SOME FACTORS INFLUENCING OBSERVED SEX RATIOS IN A POPULATION OF EVENING GROSBEAKS

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Observed sex ratios in local populations of wintering passerines sometimes differ from unity. Uneven sex ratios may be produced by such factors as geographic differences in migration between the sexes (King et al., 1965; Johnston, 1970; Ketterson, 1974; and others) or differential sexual mortality (discussed by Balph, 1975). Observed sex ratios also may be subject to sampling bias (Beimborn, 1976). For example, sex ratios estimated from trapping data or from observations at winter feeding stations might be influenced by sexual differences in trap response or by sex-related dominance. During a study of winter social behavior in Evening Grosbeaks (*Hesperiphona vespertina*), a species whose sexes are readily distinguishable in all plumages, we had the opportunity to explore some questions pertaining to the sex ratio of a migratory population in northern Utah.

METHODS

Evening Grosbeaks were studied at Logan, Utah during the late winter and spring of 1976. The research was conducted on a 200-m semi-urban wooded stretch bordering the Logan River. Although grosbeak flocks were present in the study area from 13 February to 17 May, most of our data on sex ratios were collected between 16 April and 13 May. Results from this 4-week period are analyzed separately from those obtained in an earlier period, because studies in the eastern United States indicate that Evening Grosbeaks are relatively mobile during the winter and that the sex ratio at any single location may change from one part of the winter to another (M. H. Clench, pers. comm.).

Numbers of male and female grosbeaks were obtained in four situations: (1) in the crowns of Box Elder (*Acer negundo* L.), Narrow-leaf Cottonwood (*Populus angustifolia* James), and Lombardy Poplar (*Populus nigra* L., var. *italica* Muenchh) trees within the study area; (2) during trapping and banding operations; (3) at a large (0.86 × 0.86 m) elevated tray provisioned with sunflower seeds; and (4) at a small (0.30 m diameter) elevated circular tray provisioned with sunflower seeds. The large tray, the small tray, and the traps all were located at a site near the center of the study area but were baited at separate times from one another. Counts in the trees were made at times when no grosbeaks were present at the central feeding site.

One hundred samples were obtained of the number of male and female grosbeaks in the crowns of leafless or budding trees (23 April to 10 May) by using binoculars. To promote independence of the samples from one another, consecutive counts either were separated temporally from each other (usually by more than 1 hour) or were made in separate trees or groups of trees. The mean number of birds counted per sample was 20.1 (SD = 13.08).

Grosbeaks were captured periodically using Potter traps and McCamey chickadee traps baited with sunflower seeds. In most cases 21 cells were set within a 1.22 × 2.44 m area. Of 300 grosbeaks trapped and banded, 54 (15 males, 39 females) were banded in early March, 53 (22 males, 31 females) in late April, and 193 (87 males, 106 females) in early May. Comparisons of the relative numbers of banded and unbanded grosbeaks visiting the central feeding site in early May suggested that about 700-800 individuals frequented the study area at this time.

One hundred and 200 samples were obtained, respectively, at the small and large food trays between 16 April and 4 May. Observations were made over distances of 0.5-1.5 m from a blind equipped with one-way glass. The number of males and females recorded for each sample represented an average of four counts made at 15-second intervals over a 1-minute period. Consecutive samples were separated from each other by at least 5 minutes to permit turnover of individuals at the tray. When large numbers of grosbeaks were present, two observers collected data simultaneously, one observer tallying males while the other tallied females. The mean number of birds recorded per sample was 5.8 (SD = 1.91) at the small tray and 24.7 (SD = 11.10) at the large tray.

RESULTS

The ratio of female to male grosbeaks at capture was 2.60:1.00 in early March, 1.39:1.00 in late April, and 1.28:1.00 in early May. The sex ratios of individuals trapped in late April (23 males, 32 females) and in early May (91 males, 116 females) were not significantly different ($\chi^2 = 0.08$, df = 1, $P > 0.5$). However, the sex ratio of birds trapped in early March (15 males, 39 females) differed significantly from that for late April and early May combined ($\chi^2 = 4.45$, df = 1, $P < 0.05$). The relative numbers of males and females that were captured departed significantly from equality, both in early March ($\chi^2 = 10.67$, df = 1, $P < 0.01$) and in late April and early May ($\chi^2 = 4.55$, df = 1, $P < 0.05$). Thus in both periods, females predominated over males at capture; but the preponderance of females was greater in early March than in late April and early May.

We observed the following sex ratios in four situations during late April and early May: 1.31 females to 1.00 males in the trees and in traps, 1.41 females to 1.00 males at the large (0.74 m^2) food tray, and 0.65 females to 1.00 males at the small (0.07 m^2) food tray (Table 1). In each of these situations, the observed sex ratio differed significantly from an expected value of unity ($\chi^2 = 35.77$, df = 1, $P < 0.001$ in the trees; $\chi^2 = 143.34$, df = 1, $P < 0.001$ at the large tray; $\chi^2 = 25.75$, df = 1, $P < 0.001$ at the small tray). Thus, males predominated at the small food tray, whereas females predominated in the other three situations.

Significant heterogeneity existed among the April-May sex ratios observed in the trees, at capture, at the large food tray, and at the small food tray ($\chi^2 = 76.58$, df = 3, $P < 0.001$). Two by two contingency analyses revealed that the sex ratio at the small food tray differed significantly from that in the trees ($\chi^2 = 53.45$,

TABLE 1.

Evening Grosbeak sex ratios obtained in several situations

Situation	Males n	Males %	Females n	Females %	Total n
Trees	870	43.3	1,138	56.7	2,008
Traps[1]	110	43.3	144	56.7	254
Large food tray	2,052	41.5	2,894	58.5	4,946
Small food tray	350	60.6	228	39.4	578

[1]Sample consists of individuals banded in late April and early May, as well as those banded earlier but recaptured during this period.

df = 1, $P < 0.001$), during trapping ($\chi^2 = 21.23$, df = 1, $P < 0.001$), or at the large food tray ($\chi^2 = 76.55$, df = 1, $P < 0.001$). Although females predominated to a slightly greater extent at the large food tray than they did in the trees or at capture, the differences were not statistically significant ($\chi^2 = 1.98$, df = 1, $0.1 < P < 0.2$; $\chi^2 = 0.33$, df = 1, $P > 0.5$; respectively). There was no difference between the sex ratio in the trees and that at capture ($\chi^2 < 0.01$, df = 1, $P > 0.5$).

DISCUSSION

The sex ratio of Evening Grosbeaks observed in the trees (1.31: 1.00 in favor of females) probably was the relation least likely to be influenced by potential procedural biases. The April-May sex ratios obtained from trapping records and at the large food tray did not differ significantly from that observed in the trees. Hence it seems likely that the study population contained about four females for every three males in late April and early May. Banding data from early March suggested an even greater preponderance of females (2.60 females to 1.00 males) at that time. Differential movement of the sexes, whether local or otherwise, might have produced a shift in the sex ratio of the population from early March to late April and early May.

At least two factors might have contributed to the relative abundance of females in the study population, assuming a primary sex ratio at unity for this species. Differential mortality possibly occurs between male and female Evening Grosbeaks; the visual conspicuousness of males may render them more susceptible than females to predation. However, it seems unlikely that differential losses to predation could account per se for a discrepancy of the magnitude we observed. Furthermore, the effect of such losses upon the sex ratio might be counteracted by differential mortality associated with social status; females of this species are subordinate to males during the winter (Balph and Balph, Ms) and thus may be at a disadvantage when essential resources are scarce. A more important reason for the uneven sex ratio is suggested by some published banding records for Evening Grosbeaks wintering at different latitudes. The ratio of females to males averaged 0.87:1.00 at Sault Ste. Marie, Michigan (Magee, 1939); 1.36:1.00 at Hartford, Connecticut (Parks, 1945, 1947), 1.42:1.00 at Logan, Utah (this study); 1.77:1.00 in northeastern Ohio (Dexter, 1968); and 2.30:1.00 at Nacogdoches, Texas (Michael, 1970). These published data suggest the hypothesis that differential migration may occur in this species, with females wintering farther to the south on the average than males. Extensive sampling in many localities would be necessary to test this hypothesis, particularly since the sex ratio at any given place may vary through the winter or from one year to another (Parks, 1947; M. H. Clench, pers. comm.).

Sampling bias may have been involved to varying degrees in the sex ratios we documented at the central feeding site in late April and early May. The sex ratio observed at the large food tray (1.41 females to 1.00 males) was skewed in favor of females to a slightly greater degree than was the ratio observed in the trees or at capture (1.31 females to 1.00 males). Although the differences were not statistically significant, the grosbeaks exhibited a sexual difference of alarm response which might have introduced a small amount of sampling bias into some of our results. When grosbeaks at the large food tray became frightened, females tended to "freeze" at the tray, whereas males tended to fly away (Balph, Ms). This difference in behavior was statistically significant ($P < 0.001$) and might have been related to the fact that males of this species are visually more conspicuous than females against a variety of backgrounds. Females, by tending to remain at the central feeding site during and after a "fright," may have been slightly overrepresented at the food tray. Although frights also occurred in the crowns of trees, they were much more infrequent in this situation than at the central feeding site; hence we believe that differential alarm responses exerted no appreciable effect upon the relative numbers of males and females observed in the trees.

The sex ratio documented at the small food tray (0.65 females to 1.00 males) differed markedly from those observed in the other three situations. This difference probably was attributable to the grosbeaks' social behavior. Males consistently dominated females during agonistic interactions (Balph and Balph, Ms). Under relatively crowded conditions, which sometimes existed at the food trays, males readily attacked females and forced them to retreat several centimeters. The number of birds per unit area and the frequency of agonistic encounters per individual tended to be greater at the small (0.07 m^2) tray than at the large (0.74 m^2) tray (Balph and Balph, Ms). In addition, because of the difference in size between the two feeding stations, a grosbeak that was defeated at the small tray often was obliged to depart from the food source, whereas at the large tray such a bird commonly moved to another part of the feeder and resumed eating. The tendency of males to exclude females from the small food tray resulted in a sex ratio skewed in favor of males rather than females.

Our results suggest that as the size of a feeding station decreases, the probability of obtaining a sample sex ratio biased in favor of males increases. A comparable relationship might be expected to hold between the number and dispersion of traps and the relative numbers of males and females captured. Apparently sampling bias associated with social dominance can be reduced or eliminated by observing the sex ratio of Evening Grosbeaks under conditions in which intersexual competition is not strongly evident.

SUMMARY

The sex ratio of a migratory population of Evening Grosbeaks at Logan, Utah was estimated in four situations. The observed ratio of females to males in late April and early May was 1.31: 1.00 in the crowns of trees, 1.31:100 in birds that were trapped, 1.41:1.00 at a large food tray, and 0.65:1.00 at a small food tray. The sex ratio at the small food tray differed significantly from those in the other three situations, apparently because males tended to exclude females from the small feeding area. Trapping records from early March, as well as from late April and early May, suggested that females outnumbered males in the study population. Some factors possibly contributing to the uneven sex ratio were differential mortality and differential migration of the sexes.

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