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## FIELD STATIONS BULLETIN



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### SPECIES COMPOSITION AND ABSOLUTE POPULATION DENSITY OF BREEDING BIRDS OBTAINED BY TWO METHODS

John Emlen in 1971 (Auk 88:323-341.) explained details of a new technique for determination of bird population densities involving a transect or strip-census count. From this count, using previously established coefficients of detectability, absolute population densities can be determined. The Emlen technique is applicable in summer and winter while necessitating proportionately fewer man-hours in the field than comparable methods. This study was an evaluation of the technique by comparing it with the territorial mapping method. The study was conducted in the upland beech-maple woods at The University of Wisconsin—Milwaukee Field Station. Twelve censuses each year were taken from June 28 to July 28 in 1972 and from June 2 to July 11 in 1973. Each census began after sunrise (after 0500 hours C.D.T.) and lasted 3 to 4 hours.

A transect line was plotted across the area in a zig zag pattern totaling 1.75 miles. Separation between transect lines was 330 feet, following the existing grid system. Observations were made out to 165 feet on each side of the transect line, compared to 412 feet in Emlen's study. The total area encompassed by the transect line with 165 foot strips along each side was 67 acres. All detections were recorded on maps for each species. These observations were then assigned to 10 foot substrips on the map, parallel to the transect line. An average of the number of observations per substrip was calculated, including all substrips out to the one with the greatest number of observations. This average was then extrapolated out to the 165 foot limit to determine the projected count for each

species in the census area. Ratios of the actual count total and the projected count total for each species were termed coefficients of detectability (C.D.). After conversion to a 100 acre basis, the actual count total was divided by the C.D. value of the species to determine the absolute population density for that species. These density values were then compared with species densities obtained by the traditional territorial mapping method which has been in use for many years.

Census results in 1972 and 1973 totalled 50 bird species, 34 being present in sufficient numbers to enable territorial mapping. The remaining 16 species recorded less than four times are:

Mallard	Cedar Waxwing
Cooper's Hawk	Black and White Warbler
Yellow-billed Cuckoo	Blue-winged Warbler
Barred Owl	Yellow Warbler
Ruby-throated Hummingbird	Cerulean Warbler
Eastern Kingbird	Chestnut-sided Warbler
Willow Flycatcher	American Redstart
Common Crow	Northern Oriole

Densities of 17 species present in both years were great enough to enable calculation of coefficient of detectability values and Emlen technique density values. Population density values for all species, based on territorial mapping, were 391 birds/100 acres in 1972 and 399 birds/100 acres in 1973. Previous banding studies, in the case of the Ovenbird, substantiated these results, while density values from Emlen's method averaged 45% lower. Statistical evidence indicated that the coefficient of detectability (C.D.) values in this study varied significantly between species as expected, but not between years, with about 12% of variance due to error. These results suggest some validity to C.D. values, but several sharp contrasts in specific C.D. values must be recognized between this study and similar studies by Emlen. Higher C.D. values were anticipated in this study due to the narrower 165 foot census strip and the resultant greater ease in detection. However, the rank order of different species on the C.D. value spectrum exhibited little correlation between the two studies.

When the differences in estimated population density between the two methods were tested statistically by matched pairs analysis of variance, the difference due to method composed almost 70% of the total variation in density results. Variation between species was also significant, as expected, amounting to 28% of all variation, other sources being minor. Such considerable disagreement between methods indicates the need for a correction factor for densities in Emlen's method, called an adjustment for incompleteness. This adjustment averaged 1.86 over both years of the study, compared to Emlen's suggestion of 1.5. The difference may be due to normal variation or to a possible overestimation of territories in this study. Use of coefficients of detectability and adjustments for incompleteness with Emlen's transect census shows some promise of alleviating the many tedious field hours required in similar studies. Also it is

	Territory-mapping Method				Emlen Method					
	1972		1973		1972			1973		
	No. Terr.	Birds Per 100 Acres	No. Terr.	Birds Per 100 Acres	Total Count	C.D.	Birds Per 100 Acres	Total Count	C.D.	Birds Per 100 Acres
Red-should. Hawk	1	3	1	3	14*	—	—	8*	—	—
Black-billed Cuckoo	1-2	4.5	1-2	4.5	10*	—	—	9*	—	—
Common Flicker	4	12	2-3	7.5	34	0.66	6.5	25	0.72	4.4
Red-b. Woodpecker	—	—	3	9	2*	—	—	24	0.69	4.4
Red-h. Woodpecker	4-5	13.5	3-4	10.5	29	0.53	6.8	31	0.63	6.2
Hairy Woodpecker	4	12	4-5	13.5	34	0.55	7.7	31	0.54	7.2
Downy Woodpecker	4	12	5	15	30	0.61	6.2	40	0.57	8.7
G. C. Flycatcher	4	12	4-5	13.5	33	0.80	5.1	46	0.70	8.2
Acad. Flycatcher	—	—	1	3	1*	—	—	8*	—	—
E. Wood Pewee	10	30	7	21	106	0.92	14.3	73	0.93	9.8
Blue Jay	9	27	8	24	97	0.71	17	85	0.72	14.8
Black-c. Chickadee	10	30	4-5	13.5	83	0.72	14.4	40	0.65	7.7
White-b. Nuthatch	6	18	4	12	70	0.76	11.5	59	0.81	9.1
Brown Creeper	—	—	1-2	4.5	—	—	—	31	—	—
House Wren	5-6	16.5	.5	1.5	44	0.64	8.6	4*	—	—
Gray Catbird	2	6	1-2	4.5	9	0.41	2.7	9*	—	—
Robin	3-4	10.5	2-3	7.5	26	0.53	6.2	31	0.66	5.8
Wood Thrush	7-8	22.5	8-9	25	80	0.74	13.5	89	0.83	13.4
Veery	—	—	1	3	—	—	—	5*	—	—
Eastern Bluebird	—	—	1	3	1*	—	—	5*	—	—
Starling	2	6	7	21	11	0.42	3.3	46	0.58	9.9
Red-eyed Vireo	17-18	52	17	51	239	0.76	39	179	0.82	27
Ovenbird	16	48	18	54	223	0.78	35.5	185	0.83	28
Mourning Warbler	1	3	2	6	7*	—	—	13*	0.70	2.3
Com. Yellowthroat	1	3	1	3	11*	—	—	4*	—	—
Common Grackle	—	—	1-2	4.5	—	—	—	15*	—	—
Brown-h. Cowbird	—	—	2-3	7.5	—	—	—	15*	0.72	2.6
Scarlet Tanager	7-8	22.5	8	24	80	0.68	14.5	81	0.77	13.2
Cardinal	2	6	2-3	7.5	16*	0.70	2.9	23	0.62	4.6
Rose-b. Grosbeak	3	9	2-3	7.5	17*	0.59	3.6	15*	0.42	4.5
Indigo Bunting	1-2	4.5	1	3	8*	—	—	6*	—	—
Am. Goldfinch	—	—	1	3	—	—	—	7*	—	—
Rufous-s. Towhee	1-2	4.5	2-3	7.5	6*	—	—	17*	0.68	3.1
Song Sparrow	1	3	—	—	4*	—	—	3*	—	—

\* less than one detection per mile

Table 1. Comparison of Breeding Bird Population Densities Obtained by Two Methods

applicable to birds over a wider range of seasons and habitats, the territory mapping method being restricted to the breeding season. Major obstacles encountered in use of the Emlen method included: 1) necessity of an alternate census until standardized C.D. values and adjustments for incompleteness can be developed, 2) inconsistency of C.D. values between and within several species, questioning the possibility of developing acceptable standardized values, and 3) the wide degree of freedom given to observer judgment, increasing the margin for error. Some of these can be overcome with additional research.

Within the total population, clear decreases were evident from 1972 to 1973 in the Common Flicker, Wood Pewee, Black-capped Chickadee, White-breasted Nuthatch, and especially the House Wren (see Table 1). Possible explanations are: inclusion of non-breeding birds in the latter part of the 1972 census, scarcity of insects in 1973, competition with starlings for nesting cavities in 1973, and normal yearly fluctuations within species. Increases were noted in the Red-bellied Woodpecker, Starling, and Cowbird (see Table 1). These increases may also be due to normal yearly fluctuations, or differences in starting times of the censuses. Comparisons with other censuses in similar habitats showed the density results of this study well within an acceptable range, but somewhat lower than the average. Such differences might be the result of differences in observer experience and judgment, but more likely reflect a low carrying capacity for birds in the UWM upland maple-beech forest.

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