

REAPPRAISAL OF THE WINTER BIRD-POPULATION STUDY TECHNIQUE

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ABSTRACT.—Standardized morning and afternoon counts were conducted in two deciduous forest plots during seven winters. Morning counts yielded more species than afternoon counts, as well as higher counts of most species. A minimum of eight visits is recommended. Six visits yielded 2% to 5% fewer species, depending on the size and bird population of the study plot. Cumulative means for individual species varied erratically for most species when the number of visits was less than seven.

This study was conducted to determine the relative effectiveness of morning and afternoon counts in winter, and to determine the optimum number of visits. Unlike the Audubon Breeding Bird Census, the totals published are the seasonal means for each species, which are typically somewhat less than the actual population. Thus the number of visits may greatly affect the total number of species recorded, and the timing of these visits influences the number of individuals and their reported density.

METHODS

Four morning and four afternoon visits were made to each of two deciduous forest plots along the Middle Patuxent River in Howard County, Maryland, in seven winters from 1972 to 1980. The Audubon Winter Bird-Population Study instructions (Anon. 1950) were followed. These specify making at least six visits during the period 20 December to 10 February, mapping all birds observed on each visit, and determining as closely as possible the number of each species present on each trip. The mean number per trip is then computed and rounded to the nearest half bird. Finally, the density per 100 ha is computed and the means for each species are summed to get the total mean population.

The 56 morning visits started at about sunrise; the 56 afternoon trips ended shortly before sunset. Visits to the floodplain plot averaged about three hours each, those to the smaller upland plot, about two hours. The same route was followed on each visit. All birds observed on each trip were plotted on census maps, from which the trip totals for each species were determined. Results of each winter's study were published in the respective issues of *American Birds* under the titles Hickory-Oak—Ash Floodplain Forest, and Upland Tulip-tree—Maple-Oak Forest, as was also a preliminary appraisal of the method based on the 1972 results (Robbins 1972). Because the two plots were of different size (18.4 ha for the floodplain plot, 12.0 ha for the upland plot) and different bird densities, and because of year-to-year changes in these populations, the counts for each of 19 common species were analyzed by analysis of variance in order to detect any differences attributable to time of day.

Cumulative species totals for each year in each plot

were fitted to the equation $y = a - be^{-cx}$ to learn what percentage of the estimated number of species using each of the plots was detected in any given number of visits.

To determine the influence of number of visits on the counts of individual species, the 8-trip mean for each year was used as a standard with which the means of lesser numbers of visits were compared. Percentage departures from the 8-visit mean were computed and the absolute values averaged for each species over the 7-year period (excluding any years when a species was not observed on the plot).

RESULTS

TIME OF DAY

Results of the analysis of variance for 19 of the more common species are summarized in Table 1. For all except the junco, the 56 morning trips yielded a higher mean than did the 56 afternoon trips, but only eight species showed a significant ($P < .05$) difference between the morning and afternoon. The mean number of species recorded was also higher ($P < .01$) in the morning. The greatest differences noted were for the Evening Grosbeak (95% fewer in the afternoon), Blue Jay (59% fewer), and Purple Finch (42% fewer).

NUMBER OF VISITS

Estimates of both the species composition and the mean numbers of individuals vary with the number of visits. As visits increase, the number of species detected increases toward an asymptote that varies from year to year. Also, as visits increase the cumulative mean number of birds of each species tends to stabilize. The number of visits that will be made is, of necessity, a compromise between the number needed to obtain stable estimates and the manpower, cost, and number of days with favorable census weather available prior to beginning of spring migration.

Species richness

Cumulative species estimates were generated separately for each year in each plot. In six out of seven years in the 18.4 ha floodplain plot, 84–

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TABLE 1
COMPARISON OF MORNING AND AFTERNOON VISITS

Principal species	Mean of 56 visits		
	Morning	Afternoon	% difference
Common Flicker (<i>Colaptes auratus</i>)	3.70	2.80	-24
Red-bellied Woodpecker (<i>Melanerpes carolinus</i>)	4.11	3.66	-11*
Hairy Woodpecker (<i>Picoides villosus</i>)	1.63	1.57	-4
Downy Woodpecker (<i>Picoides pubescens</i>)	7.27	6.18	-15
Blue Jay (<i>Cyanocitta cristata</i>)	1.95	0.79	-59**
Carolina Chickadee (<i>Parus carolinensis</i>)	7.43	6.39	-14
Tufted Titmouse (<i>Parus bicolor</i>)	4.79	3.46	-28*
White-breasted Nuthatch (<i>Sitta carolinensis</i>)	2.89	2.18	-25*
Brown Creeper (<i>Certhia familiaris</i>)	.73	.45	-38*
Winter Wren (<i>Troglodytes troglodytes</i>)	.39	.21	-46
Carolina Wren (<i>Thryothorus ludovicianus</i>)	2.18	1.70	-22
Golden-crowned Kinglet (<i>Regulus satrapa</i>)	.64	.55	-14
Yellow-rumped Warbler (<i>Dendroica coronata</i>)	18.79	15.55	-17
Northern Cardinal (<i>Cardinalis cardinalis</i>)	7.34	5.91	-19
Evening Grosbeak (<i>Hesperiphona vespertina</i>)	5.18	.25	-95**
Purple Finch (<i>Carpodacus purpureus</i>)	2.88	1.68	-42**
American Goldfinch (<i>Carduelis tristis</i>)	1.23	1.02	-17
Northern Junco (<i>Junco hyemalis</i>)	.96	1.30	+35**
White-throated Sparrow (<i>Zonotrichia albicollis</i>)	7.70	7.46	-3
Number of species	16.68	14.88	-11**

* = $P < .05$.

** = $P < .01$.

TABLE 2
PERCENT OF SPECIES DETECTED EACH YEAR AS NUMBER OF VISITS INCREASED

Plot and year	Species recorded	Number of visits				
		4	6	8	10	12
Floodplain						
1972	33	93	99	99	100	100
1973	36	54	61	67	72	76
1975	39	96	96	100	100	100
1976	41	89	99	99	100	100
1977	28	84	91	98	98	99
1978	38	87	92	98	99	100
1979	31	94	97	97	100	100
6-yr. mean	35.4	90.5	95.7	98.5	99.5	99.8
Upland						
1972	30	95	95	99	100	100
1973	27	86	90	97	99	99
1975	29	77	86	89	95	97
1976	27	47	55	65	71	77
1977	24	82	91	99	98	99
1979	19	79	96	96	99	100
1980	19	81	81	91	96	98
6-yr. mean	24.7	83.3	89.8	95.2	97.8	98.8
All years combined						
Floodplain		89	96	98	99	100
Upland		77	88	94	97	98

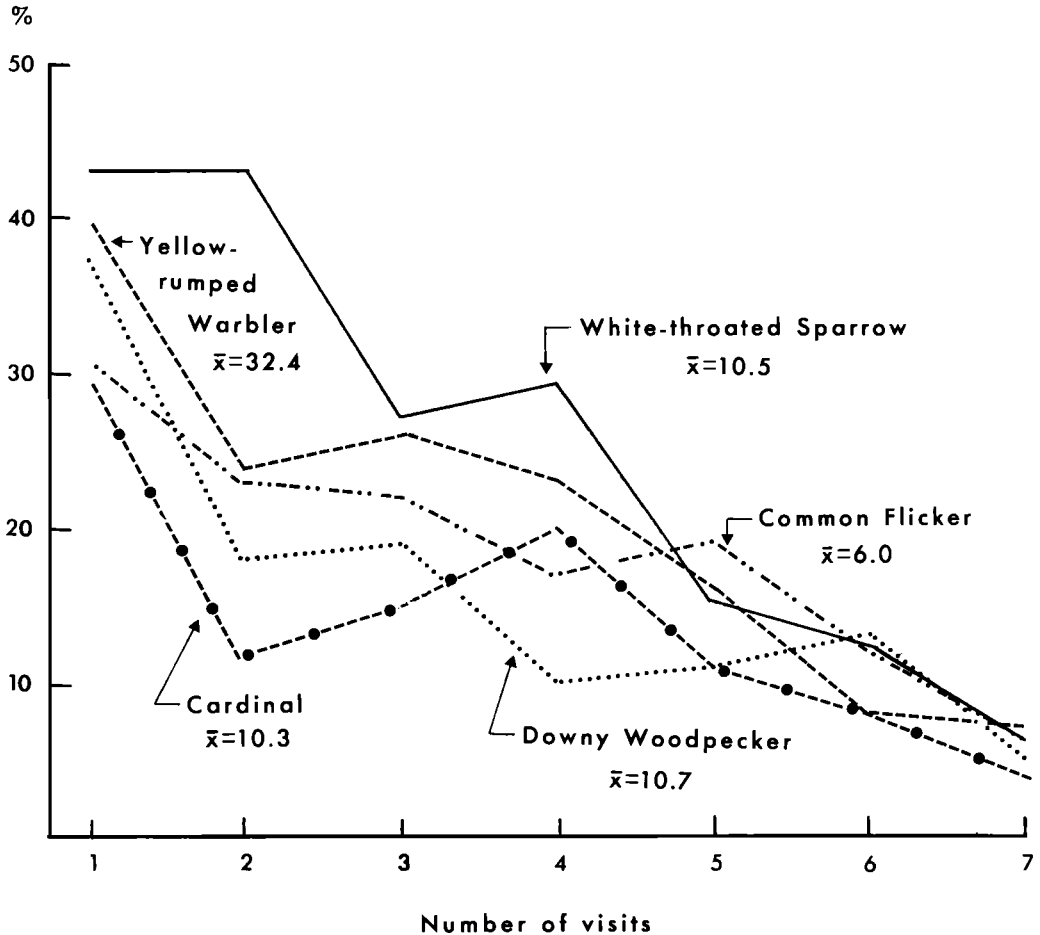


FIGURE 1. Cumulative effect of number of visits on the means for five common species in the 18.4 ha floodplain plot. Percentage departures from the eight-visit mean become less as the number of visits increases.

96% of the projected number of species were detected in the first four visits, 91–99% were detected in six visits, and 97–100% in eight visits (Table 2). In six out of seven years in the 12.0 ha upland plot, 77–95% of the species were detected in four visits, 81–96% in six trips, and 89–99% in eight visits. In one year in each plot, the cumulative species totals were so erratic that eight trips were insufficient to generate valid predictions. This resulted in the estimates being too low. The results for these two years, 1973 in the floodplain plot and 1976 in the upland plot, are not included in the means in Table 2.

Counts of individual species

Figures 1, 2, and 3 show, for selected species, how the results of one through seven visits compare with the 8-visit mean. For five common species (Fig. 1), with mean winter populations

of 6 to 72 individuals on the floodplain study plot, the first four visits resulted in a mean that averaged 10% to 29% away from the 8-visit mean. With five visits the departures narrowed to 11% to 19%; with 6 it decreased to 8% to 13%, and with seven visits departures ranged from 4% to 7% away from the 8-visit mean.

For flocking fringillids, however, the estimates from small numbers of trips were extremely variable (Fig. 2). Departures from the 8-visit mean computed from the mean of 4, 5, 6, and 7 visits were 20–34%, 24–28%, 18–27%, and 6–30%, respectively.

In the upland plot, where bird populations were much smaller (Fig. 3), variability was much greater than in the floodplain. For example, departures for the Yellow-rumped Warbler were about four times as great in the upland plot, where the mean was 1.72 (Fig. 3), as in the

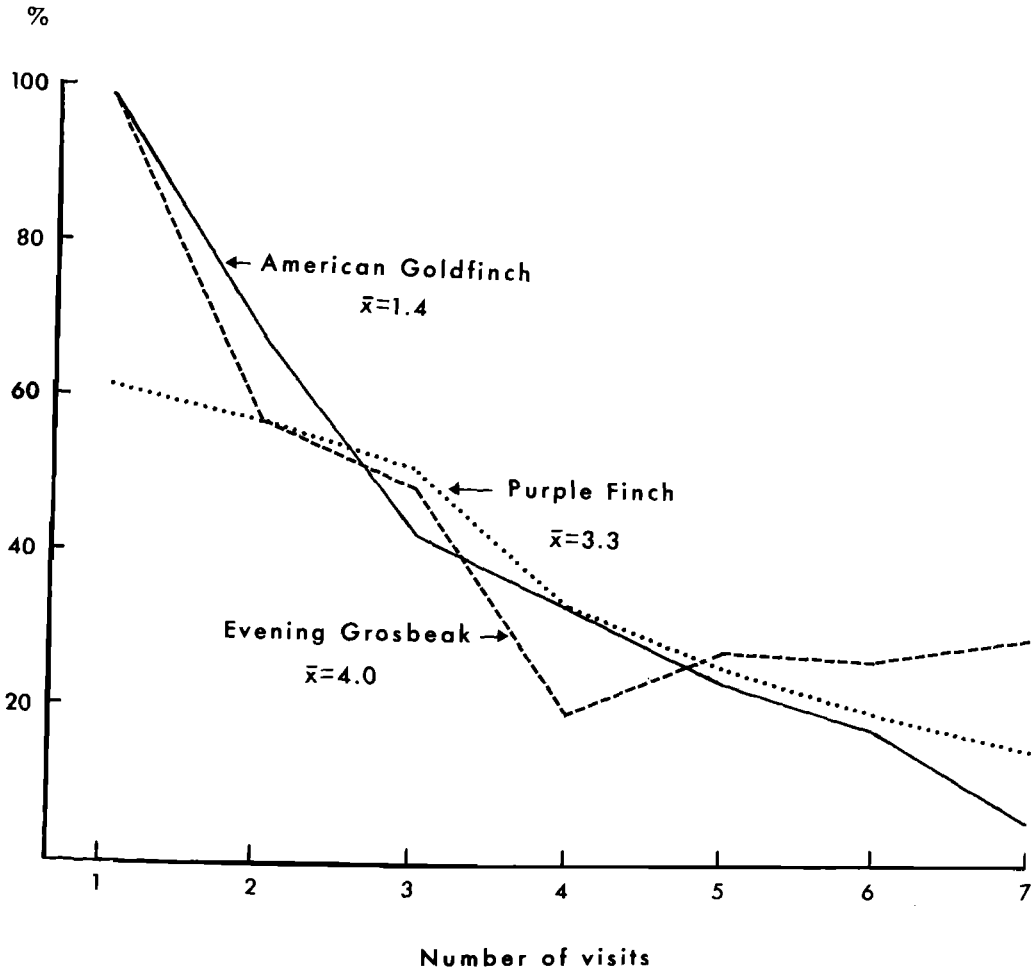


FIGURE 2. Cumulative effect of number of visits on means for flocking fringillids in the floodplain plot.

floodplain, where it was 32.4 (Fig. 1). For the Cardinal they averaged about three times as great in the upland, where the mean was 2.59, as in the floodplain, where the mean was 10.3. For the White-throated Sparrow they averaged about twice as great in the upland, where the mean was 4.68, as in the floodplain, where it was about twice as high (10.5). For a non-flocking species such as the Downy Woodpecker, however, the small number of visits gave fairly dependable results even with a small population.

DISCUSSION

In the comparison of morning and afternoon counts based on only a single year (Robbins 1972), significantly higher numbers of total individuals were recorded in the morning ($P < .01$): 20% higher in the 18.4 ha floodplain, 47% higher in the 12.0 ha upland. Although only two

species, Blue Jay and Evening Grosbeak, revealed significant ($P < .05$) differences with this small sample of data, the mean values of 11 of the 13 species tested were higher in the morning than in the afternoon in both plots (if present in both). The other two species, Common Crow and Carolina Wren, had higher morning counts in one plot, while morning and afternoon tallies were identical in the other plot.

With the addition of six more years of data from the same two plots, the differences between morning and afternoon counts become more obvious. The Blue Jay, Evening Grosbeak, and Purple Finch now show highly significant differences ($P < .01$), and four other species have joined the significant list. Of the 19 species examined, only the junco had higher afternoon counts, as a result of birds entering the plots from nearby fields late in the day. With the pos-

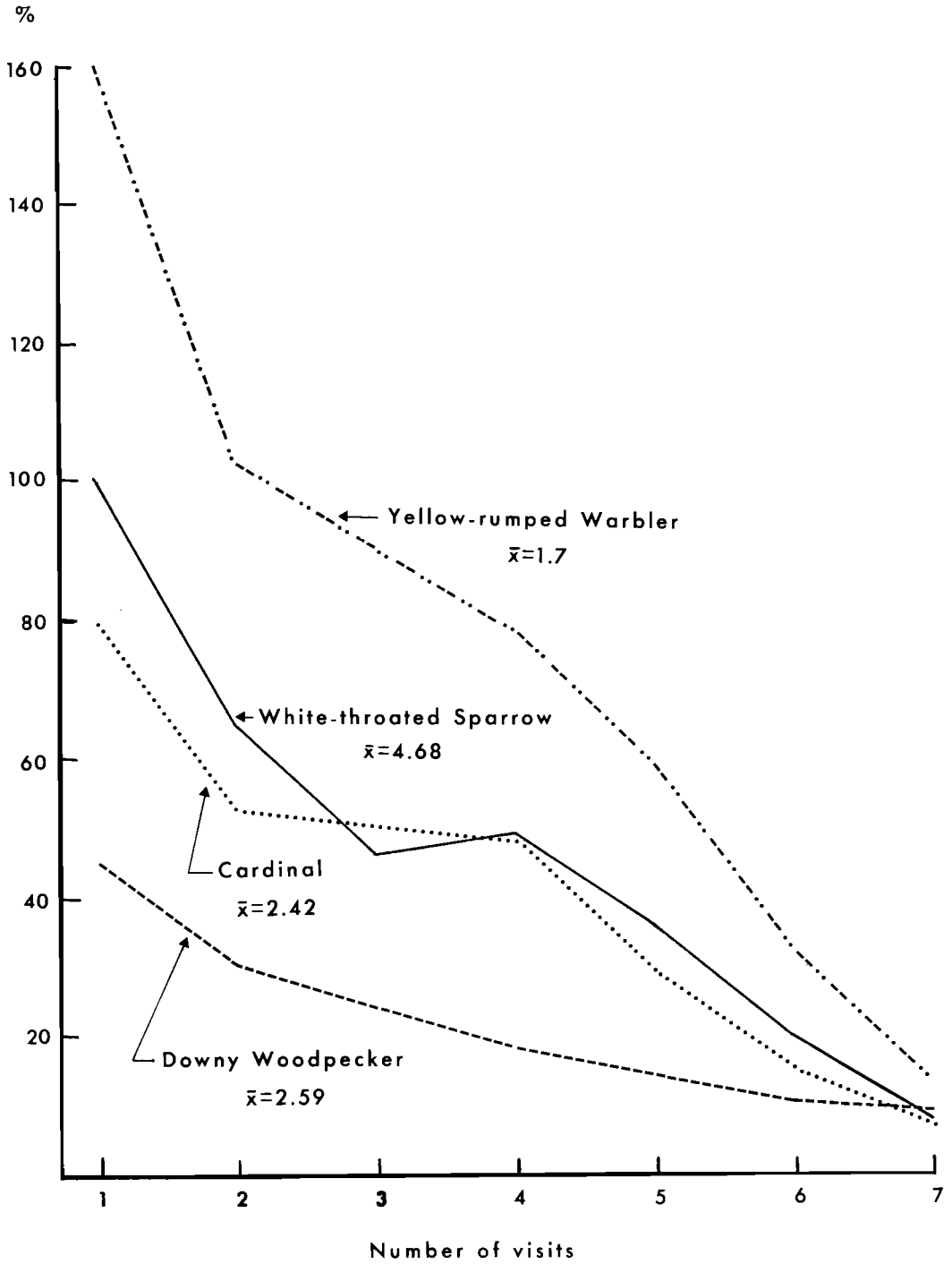


FIGURE 3. Cumulative effect of number of visits on means for species with low populations in the 12.0 ha upland plot.

sible exception of the Evening Grosbeaks, I believe the differences noted resulted from lower detectability in the afternoon rather than any important difference in the numbers of birds present in the study plots. I conclude, therefore, that the morning trips are more productive than the afternoon trips, both for total number of species and for the numbers of individuals of each. As no counts were made in mid-day, the comparative efficiency of mid-day counts is not known.

The Winter Bird-Population Study instructions call for a minimum of 6 visits, preferably more. In practice, eight is the number most frequently used. Of the 64 studies published in *American Birds* in 1980, 2 had 5 visits, 12 had 6, 5 had 7, 16 had 8, 10 had 9 or 10, 5 had 11 or 12, 13 had 13, 14, or 15, and 1 had 22.

Results of the present study indicate that in forest habitats in the 12–18 ha range, which is about the average size of Winter Bird-Population Study plots, six visits should be the very minimum, and eight or more would be preferable. Whereas an estimated average of 5% of the species in the 12.0 ha plot were missed with eight visits (Table 2), 10% were missed with six visits, and 17% with only four visits. In the 18.4 ha plot, an average of 2% of the species were missed with eight visits, 4% with six visits, and 10% with four visits. If all visits had been made in the early morning, fewer species would have been missed.

On an individual species basis, we must recognize that only the commoner species, those averaging at least one and preferably five or more birds per visit, can be satisfactorily estimated with eight visits. And it must be re-emphasized here that a satisfactory estimate is not a valid estimate of the actual population, but rather a stable index that can be used for comparison with other years or possibly other study plots.

Day-to-day variability in winter was so high that eight visits per year for seven years could

not adequately define the number of visits required for various species. This variability was caused in part by birds moving in and out of the plots, but also in part by weather factors and sampling error. Figures 1, 2, and 3 do suggest, however, that non-flocking species and common species are more reliably estimated than others, and that studies based on fewer than seven trips can give misleading results for many species.

CONCLUSIONS

The Winter Bird-Population Study method is adequate for describing average use of a plot by wintering birds if published instructions are followed, and if the following recommendations are considered:

(1) The study plot should be large enough or rich enough so the more important bird species are represented by an average of five or more individuals each.

(2) Plan to make at least eight visits unless results show that counts of the major species have stabilized and no additional species are being found.

(3) If recommendation 1 cannot be met, extra visits (more than eight) are recommended to obtain better population estimates.

(4) Plotting of a cumulative species "discovery curve" or calculating the estimated total species present using the formula presented above will show whether enough visits have been made to detect most of the species present.

(5) Expect morning visits to be more productive than afternoon visits.

(6) Consider making extra visits for nocturnal or crepuscular species. Mid-day trips may reveal presence of vultures, buteos, or other birds not found in early morning.

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