

ESTIMATING NUMBERS IN A ROOSTING CONGREGATION OF BLACKBIRDS AND STARLINGS

PAUL A. STEWART

THE various methods earlier workers used to determine numbers of birds in large roosting congregations of blackbirds and associated species have generally involved parameters that could not be precisely measured. Thus, Neff and Meanley (1952) reported different persons working with the same congregation made estimates varying from 5 to 20 million birds. Clearly an objective method is needed to measure the sizes of these congregations if realistic measurements are to be attained. Determination of the amount of fecal material produced by individual birds and the entire congregation seems to provide such a method. If measurement of the area occupied by the roosting congregation is accurate, if sampling of fecal material is representative of the area and individuals, and if proportions represented by the various species are determined accurately, this method gives an absolute measurement of the numbers of birds in a roosting congregation. At some sites these are all parameters that can be measured with full objectivity.

The congregation I so measured the weekend of 29–30 January 1972 contained Starlings (*Sturnus vulgaris*), Red-winged Blackbirds (*Agelaius phoeniceus*), Common Grackles (*Quiscalus quiscula*), and Brown-headed Cowbirds (*Molothrus ater*).

STUDY AREA

The study was conducted in the wooded area adjacent to Scotland Neck, Halifax County, North Carolina. The roosting congregation used a corner of the 123-ha woods where most of the trees were less than 10 m tall. On two of its sides the roosting site was 24–30 m from the edge of the woods, the woods being bordered here by open fields, a field where peanuts had grown in the preceding growing season on one side, and an unused field with various herbaceous perennials on the other side. The woods was traversed with relative ease.

MATERIALS AND METHODS

To determine the size of the area the roosting congregation occupied, sheets of paper were placed on the ground 15 m apart on two lines in the form of a cross. These papers were laid by compass on straight lines through the roosting site, and their spacing and the line lengths were measured by steel tape. The presence or absence of droppings on the papers was taken to indicate the areal limits of the roost. The

size of the area was also checked by pacing off in the adjacent fields the roost limits as indicated by birds' chattering voices after they had settled down. It was further checked by flying over the roost during an earlier evening and outlining the area from which the birds flushed on an aerial photograph obtained from Eastern Aerial Photography Laboratory, Asheville, North Carolina.

The papers were collected the following morning and then dried, together with the fecal material on them, by keeping them in the laboratory 1 week at room temperature. They were then weighed to determine the amounts of dried fecal material falling to the ground during one night at scattered spots in the roosting area. The amount of fecal material intercepted by tree branches was determined by cutting and measuring the diameters of branches directly over 10 papers and by mounting horizontally about 2 m above ground 10 small sticks weighed before and after the dried fecal material was brushed from them. Assuming that branches would intercept progressively less fecal material as they neared the top of the roosting stratum and had fewer birds above them, half of the value obtained from the sticks near the ground was used in the final calculation of the total amount of fecal material intercepted by branches. The mean of the combined total of fecal material intercepted and of that falling to the ground was expanded to involve the area of the roosting site. An additional series of samples was collected along the edge of the roost in the area occupied chiefly by Brown-headed Cowbirds. To determine the amount of fecal material deposited by individuals, birds mist-netted as they entered the roost were kept overnight in cages, and the feces they deposited during the night were dried and weighed.

Because Common Grackles and Starlings were the chief birds in one part of the roost and Brown-headed Cowbirds in another, the number of birds in the roosting congregation was calculated in two segments. The sex ratio of Brown-headed Cowbirds was determined by examining with binoculars 25 samples of 25 birds foraging on the ground of the adjacent peanut field before they entered the roost. The proportions of Common Grackles, Starlings, and Red-winged Blackbirds in the congregation were determined by examining 186 successive samples of 10 birds as they flew over the site after being flushed by discharging a shotgun in the roost. The sex ratio of Common Grackles was determined by examining the gonads of birds collected randomly in three different parts of the roost.

RESULTS

The roosting congregation covered an area about twice as long as wide near the side of the woods and containing 3.20 ha. Along the two sides of the roost adjoining the fields was a strip of woods averaging 24.3 m wide and containing 0.87 ha, occupied chiefly by Brown-headed Cowbirds. To determine whether the edges of the site were reasonably straight, I followed the edge about three-fourths of its distance. The presence or absence of droppings showed only a slight unevenness on the sides within the woods. The two sides next to the open fields were at a reasonably uniform distance from the straight edges of the woods.

Sticks placed under the roosting birds to measure the amount of feces intercepted by branches caught 0.0017 g per square centimeter of diameter, and there were 826.8 square centimeters of intercepting branches

TABLE 1
NUMBERS OF BIRDS IN MAIN PART OF ROOST, BASED ON AMOUNT OF FECAL
MATERIAL DEPOSITED.

Species	Sexes	Fecal material per bird (g)	Percentage of population	Total fecal material (g)	No. birds
Starling	Both	1.3	17.5	398,719	306,707
Red-winged Blackbird	Male	1.2	0.1	2,103	1,753
Common Grackle	Male	1.9	42.4	1,411,904	743,108
Common Grackle	Female	1.6	40.0	1,121,672	701,045
TOTALS			100.0	2,934,398	1,752,613

per square meter of sample-collecting papers. Branches at mid-height thus intercepted an average of 0.7 g of feces per square meter. Adding this to the amount of fecal material reaching the ground showed that fecal material was deposited at rates of 91.7 g per square meter in the area occupied chiefly by Common Grackles and 53.1 g per square meter in the area occupied chiefly by Brown-headed Cowbirds. Thus a total of 2,934,398 g was deposited in the grackle section and 462,086 g in the cowbird section, and a total of 3,396,484 g was deposited during one night in the entire roost.

The total population of the roost was calculated to be 2,294,713 birds (Tables 1 and 2). The birds in the main roosting site, consisting chiefly of Starlings and Common Grackles, roosted at a mean density of 56 and a maximum of 195 birds per square meter. In the area occupied chiefly by Brown-headed Cowbirds, the mean density was 68, with a maximum of 178 birds per square meter.

Because male and female Starlings are approximately the same size and thus presumably deposit about the same amounts of feces, no attempt was made to determine the Starling sex ratio. The congregation contained no female Red-winged Blackbirds. A few Brown-headed Cowbirds roosted, widely scattered, among the Common Grackles; likewise, a few Common Grackles roosted among the Brown-headed Cowbirds. These were omitted from the calculations as being insignificant.

Of the three methods used to measure the size of the area occupied by the roosting congregation, measuring the length and width can, of course, be considered most accurate. Pacing the limits of the roost in the adjacent fields yielded almost the same results and was much easier and simpler than walking through the woods. Because the birds quickly moved beyond the limits of their roost site when they flushed ahead

TABLE 2
 NUMBER OF BROWN-HEADED COWBIRDS IN AREA OCCUPIED CHIEFLY BY THIS
 SPECIES, BASED ON AMOUNT OF FECAL MATERIAL DEPOSITED.

Sexes	Fecal material per bird (g)	Percentage of population	Total fecal material (g)	No. birds
Male	1.0	50.8	275,387	275,387
Female	0.7	49.2	186,699	266,713
TOTALS		100.0	462,086	542,100

of the airplane, flying over the roost yielded data suggesting that the birds occupied much more space than they actually did.

Flushing the birds from the main roost after many had settled on their perches and then making counts of successive samples as they flew overhead seemed a satisfactory method for determining the proportions of Starlings, Red-wings, and grackles. To get discrete samples, it was found necessary to restrict each sample to only a few birds, 10 being the size of the sample used. While Starlings were generally mixed among the flying Common Grackles, they were also somewhat segregated, as was shown by samples of the birds flying over the roost. The sex ratio of Brown-headed Cowbirds was easily determined by counting scattered samples as the birds foraged on the adjacent field before entering the roost.

DISCUSSION

Obviously the method described in this paper for estimating numbers of birds in large roosting congregations cannot be applied with equal ease at all roosts because of the varying denseness of branches or vegetation intercepting the droppings and because of the difficulty in traversing some roosting sites. Still, with only slight modifications in the methods, I could have measured the populations at all four additional roosts I examined in North Carolina during the fall and winter of 1971-72.

This indirect measurement of the number of birds in a roost clearly involves greater objectivity than the direct counts earlier workers used. Some authors (Meanley, 1965; Goddard, 1971) estimated roosting congregations by counting birds flying to or from their roosts or by estimating numbers passing over adjacent areas in measured periods of time. In its highest refinement this method makes use of a large number of observers stationed at measured intervals short distances outside the entire circumference of the roost. The number of observers may be reduced when, as sometimes happens, all or nearly all the birds leave

the roost on one line. Estimates can only be highly subjective when thousands of birds fill the air or come to the roosting site from all directions.

Meanley (1965) used counts of birds on photographs made when birds were flying to the roost to estimate the total numbers in the congregation. Experience in thus photographing and counting birds should help improve one's proficiency in estimating numbers of birds in flocks, but the complexity in relating samples to specific segments of the flight and thence to the entire flight makes such photograph counts useful only in guiding estimates. The precise values they yield can seldom be expanded to measure the entire congregation accurately. In a situation where bats were funneling through a canyon, rather than flying to or from all directions, Humphrey (1971) used photographs of a flying column successfully to estimate the bats in the roost.

Wynne-Edwards (1929: 146) and Meanley (1965) developed estimates of the total numbers of roosting birds by first determining the density of the birds in fractional units of the sites, sometimes actually counting birds in specific areas. Meanley (1965) found this method effective only for use with ground-roosting birds.

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SUMMARY

The numbers of birds in a roost were calculated by determining the amount of fecal material deposited overnight by individual birds and by all birds in the congregation. To measure the amount of feces produced by individuals, birds netted as they approached the roost were caged overnight; the total amount deposited in the roost was estimated from samples caught on the ground at measured locations over the site. The roosting congregation was calculated to contain 2,294,713 birds.

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Entomology Research Division, Agricultural Research Service, U. S. Department of Agriculture, Oxford, North Carolina 27565. Accepted 8 May 1972.