0.25	0.25	0.5	0	0.17	0	0.17	
Red-winged Blackbird	1	0.25	0.5	0.25	1	0.17	0.33	0.2	0.7	
Savannah Sparrow	39.5	6	4.5	6	16.5	2.67	3.5	4.4	10.57	
Song Sparrow	15.5	1.5	0.5	2	4	2.5	1.5	2	6	

richness is a reliable index for total abundance in the community, the two being highly correlated in Oak forests. DeSante (1981) found that the variable circular-plot method tends to overestimate densities when species are rare and underestimate them when they are dense. Ideal workable distance for a fixed radius in agricultural landscapes seems to be at around 150 m, although less accuracy in the number of individuals is to be expected between 100 and 150 m from the observer, especially for species with smaller territories and for more abundant species. Many species can be easily detected in an open landscape, well up to 150 m. It would not seem advantageous to use a plot with a radius smaller than 150 m in such habitats.

A note of caution is important in regard to the expectation that the comparison would be feasible for all the species

encountered. In fact, because many species use edges as their prime habitat, the value of the analysis might be altered if not enough care is taken to reduce the effect of surrounding habitats bordering the points. This by itself might affect the species composition more than the choice of method to collect the data. This is especially important because a majority of the species encountered are breeding outside of the habitat under consideration.

Acknowledgments

This study was financially supported by the Canadian Wildlife Service of Environment Canada. We thank Sam Droege for helpful comments on the manuscript.

