Comparison of Breeding Bird Census Techniques

by James G. Dickson

Three different census methods are compared for accuracy, and show wide variations in breeding bird detection

CENSUSING OF MOST PASSERINE and some non-passerine non-flocking birds during the breeding season is based primarily on detections of conspicuous singing male birds. Many different census techniques have been employed (Emlen, 1971, Berthold, 1976), and although there are comparisons of results in European ornithological literature (Enemar, 1959, Berthold, 1976), few are available to the American bird censuser. Differences in census results could be owing to differences in configuration of census area, number of individual censuses (counts), or methods of counting. The purpose of this study was to compare bird population estimates from an area spot map with estimates from transect spot maps, maximum detections (summation) and mean detections per count.

The spot map census method (Williams, 1936) is commonly used for censusing territorial males in the United States (Hall, 1964). The position of each singing male detected during each count is plotted. After a series of counts these detection positions are plotted for each species and clusters are interpreted as territories (International Bird Census Committee, 1970). Williamson (1964) thought a minimum of three individual detections for the series of counts was sufficient for interpretation as a valid territorial male, as did the International Bird Census Committee (1970) when the number of counts exceeded seven.

Another method of censusing singing males is the summation method (Palmgren, 1930). The highest number of males of each species calling on any count is the total estimated singing male population. The assumption is that the probability will approach 1.0, that all the territorial males of each species will be detected on a minimum of one count. Both the spot census and the summation technique, were devised to compensate for incomplete censusing of territorial males on any single count.

MEAN DETECTIONS PER COUNT, commonly used in estimating winter bird populations (Kolb, 1965), are also sometimes used to estimate breeding bird populations (Emlen, 1971).

I used these census methods to estimate bird populations from transect counts. Transects have been used previously in censusing animal populations *e.g.*, Ruffed Grouse, *Bonasa umbellus* (Leopold 1933:151), marsh wrens (Breckenridge, 1935), and songbirds (Emlen, 1971).

Study Area and Methods

THIS INVESTIGATION WAS CONDUCTED on the Thistlethwaite Wildlife Management Area (hereafter, T.W.M.A.), St. Landry Parish, Louisiana. The area is an old floodplain of the Mississippi and Red Rivers, dominated by a mature forest classified as hardwood bottom (Braun 1950:293). Cane (*Arundinaria gigantea*) and Palmetto (*Sabal minor*) are the predominant understory species.

Population estimates were determined from a 1.6 km transect and a 8.1 ha rectangular area on the northwest portion of T.W.M.A. Part of the 8.1 ha area and transect physically overlapped, and the non-overlapping portions of each were physiographically and vegetationally similar. The rectangular area was counted eight mornings between May 14 — June 20, 1973, and the transect was counted eleven mornings between April 18 — June 20. The later transect counts were used to tabulate results for six and eight counts. Comparisons were made with population estimates from area spot mapping and transect spot mapping, summations, and mean detections per count. Only singing male birds were counted in the spot mapping and summation methods, however, all birds were included in the mean detection counts.

The transect was established with strips of different widths for different species. Effective detection distances (hereafter, edd) were determined for each species from the distribution of detection points perpendicular to the transect line. Visually estimated distance units from transect (6.4, 12.5, 18.9, 25.0, 31.4, 62.8, 125.6, 251.5 m) were selected for easy conversion to area (Emlen, 1971). Based on general field observations and the overall distribution of detection distances, we assumed that each species was detected effectively to a minimum of 18.9 m. Beyond this point the effective distance for each species was defined as the point beyond which the number of birds per unit area declined below 75% of the mean number of birds per unit area nearer the transect line. This point of the limit of effective detection would correspond very closely to Emlen's inflection point (1971), used to determine the level of maximum detection.

APPROXIMATELY 90% OF THE DETECTIONS during the breeding season study were aural, mostly singing males. Effective detection distances of various species of common birds were: Kentucky Warbler (*Oporornis formosus*) and Hooded Warbler (*Wilsonia citrina*) 25.0 m, Acadian Flycatcher (*Empidonax virescens*), Swainson's Warbler (*Limnothlypis swainsonii*) and Cardinal (*Cardinalis cardinalis*) 31.4 m; Yellow-billed Cuckoo (*Coccyzus americanus*), Red-bellied Woodpecker (*Centurus carolinus*), Tufted Titmouse (*Parus bicolor*), Carolina Wren (*Thryothorus ludovicianus*), White-eyed Vireo (*Vireo griseus*), Yellow-throated Vireo (*Vireo flavifrons*) and Red-eyed Vireo (*Vireo olivaceus*) 62.8 m.

Results and Discussion

DIFFERENCES WERE NOTICEABLE from comparisons of census results (converted to singing males per km², Table 1). Singing male populations estimated from spot mapping on the 8.1 ha area were generally higher than results from the same number of census counts (8) on the transect. Of the 12 common species of birds (≥ 5 singing males per km² on all censuses), 8 were less numerous on the transect census by a range of 17 to 68%. The total number of birds by the transect census was 20% fewer than the area census total. We believe that configuration of the censused area was the main factor underlying the difference On the transect a continuous path was followed. In censusing the rectangular area, a series of essentially parallel strips were traversed (Fig. 1). The probability of the observer coming within a bird's detection area more than once was greater with the series of

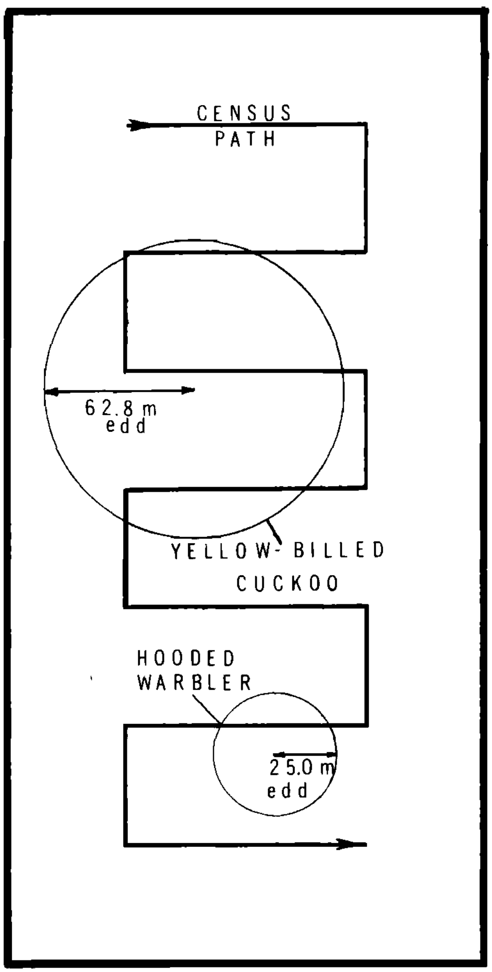

Fig. 1. Hypothetical area census with detection areas of species with short and long effective detection distances (edd).

parallel strips, than with one continuous strip Strip widths were established as approximately twice the effective detection distance of the species with the shortest effective detection distance. Therefore, a small portion of species with shorter detection distances (*i.e.,* those detected outside their EDD) and a substantial proportion of the species with longer detection distances, had a higher probability of being detected by a series of parallel transects. We were within the detection areas of many birds longer in the area count than in the transect count, therefore, there was a greater probability of detecting a particular bird in the area count. Also the probability of counting a mobile individual bird more than once might be greater in the area count than within a single continuous census path (transect). After birds moved they might be redetected and erroneously counted as different individuals, but these were probably approximately compensated for by birds moving from the area to be censused before detection (Stewart *et al.,* 1952 268). Although populations estimated from the area spot map census are biased in favor of species with longer detection distances, it is believed they were closer to actual populations than the other methods. Estimates from spot mapping were probably below actual populations (see Best 1975).

ESTIMATED POPULATIONS of singing males per unit area increased with number of counts in the spot census from transect. Of the 12 species, 9 increased in number from 6 to 11 counts, and total estimated territorial males increased by 39% from 6 to 8 counts, and by 20% from 8 to 11 counts. The less frequent census (6 counts) appeared to "miss" many singing males because of insufficient detections (< 3). In a census consisting of 6 separate counts the probability of an individual bird emitting a detectable signal would have to be ⩾ .50 to be included as a territorial male in the census results (*i.e.,* be counted ⩾ 3 times). After intensive censusing on the Patuxent Research Refuge in Maryland, Stewart *et al.* (1952) reported the number of singing males recorded on counts varied between 36 and 81% of the total populations of different species and that only 5-10 species were detected on at least one-half of the counts. Conversely, the most frequent census (11 counts) covering a longer time span appeared to count some males more than once as they moved into different territories. Population estimates with 8 counts probably came

Table 1

Number of Birds per km². Determined by Spot Mapping, Summation, and Mean Detections per Count[1] and Mean Detections per Count[1]

Species	*8.1 ha Area Spot Map Census*		*Transect Censuses: Spot Map Census*		*Maximum Detections Per Count (Summation)*	*Mean Detections Per Count*
	Number of Counts					
	8	11	8	6	1	11
Yellow-billed Cuckoo	86	47	47	47	54	32
Red-bellied Woodpecker	12	39	25	15	30	17
Acadian Flycatcher	62	39	39	39	59	28
Tufted Titmouse	80	104	89	53	64	46
Carolina Wren	148	138	121	94	94	70
White-eyed Vireo	136	133	99	79	99	64
Yellow-throated Vireo	31	15	10	5	20	10
Red-eyed Vireo	25	39	30	12	20	15
Swainson's Warbler	25	20	10	0	20	10
Kentucky Warbler	12	20	20	10	20	12
Hooded Warbler	12	10	10	10	20	7
Cardinal	93	84	74	49	54	40
Total	722	688	574	413	554	351

[1]Figures represent singing males except mean detections which includes all detections.

closest to the actual number of territorial males present. However, most of the basic assumptions underlying the spot map census technique remain untested.

The summation population estimates (total 554/km^2) from 11 counts were generally lower than the area spot map estimates (722/km^2) and transect spot map estimates with 11 counts (688/km^2), but similar to those from spot mapping with eight counts (554 vs 574/km^2). Estimates of all species differed $\leqslant$ 50%. Summation population estimates were consistently higher than spot census estimates with six counts (413/km^2). Higher estimates were noted in all species but one, in which estimates were identical.

Mean numbers of birds per count were mostly lower than population estimates from the other methods. Estimates of seven of 12 species were lower than all other estimates. In five of the relatively uncommon species, census means were higher than spot mapping estimates with six counts, but not greater than estimates with eight counts. The mean of total birds was lower than all other census methods. The summation and spot census techniques were adjustments for incompleteness in the detection of singing males on each count, and resulted in higher population estimates than the mean number of birds per count. Although all birds, singing and non-singing, were included in mean detection counts, the addition of detections other than singing males had no appreciable effect.

Summary

A WIDE RANGE IN ESTIMATED populations resulted from a comparison of different breeding season censuses in a Louisiana bottomland hardwood forest. The largest number of birds was estimated from the area spot map census. In the area census the censuser was within the detection areas of many birds longer, therefore, the probability of detecting an individual bird was greater. In spot mapping from transect, estimated populations increased steadily as number of counts increased from six to eleven. Maximum population estimates per count for each individual species (summation method) produced estimates similar to spot mapping with eight counts. Owing to incomplete counting of singing males during any one count, mean detections per count resulted in lowest estimated populations.

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