A CIRCULAR PLOT METHOD OF CENSUSING POST-BREEDING BIRD POPULATIONS[1]

Dale K. Fowler,
Tennessee Valley Authority,
Norris, Tennessee
Burd S. McGinnes,
Virginia Cooperative Wildlife Research Unit
Virginia Polytechnic Institute and State University,
Blacksburg, Virginia[2]

ABSTRACT

A circular plot method of censusing non-game birds on southern Appalachian forest recreation Forest recreation areas was devised and tested. Plot boundaries were defined with a range finder. Accuracy of the method was affected by the variability inherent in wild bird populations, rain and wind, dense vegetation, and complexity of the late summer period. Data are presented indicating significant differences in evening and morning bird activity and a significant within-season decline in late summer bird population estimates. The census method used was judged satisfatory for a post-breeding bird census.

An exploratory study, designed to furnish data on the late summer habitat of non-game birds in the region of the southern Appalachian mountains, was conducted in 1969 (Fowler, 1970). Since no suitable techniques for censusing late summer birds were available, it was necessary to devise a procedure for use in campgrounds of 5 to 9 acres. This paper presents the census method devised to meet the study requirements.

The majority of bird species in the southern Appalachians exhibit post-breeding behavior by early or mid-July, and begin migration in late September. Consequently, the study began July 7 and terminated September 12, 1969. Census trips to each study site were spaced evenly over this time interval.

Non-game birds form a conspicuous element of the wildlife on these developed forest recreation sites. To maximize public benefits derived from these sites, the habitat should be manipulated for an optimum blend of species and numbers of birds. Unfortunately, very little quantitative information is available pertaining to habitat requirements of non-game birds or to which species the public wishes to see. The situation has been well stated by Hooper and Crawford (1969:204): "The post-breeding period of late summer has received little recognition, mainly because of the complex ecological and behavioral factors during the period. Few species are engaged in the same activity—some renest, some nest for the first time, some are busy raising a brood, some are undergoing the post-nuptial molt, and some begin migration. This neglect in research is unfortunate because the period is also a peak human recreation period."

Several approaches have been taken to estimate post-breeding bird populations; none were suitable for use on our small study sites. Kendeigh (1944) recorded the average number of birds of each species seen per trip to a study area. These data were summarized for each month, and the percentage of all trips during the month on which the various species were observed was calculated. Dobrokhotov and Ravkin (1961) determined the optimal width of

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census strips for several species of birds in Russia during the post-breeding period. The procedure used during the annual winter bird count sponsored by the Audubon Society (Kolb, 1965) consists of an attempted total count of all birds observed within a mapped census plot. For each species, the average number of observations per trip is expressed as birds per 100 acres. Hooper (1967) counted the number of individuals of each bird species observed on transects 200 feet wide and 1000 feet long during a 30-minute counting period. The mean number of times a species was included in the counts was calculated, and these averages were totaled for all species. The sum of the averages comprised relative abundance indices.

Emlen (1971:340) devised a bird census method applicable at all seasons. "In the new method foot transect counts are made in which all detections, visual and aural, out to the limit of detectability are tallied. The count for each species is then multiplied by a conversion factor (coefficient of detectability) representing the percent of the population that is normally detected by these procedures. Conversion values are derived directly from distribution curves of detection points laterally from the observer's trail." This technique was not available at the time of our study.

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METHODS

Fifteen study sites of 5 to 9 acres were selected from developed recreation sites within the Cherokee, Nantahala, and Chattahoochee National Forests of southeastern Tennessee, southwestern North Carolina, and northern Georgia. These sites ranged in density of understory vegetation from very sparse to thicket-like conditions. Campsites and small roads were laced throughout the study sites.

Twelve circular plots, 75 feet in radius, were used for each population estimate on a study site. The center of each plot was marked with an 8-foot range pole, and a 6-inch range finder was used to verify the imaginary plot boundaries. The plot radius was chosen on the basis of preliminary testing over a range of vegetation densities.

The average number of birds observed on the 12 plots during 10-minute counting periods constituted one complete estimate. Each of the 15 study sites was censused three times in the morning (0700 to 1100 hours EST) and evening (1500 to 1900 hours EST). The average of these six counts comprised the late summer bird population estimate for a study site. Bird density was calculated by dividing the percentage of an acre which a plot comprised into the mean number of birds per plot and multiplying this figure by 100 to give birds per acre for that particular count.

Because of the small size of the study sites, the circular plots were systematically located along a compass bearing. The bearing was taken parallel to the long axis of the study site and was used for all subsequent censuses on that site. A point 30 paces from two boundaries of a study site located the first plot in a series, and was also arbitrarily chosen as the nearest distance that a plot center could be to a site boundary. Subsequent plot centers were located by pacing along the previously determined compass bearing. The same number of paces was used to space plot centers and compass lines, and was chosen randomly from a number interval of 50 to 75. That number interval was chosen to minimize plot overlap and obtain good site coverage.

Plot locations were watched closely on the approach to detect any bird movement within the plot area. Flushed birds were counted since they would have been within the plot during the counting period had it not been for the intrusion of the investigation. Birds flying onto a plot after the start of a count were also tallied because this movement was considered part of their normal activity.

Time was noted when the plot center was marked with the range pole. Birds in the understory were detected during a slow circular traverse of the plot. At the same time, the overstory was watched carefully. This activity usually required five to seven minutes, and the remaining time was spent scanning the overstory from one or more vantage points outside the plot. The location of a bird in relation to a plot was checked with the range finder by either standing in the plot center and focusing on an object near the bird, or standing at the bird's location and focusing on the range pole. Approximately three hours, including plot location, were required to census a study site.

Confidence limits were calculated for the late summer bird population estimates on each of the 15 study sites. Analysis of variance was used to test the hypothesis that there were no significant differences in within-season bird density estimates or between morning and evening counts. The Duncan's new multiple-range test was used to compare within-season density estimates.

RESULTS AND DISCUSSIONS

Late summer is a time of great variability in wild bird populations. With the breakdown of territorial behavior, some species begin to forage widely in small bands, while others form small flocks in preparation for the southward migration. Some migrants from the North begin to arrive during the latter part of the period. This normal variation in bird population density is reflected in the six population estimates for each of the 15 duty sites, the mean late summer population estimates, and the 95-percent confidence limits for those estimates (Table 1). Late summer estimates range from 1.2 birds per acre at Lake Blue Ridge to 8.5 birds per acre at Indian Boundary A. Lake Blue Ridge also had the lowest number of bird species observed (10 species) while Indian Boundary A, had the highest number (25 species). The best population estimate, (3.6 birds per acre) obtained at Spivey Cove, had a 95-percent level of 3.2 to 4.0 birds per acre. Confidence levels for the worst estimate, (2.7 birds per acre) at Lake Russell A. ranged from 1.52 to 3.88 birds per acre.

Other factors that affected the accuracy of the census techinque, adding still more to the variation, included rain and thick vegetation. Dense understory and canopy restricted visibility, resulting in undetected birds and hard-to-determine plot boundaries. Wet conditions "fogged up" the window of the range finder; wind and dripping foliage concealed bird movement and sound. The only factors thought to depress bird activity severely were hard wind and rain. One count conducted under these conditions was repeated because the low estimate obtained was not considered representative of the actual number of birds in the site.

In view of the outlined caused of variability, the 95 percent confidence limits are not unreasonable. It is likely that even with accurate plot counts and accurate estimates of bird density for each site, the confidence limits would still be wide. Indeed, accurate bird density estimates are probably not necessary as long as the estimates are consistent with the intensity of bird activity on a study site. These population estimates, although not completely accurate, should still regress against the important habitat variables.

Significant differences in morning and evening bird population estimates (means of 36 a.m. and 36 p.m. plot counts) were revealed on the Pocket campground ($p<0.01$) and the Lake Russell C campground ($p<0.05$). Morning and evening count means (Table 1) for the Pocket were 8.3 and 3.3 birds per acre, while they were 4.1 and 1.6 birds per acre at Lake Russell C. No other sites were significantly different. However, morning and evening population estimates based on polled data from all sites (means of 540 a.m. and 540 p.m. plots) were significantly different ($p<0.01$). The polled morning estimate was 5.4 birds per acre, while the evening estimate was 4.2 birds per acre.

There appears to be a significant difference in evening and morning bird activity, but caution must be used in interpretation of our data. The study sites were not censused in the morning and evening of the same day, nor was a morning count on a study site always followed by an evening count (Table 1). For valid comparisons of a.m. and p.m. bird activity, these criteria should be observed. Travel and time requirements prevented us from achieving that consideration. However, our data does indicate a difference between a.m. and p.m. bird activity and other investigators should consider that possibility when designing similar studies. Bird estimates obtained with unequal a.m. and p.m. replications could lead to erroneous conclusions about bird-habitat relationships.

The complexity of the late summer period is further compounded by examination of within-season changes in wild bird populations. When the six daily population estimates for each site were subjected to analysis of variance, Spivey Cove ($p<0.05$), Rabun Beach B($p<0.05$), Lake Russell C($p<0.05$), and Lake Russell B(p 0.01) revealed significant within-season differences in bird density estimates. Six within-season population estimates were then calculated by pooling data from all sites. These pooled estimates were significantly different ($p<0.01$). When these six pooled treatment means were arranged in sequence and examined by use of the Duncan's new multiple-range test, it was found that mean one differed significantly from six, five, four, and three, while mean two differed significantly from means six and five (p 0.05). No other means were significantly different. The trend was for bird density estimates to decline as the season progressed (Figure 1).
probably due to the addition of young birds to the population. Shortly thereafter the estimates began to decline due to natural mortality, decreased observability of non-breeding birds. and the abrupt desertion of breeding grounds by many bird species. The Virginia pine overstory at the DeSoto Falls study site contained American redstarts (*Setophagia ruticilla*), yellow-throated warblers (*Dendroica dominica*), and black-throated green warblers (*Dendroica virens)* during the breeding period. By the second post-breeding census, all three species had departed from the site. Whether the birds migrated or simply changed localities is open to question. The major factor contributing to the decrease in bird density estimates may be a within-season decline in bird activity and resultant low population estimates. The observations of Williams (1936:385) concerning post-breeding bird populations within a beech-maple climax community in Ohio parallel our findings. "The probability is that when the summer is over, the net increase in the bird population is not large. Depletions from the ranks of the older birds are made good by the entrance of younger birds into the community, perhaps in numbers just large enough to absorb the losses that are due to come as a result of autumn and winter casualties, and so maintain the species at its normal numbers."

In view of this within-season decline in bird populations, the bird census aspect of a late summer habitat study in the southern Appalachian area should be conducted in as short a time span as possible. The study should also be initiated at least a week later than our study to reduce the variability due to the proximity to the breeding season. If possible, two weeks should separate the two periods. Otherwise, the variability due to the transition from breeding to post-breeding behavior may mask the important bird-habitat relationships.

In the final analysis, much of the evaluation of this censusing method must rest on the opinion of the authors who used it for 275 hours in the field. We believe that the technique filled the conditions and objectives of this study and should be considered by other researchers working during the late summer period. Details such as plot radius, location, and number could be modified to fit other study objectives, while use of the range finder to check plot boundaries should lend itself well to transect use.

In conclusion, the accuracy of the circular plot bird census method is affected by the variability inherent in wild bird populations, by rain and dense vegetation, and by the complexity of bird behavior in the late summer period. However, the authors feel the census method presented has merit for studies conducted during this period. The possibility of differences in a.m. and p.m. bird activity should be considered in the design of post-breeding bird studies. Finally, late summer bird studies should be initiated one to two weeks after the cessation of the breeding season.

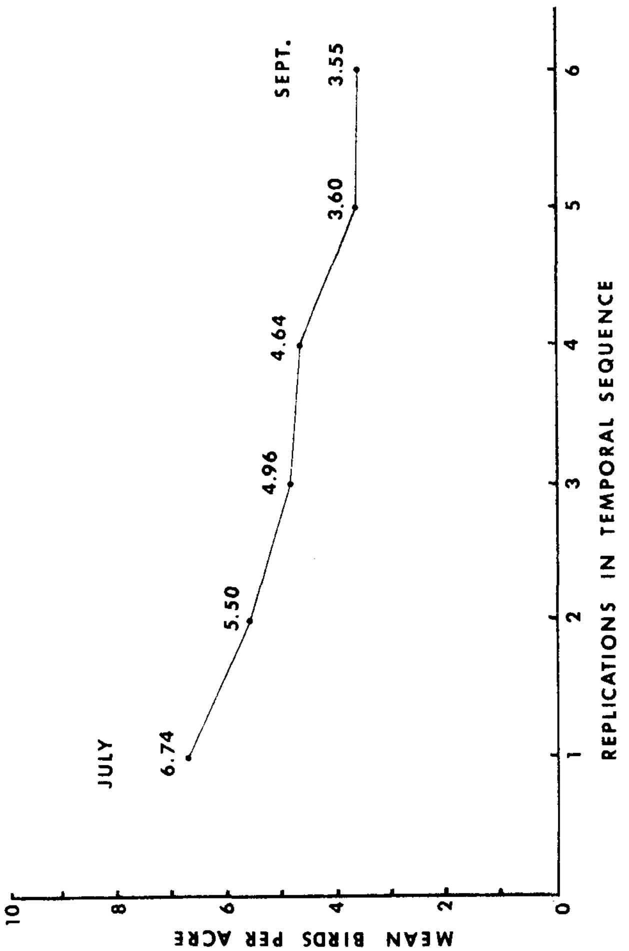

Fig. 1. The decline of late summer bird density with season progression.

Figure 1. The decline of late summer bird density with season progression.

Table 1. Bird population estimates and confidence limits for the late summer study sites.

Study Site	Daily Estimates (Birds/Acre) Replications in Temporal Sequence						Late Summer Estim. (Mean birds/acre)			95% Confidence Limit 5c
							a.m.	p.m.	All data	
Indian Boundary A	11.5Ea	8.6Mb	4.5E	10.3M	8.4E	7.6M	8.8	6.1	8.5	6.12 - 10.88
Morganton Point	7.0M	7.2E	7.4M	8.2E	6.0M	7.8E	6.8	7.7	7.3	5.65 - 8.95
Rabun Beach A	9.2M	8.6E	8.4M	4.1E	5.3E	3.3M	7.0	6.3	6.5	4.75 - 8.25
Jack Rabbit Mt.	7.2E	8.2M	9.4M	4.1E	5.7M	4.1E	7.8	5.1	6.5	4.85 - 8.10
Pocket	10.9M	5.3M	2.3E	8.6M	4.3E	3.5E	8.3	3.3	5.8	3.93 - 7.67
Indian Boundary C	7.0M	8.4E	8.2M	2.7M	3.7E	4.1E	6.0	5.4	5.7	4.20 - 7.20
Rabun Beach B	9.1E	4.5M	4.3M	8.6M	2.9M	2.7E	5.3	5.4	5.3	3.79 - 6.81
Winfield Scott	10.5M	4.1E	4.1E	2.3E	4.5M	3.9M	6.3	3.5	4.9	1.13 - 6.67
DeSoto Falls	6.2E	5.5M	5.3E	2.9E	3.3M	3.9M	3.6	4.8	4.5	3.18 - 5.82
Lake Russell B	6.8M	3.9E	5.3M	4.1M	2.4E	1.9E	5.4	2.7	4.1	2.42 - 5.78
Spivey Cove	6.2M	3.5E	2.1M	6.4E	3.1M	0.6E	3.8	3.5	3.6	3.20 - 4.00
Hanging Dog Creek	2.1M	4.9E	6.2M	1.9E	2.3E	2.1M	3.5	3.3	3.2	2.21 - 4.19
Lake Russell C	1.4E	6.8M	2.4E	2.1M	1.0E	3.3M	4.1	1.6	2.8	1.69 - 3.91
Lake Russell A	4.7M	1.2E	2.7M	2.3E	1.4M	3.7E	2.9	2.4	2.7	1.52 - 3.88
Lake Blue Ridge	1.2E	1.4M	1.7E	1.0M	0.6E	1.0M	1.1	1.2	1.2	0.70 - 1.70

a. E denotes evening population estimates (mean of 12 plots).

b. M denotes morning population estimates (mean of 12 plots).

c. Calculated only for population estimates based on all data (mean of 72 plots).

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PREDATION IN WARM WATER RESERVOIRS BY WINTERING COMMON MERGANSERS

Steven W. Miller
Present Address:
Department of Natural Resources
Bureau of Fish & Wildlife Management
Box 450, Madison, Wisconsin 53701

John S. Barclay
Zoology Department, Oklahoma State University
Stillwater, Oklahoma 74074

ABSTRACT

The impact of predation by common mergansers (*Mergus merganser* americanus) wintering on Lake Carl Blackwell (650 ha) in Payne County, Oklahoma was investigated. Parameters measured included merganser use-days, daily food consumption, and food habits; plus the standing crops of fish in the lake. There were 27,500 use-days in the winter of 1971-72 and 13,100 in the 1972-73 winter. The approximate daily food consumption was determined to be 454 g (1 pound) per merganser. Common Mergansers consumed an estimated 12.5 and 6.0 percent of the mean standing crop of fish in the winters of 1971-72 and 1972-73, respectively. Gizzard shad (*Dorosoma cepedianum*) comprised 84 percent of the mergansers' food by weight, and 25.6 and 12.6 percent of the standing crop of this fish was consumed in the respective winters. In 1971-72, 27.5 percent of the standing crop of white crappie (*Pomoxis annularis*) was consumed, as compared to 13.2 percent in 1972-73. From observations on the feeding behavior of this waterfowl it would appear that aggregations of fish are vulnerable to feeding flocks of wintering mergansers.