SEX RATIO AND MORTALITY IN THE BROWN-HEADED COWBIRD

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THIS paper presents some data on sex ratio, age, and mortality in the various groups in a population of breeding Brown-headed Cowbirds (*Molothrus ater*). It supplements earlier reports of excess males by Friedmann (1929) and McIlhenney (1940) by taking into account the ratio obtained from a large breeding population and determining the age groups and sex responsible for the unusual ratio. This report constitutes a part of a more extensive study of the social organization of breeding cowbirds.

METHODS

This study was made on the campus of the University of Western Ontario in London during the 1966 and 1967 breeding seasons. Judged from egg-laying dates, the breeding season begins in the third week of April and ends about mid-July (Scott, 1963). The campus consists mainly of lawn interspersed with trees and shrubs and riparian growth along the Thames river. The 256 cowbirds studied were caught in Potter traps baited with a mixture of weed and millet seed, scratch grain, and waste seeds from threshing millet. The birds were banded with numbered aluminium bands and unique combinations of colored plastic bands. Because the bands are difficult to see when the birds walked in the grass, wing tags were used in 1967; colored ¼-inch wide pieces of 3M Scotch Brand tape of the same color combination as the colored bands were placed around the base of the outer two primary feathers with a 1-inch leader projecting down. These tags did not appear to affect the flight or behavior patterns of the birds. In 1966 banding began 16 April and continued on weekdays for 3 weeks, after which sporadic banding was continued up to 24 June. In 1967 birds were banded on weekdays from 11 April until 19 June. Three main banding areas were used in 1966 and 1967, one in the middle of the campus, one at its northern end, and the third in the southern region. In 1967 the study area was 150 hectares, approximately twice the size of the 1966 area.

Field notes recorded on a portable Philips recorder with a microphone attached to 10 × 50 binoculars included the date, time, period of observation, participants, behavior, and the location of birds sighted (to the nearest 25 m^2 on aerial photograph). I recorded my location every 15 minutes, examined these notes daily, and altered my movements as necessary to maintain equal coverage of all parts of the study area.

Yearlings were distinguished from adults by the presence of some juvenal feathers in an apparent adult plumage (Baird, 1958; Selander and Giller, 1960). As the first molt of cowbirds occurs in September of their first year, birds that had completed one molt were considered yearlings, those that had completed two or more molts were called adults.

RESULTS

Population structure.—The sex ratio of banded males to females in the study area, was 1.5:1 (Table 1). The ratio of yearling males to

TABLE 1

NUMBERS OF BANDED ADULT AND YEARLING MALES AND FEMALES RECORDED IN THE STUDY AREA IN 1966 AND 1967

Year	Per cent adults		Per cent yearlings	
	Male	Female	Male	Female
1966	37 (31) [1]	18 (15)	23 (19)	22 (18)
1967	37 (65)	18 (32)	23 (39)	22 (37)
Totals	37 (96)	18 (47)	23 (58)	22 (55)
Sex ratio	2 : 1		1 : 1	

[1] Actual numbers in parentheses.

yearling females was 1:1 but significantly more adult males than adult females were recorded ($P < 0.005$). To determine if the proportions of males and females seen were due to differences in actual numbers or to differences in the movements of sexes (i.e. if males range farther than females, more males than females should be seen in a particular area), the feeding behavior of the birds was examined. Feeding was chosen because cowbirds range farthest while engaged in this activity (Darley, 1968). As the birds were caught by baiting in three different places, recapture data of the 1967 trapping period were examined to ascertain the feeding movements of both sexes. Trapping was continued through the breeding season at three sites arranged in a straight line, the second 1,100 m from the first, the third 600 m from the second and 1,700 m from the first. Individual birds were recaptured at a single trapping station or sometimes at two or all three stations (Table 2). If birds of

TABLE 2

NUMBER OF COWBIRDS RECAPTURED AT PRIMARY AND SECONDARY TRAPPING STATIONS IN 1967

	Number of birds recaptured		
	One trapping station only	More than one trapping station	P[1]
Adult females	10	11	$-0.9 > P > 0.75$
Yearling females	13	13	$-0.9 > P > 0.75$
Adult males	17	14	$-0.75 > P > 0.5$
Yearling males	18	12	$-0.75 > P > 0.5$

[1] Chi-square analysis.

TABLE 3
RECAPTURE RATE IN ADULT AND YEARLING MALES AND FEMALES IN 1967

	Number of birds	Average probability of recapture per day	P[1]
Adult females	20	0.51 ± 0.06	$P > 0.9$
Yearling females	25	0.49 ± 0.07	
			$0.05 > P > 0.02$
Adult males	33	0.37 ± 0.05	$0.8 > P > 0.7$
Yearling males	31	0.40 ± 0.05	

[1] t-test.

one sex habitually range farther to feed than those of the other, they should be recaptured more often at more than one trapping station. No significant differences were apparent between the sexes or in the numbers of adult and yearling birds within the sexes, recaptured at more than one trapping station (Table 2). Thus the excess of males sighted was not due to their having larger feedings ranges than females.

Another factor that might bias the relative numbers of each sex recorded is the difference in their behavior and appearance. Males often sit high in trees and sing and are generally conspicuous; females tend to be secretive and silent and are less noticeable because of their cryptic plumage. The recapture data, which were not affected by the conspicuous or secretive nature of either sex, were examined to see if they showed any differences between age groups or sexes (Table 3). To eliminate migrants this table includes only birds recaptured two or more times. The number of possible days a bird could be recaptured was determined by including all trapping days between the first and last recapture of each bird examined. The number of days the bird was recaptured was then divided by this figure to find the recapture probability per day. The rates of recapture showed no significant differences between the two age groups in females or males, i.e. yearling birds were as likely to be recaptured as adults, but females were recaptured significantly more often than males. Recapture data probably indicates a smaller ratio of males to females than actually exists in the population, as females are more likely to be caught.

The numbers of adult and yearling males and females captured at the three trapping stations (Table 4) were analyzed to determine the sex ratio. Particular birds were usually caught at one station, the "primary station," but sometimes were recaptured at other "secondary stations," i.e. the areas served by each baiting station overlapped. The male/female

TABLE 4

ADULT AND YEARLING MALES AND FEMALES RECAPTURED TWO OR MORE TIMES AT TRAPPING STATIONS IN 1967

	Number of birds recaptured									
	Adult females		Yearling females		Adult males		Yearling males		Total	
Station	P[1]	S[2]	P	S	P	S	P	S	P	S
1	13	3	13	6	16	2	12	6	54	17
2	5	8	6	5	9	9	4	6	24	28
3	3	2	7	6	8	5	14	2	32	15
Total	21	13	26	17	33	16	30	14		

[1] Primary trapping station.
[2] Secondary trapping station.

ratio of birds caught at primary stations was 1.3:1. Station 2 was a secondary trapping station for significantly more birds than station 1 ($P < 0.005$) or station 3 ($0.05 > P > 0.025$). There was no significant difference in the numbers of birds recaptured at secondary trapping stations 1 and 3 ($0.5 > P > 0.25$). The difference in numbers was probably due to the position of station 2 between stations 1 and 3. Birds caught at primary stations 1 and 3 were also attracted to station 2. Thus, the numbers of birds recaptured at primary stations 1 and 3 were probably high because these stations attracted birds from outside the range of the other baiting stations. Because females were captured more frequently than males (Table 3) the values probably favored the females, making the sex ratio of 1.3:1 a minimum value. As males are more conspicuous than females, the ratio of 1.5:1, based on sightings of birds, is probably a maximum value. The actual sex ratio probably lies between these two ratios.

The presence of an excess of males was established directly in 1967 by removing mated males from the population. Of 20 males mated to breeding resident females, 15 were removed during the last week of May and the first week of June; they could not be removed earlier because of the long observation period required to establish their status. Nine males that had been seen but had not been mated to females prior to this time became mates of 9 females, and 3 mated males established bigamous relationships with 3 females. Data were insufficient to determine if the other 3 females got new mates. If one assumes that all excess males became mated, which was probably the case as 3 mated males became bigamists, then 9 males represents the unmated segment of the male population. Thus, the ratio of males and females in the population would be 29:20 or 1.5:1.

MORTALITY

The difference in the numbers of adult males and females present suggests a difference in mortality rates if one assumes the sex ratio in eggs to be 1:1. The ratio of yearling males to females present in the population was 1:1 (Table 1), so differential mortality apparently does not operate within the first year of the cowbirds' life. The difference in sex ratio appears to become established in the adult birds (Table 1). As the adult population in one year is made up of survivors of yearlings plus adults of the previous year, and assuming a stable population, the mortality rate between departure in autumn of adult males (including molted yearlings) and arrival in spring would be 23/60 or 38 per cent. Similarly the mortality rate in adult females would be 22/40 or 55 per cent. As these mortality rates are derived from proportions present in the population, one other assumption is necessary, that if adult survivors of the previous year return elsewhere, these are in the same proportions as new adults found in the study area that were outside the area the previous year. In other words the rates of immigration and emigration are assumed to be of comparable magnitude. The calculated mortality rates indicate that the higher proportions of males in the populations are probably due to the higher mortality rate in adult females.

DISCUSSION

Some of the birds placed in age categories were probably incorrectly assigned. Yearling females are harder to separate from adults than yearling males because of the similarity of their adult and juvenal plumages. The new female second-winter or adult underwing coverts, unlike the corresponding juvenal feathers, are darker with a dark brown edge, and the vane is compact with barbs generally remaining parallel to each other. These feathers also show less wear than the juvenal feathers. The reliability of using these feather differences was tested on 68 pairs of wings from females of known age (42 adults, 26 yearlings) obtained from A. V. Kennedy. As the age of 91 per cent (39 adults and 23 yearlings) was determined correctly, the use of this aging technique probably places a few females in the wrong group. As the errors occur in both yearlings and adults, they tend to cancel one another. In addition Selander and Giller (1960) noted that 2 per cent of juvenal males had a complete postjuvenal molt and were indistinguishable from adults. Some females probably have a complete postjuvenal molt as well, hence a few birds of both sexes regarded as adults were probably yearlings.

As yearlings are present in the population in equal proportions, the sex ratio in cowbirds could be due to excessive mortality in adult females,

a very low mortality in adult males, or a combination of these two factors. In Robins (*Turdus migratorius*) the mortality rate of adults is 53 per cent (Farner, 1945). This is comparable to the 55 per cent found in adult female cowbirds, but considerably higher than the 38 per cent in adult males. The proportions of adults (55 per cent) to yearlings (45 per cent) is almost the reverse of that found by Farner (1945) in Robins (47 per cent adults, 53 per cent yearlings). This supports the idea that the high survival rate in male cowbirds is responsible for the sex ratio. If the males had the same mortality rate as females, the proportions of adults to yearlings in the population would be similar to the proportions Farner found in Robins.

The higher mortality in adult females is of interest because the reproductive duty of the female is simply to locate nests and lay eggs. Jones (1941) and Walkinshaw (1949) believe that individual females laid over 20 eggs in a season and, as a cowbird egg is about 9 per cent of its body weight (Miller, 1946), females apparently expend a considerable amount of energy in egg laying. This physiological strain may perhaps be the cause of higher mortality in adult females. It would be of particular interest to obtain data on body weights of females and males during the breeding season and just prior to migration to see if they support this theory.

In general it might be expected that freedom from parental duties of a parasitic species would enhance its survival rate, which would explain the higher survival rate in adult male cowbirds. In adult females this gain may be offset by the physiological demands of increased production of eggs. Indeed, adult female cowbirds have a survival rate similar to that of adult Robins.

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SUMMARY

The 256 Brown-headed Cowbirds recorded in 1966 and 1967 during the breeding season on the campus of the University of Western Ontario showed a sex ratio of 1.5 males to 1 female. Recapture data indicated a sex ratio of 1.3:1. An excess of males was also shown to exist by removing 15 of 20 mated males. Nine previously unmated males mated with the widowed females, confirming the 1.5:1 ratio of males to females in the

population. The population was composed of 37 per cent adult males, 18 per cent adult females, 22 per cent yearling females, and 23 per cent yearling males. The excess of males appears to stem from a higher mortality in adult females (55 per cent) than adult males (38 per cent). Yearling males and females have similar mortality rates if one assumes the sex ratio in eggs to be 1:1.

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